FACULTY OF AGRICULTURE, ENGINEERING AND NATURAL SCIENCES

School of Engineering and the Built Environment

Prospectus 2024

UNIVERSITY OF NAMIBIA

1. NOTE

This School Yearbook is valid for 2024 only. Regulations and curricula may be amended without prior notice. General regulations and information appear in the **General Information and Regulations Yearbook**.

Although the information contained in this School Yearbook has been compiled as carefully and accurately as possible, Council and Senate accept no responsibility for any errors or omissions that may occur. The University reserves the right to amend any regulation or condition without prior notice.

The information is correct up to 31 October 2024.

The fact that particulars of a specific programmes, subjects or modules have been included in this School Yearbook does not necessarily mean that such programme, subject, or module will be offered in 2024 or any subsequent year.

This School Yearbook should be read in conjunction with the General Information and Regulations Yearbook

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2.1 SCHOOL PREAMBLE

The School of Engineering and the Built Environment is located at the Jose Eduardo dos Santos Campus of the University in Namibia in Ongwediva northern Namibia. The School enrolled its first 42 students in February 2009, but the number passed 310 in February 2017, with about 22% of the students being females. About 30% of the student population comes from the SADC region, outside Namibia. On the other hand, the Namibian Engineering students represent all the 14 regions in Namibia. The School offers the degree of Bachelor of Science in Engineering with Honours in eight Engineering disciplines. All the degree programmes have been approved by the Engineering Council of Namibia and by the Namibia Qualifications Authority (NQA) and are registered in the National Qualifications Framework (NQF) as professional Engineering Degrees with Honours at NQF Level 8. The degree programmes are offered in five academic departments which have a mix of Namibian and expatriate academic members of staff as well as Namibian administrative and support staff.

The School has produced over 270 graduate engineers since inception in the following disciplines: Civil Engineering, Computer Engineering, Electrical Engineering, Electronics Engineering, Mechanical Engineering, Telecommunication Engineering, Metallurgical Engineering, Mining Engineering and Electronics and Computer Engineering. These graduate engineers have been evaluated by the Engineering Council of Namibia and found to be registerable as Professional Engineers upon completion of their professional training. About 80% of these graduate engineers are fully employed in Namibia, Angola and other SADC countries. Others went on to pursuer their postgraduate studies in Namibia and at other international universities outside Namibia. The employment rate of the graduate use to be 100% but has been recently affected by the economic down turn in Namibia.

Having successfully implemented the various Bachelor of Science (Engineering) degree programmes, the School currently also offers various postgraduate qualifications which include masters and PhD degree in all six Engineering disciplines. Masters are offered either by course work or by thesis option. All PhDs are by thesis. The School has graduated 2 PhD students and one master's student as of December 2018. This number is expected to grow in the coming years. The Masters programme by course include; MSc in Civil Engineering with three specialization options: Structures, Transport and Water, and MSc in Water Resource Management. Other MSc by course work in other field will be developed in due course.

In order to benchmark the Engineering degree programmes internationally, the School of Engineering and the Built Environment has established collaborations and exchange programmes with a number of international universities. Such programmes cover student and staff exchange, joint research projects and curriculum development. International universities that collaborate with our School are based in Germany, Japan, China, Russia, Italy, South Africa, Thailand, Kenya and Nigeria. Funding for collaboration with German Universities in the area of civil Engineering is generously provided by the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ). In 2012- 2015, final year civil Engineering students visited the University of Kaiserslautern in Germany on student exchange. In 2013, students from the University of Kaiserslautern visited the School in Ongwediva

The School is being constructed in five phases. When all the phases are completed, about 1000 students will be studying Engineering at any given time. The buildings currently occupied consist of the Namibian Wing (Phase I) that houses the Mechanical Engineering Building and the Administration Block; the Indian Wing (Phase II), which houses the Mining Engineering Building, the Computer Engineering Building and the Information Resource Centre; and the recently completed German Wing (Phase III), which houses the Department of Civil and Environmental Engineering

I wish to thank the Government of Namibia, through the Ministry of Education and the National Planning Commission for their continued support of this project. I also wish to thank Professor Kenneth Matengu, the Vice Chancellor of the University of Namibia, who continues to support the growth of the School and to bring on board new international partners from time to time. May I also thank the many donors and benefactors who have made an impact at the School financially and in kind. In particular, I wish to single out the Government of India, for their very generous donation of US$12.3 million for Phase II of the School, the German Government, for their generous donation of Euros 13.0 million channelled via GIZ and KfW Development Bank, and NamPower, who in 2013 completed the construction and installation of a Mini Sub-Station at the Ongwediva Engineering Campus worth about N$ 2 million. Many thanks are also due to the members of the University Management for their unwavering support, the School Management Committee and the Academic, Administrative and Technical Staff of the School of Engineering and the Built Environment for their hard work; and the entire Student Body of the School, for their commitment, discipline and perseverance.

Dr. Petrina Johannes
Associate Dean

SCHOOL OF ENGINEERING AND THE BUILT ENVIRONMENT CALENDAR 2024	
DATE	**FIRST SEMESTER 2024**
11 January	University Open
12 Jan – 19 January	On-Line Registration: All senior Engineering Students Commences (until 19 January 2024)
15 Jan – 31 January	On-Line Registration: 1st Year Engineering Students Commences (until 31 January 2024)
22 January	Academic staff resumes office duties
22 January	Lectures commence for CORE SEMESTER – New Curriculum for Engineering Senior Students (2nd year) (Until 1 March
22 January	Lectures commence for FIRST SEMESTER for Senior Engineering students (3rd and 4th year) (Until 7 May)
24 January	SEBE - Admissions, Assessment and Graduations Committee (Agenda closes 15 Jan) Re-Admission JEDS General Staff Meeting and SEBE Management Meeting (Agenda closes 15 Jan)
26 January	SEBE - Student Orientation/ Induction
29 January	Lectures commence for CORE SEMESTER – New Curriculum First Year Engineering students (Until 1 March) SEBE -SRC By-Elections (until 06 February) - DSA
24 January	Submission of Industrial Attachment Report
06 February	SEBE - School Higher Degree Committee Meeting (Agenda closes 31 January)
07 February	SEBE - Admissions, Assessment and Graduations Committee (Agenda closes 24 Jan) – Graduation SEBE - SRC Congress & Student leadership Workshop (until 10 February) - DSA
21 February	SEBE – School Board Meeting (Agenda close 9 Feb 2024)
04 March	Lectures commence for FIRST SEMESTER – New Curriculum Engineering Students 1st and 2nd Years (Until 7 June), and New Curricu Programmes (Until 11 June)
05 March	JEDS Management Meeting and SEBE Management Meeting SEBE - School Higher Degree Committee Meeting (Agenda closes 28 February)
13 March	SEBE - Student Lecturer Forum

28 March	FIRST SEMESTER BREAK for students commences (Until 2 April)
03 April	Lectures commence after FIRST SEMESTER BREAK
10 April	SEBE -GENERAL STUDENT ASSEMBLY (GSA) GRADUATION: NORTHERN CAMPUSES
11 April	GRADUATION: NORTHERN CAMPUSES
17 April	SEBE -Internal Audit Civil Labs
26 April	JEDS INNOVATION & ACADEMIC MOTIVATION DAY
02 May	SEBE Management Meeting (Agenda closes 25 April) :
7 May	Lectures end for the FIRST SEMESTER for Senior Engineering students (3^{rd} and 4^{th} year)
8 May	SEBE – School Board Meeting (Agenda close 23 April 2024)
13 May	First opportunity examinations commence for Senior Engineering students (3^{rd} and 4^{th} year) (until 24 May
24 May	First opportunity examinations end for Senior Engineering students (3^{rd} and 4^{th} year) End for FIRST SEMESTER for Senior Engineering students (3^{rd} and 4^{th} year)
29 May	SEBE - School Higher Degree Committee Meeting (Agenda closes 22 May)
03 June	SEBE – Industrial Attachment commences for 6 weeks (Until 12 July)
11 June	Lectures end for FIRST SEMESTER – New Curriculum for 1st and 2^{nd} year Engineering students
17June	First Opportunity Examinations commence – New Curriculum for 1st and 2^{nd} year Engineering students (Until 28 June)
28 June	First Opportunity Examinations end – New Curriculum 1^{st} and 2^{nd} year Engineering students
01 July	Second Opportunity Examinations commence – **for all Engineering students** (Until 10 July) SEBE – Drafting of 2^{nd} semester Engineering Class Timetable commences until 12 July
03 July	SEBE Management Meeting (Agenda close 19 June)

10 July	Second Opportunity Examinations end – for all Engineering students
12 July	End of FIRST SEMESTER for all Engineering Students. SEBE – Release of 2nd semester Engineering Class Timetable
15 – 19 July	Mid-year recess
DATE	**SECOND SEMESTER 2024**
22 July	Lectures commence for SECOND SEMESTER – for all Engineering Students (Until 1 November)
22 July	Submission of Industrial Attachment Report
24 July	SEBE - Admissions, Assessment and Graduations Committee (Agenda closes 21 June) - Examiners/Moderators/Graduation
25 July	JEDS General Staff Meeting
31 July	**JEDS** Cultural Festival until 03 August
05 August	SEBE -School Higher Degree Committee Meeting (Agenda closes 31 July)
07 August	SEBE – School Board Meeting (Agenda close 25 July)
14 August	SEBE – Student Lecturer Forum
21 August	SEBE – General Student Assembly (GSA)
26 August	SECOND SEMESTER BREAK for students commence (Until 31 August)
27 August	INSTITUTIONAL HOLIDAY
02 September	Lectures resume after second semester break
05 September	SEBE – SRC Elections until 04 October
06 September	SEBE -School Higher Degree Committee Meeting (Agenda closes 29 August)
11 September	SEBE Management Meeting (Agenda close 28 August)
25 September	SEBE -Management Review

27 September	Prof Kavishe Cup & Gala Dinner
18 October	SEBE – Christmas in October
01 November	SEBE -Lectures end for SECOND SEMESTER for all Engineering students SEBE Management Meeting (Agenda close 23 October)
04 November	SEBE -Drafting of Core Semester and 1st semester Engineering Class Timetable commences until 06 December
06 November	First opportunity examinations commence for all Engineering Students (until 19 November) SEBE - School Higher Degree Committee Meeting (Agenda closes 30 October)
15 November	Submission of Industrial Attachment Report
19 November	First opportunity examinations end for all Engineering Students
21 November	Second opportunity examinations commence for all Engineering Students (until 27 November)
27 November	Second opportunity examinations end for all Engineering Students
29 November	SEBE - Admissions, Assessment and Graduations Committee (Agenda closes 15 Nov) - Graduation
04 December	SEBE Management Meeting (Agenda close 20 November)
06 December	End of SECOND SEMESTER for all Engineering Students SEBE - Final date for submitting of final Design and Research Project Report as per ELOs SEBE - Releasing of Core Semester and 1st semester Engineering Class Timetable JEDS General Staff Meeting
13 December	End of ACADEMIC YEAR
09 January 2025	University opens (2025 academic year)
21 January 2025	Academic staff resumes office duties

DATE	DESCRIPTION	BLOCK
5 February	Last day to cancel Core Semester modules with 100% credit – New Curriculum Students	SC
16 February	Last day to cancel Core Semester modules with 50% credit – New Curriculum Students	SC
23 February	Last day to cancel Core Semester modules	
23 February	Last day to cancel Semester 1 and year modules with 100% credit – Old Curriculum Students	
15 March	Last day to cancel Semester 1 and year modules with 100% credit – New Curriculum Students	S0 and S1
15 March	Last day to cancel Semester 1 modules with 50% credit – Old Curriculum Students	
12 April	Last day to cancel Semester 1 modules with 50% credit – New Curriculum Students	S1
30 April	Last day to cancel Semester 1 modules – All students	
8 July	Last day to cancel Year modules with 50% credit – All Students	
09 August	Last day to cancel Semester 2 modules with 100% credit – All Students	S2
02 September	Last day to cancel Second Semester modules with 50% credit – All Students	S2
30 September	Last day to cancel Second Semester and Year modules – All Students	

2.3 STRUCTURE AND PERSONNEL OF THE SCHOOL OF ENGINEERING and THE BUILT ENVIRONMENT

2.3.1 OFFICE OF THE ASSOCIATE DEAN

Associate Dean:	Dr. Petrina Johannes BSc (Civil Eng), MSc (Civil Eng), PhD (Civil Eng) (USA)		
		Tel:	(+264 65) 232 4022)
Secretary to the Associate Dean:	Mrs Melinda Munkanda	*Tel:*	(+264 65) 232 4016~~)~~
		Fax:	(+264 65) 232 4069)
Faculty Officer:	Mrs. Paulina N. Kashihakumwa	*Tel:*	(+264 65) 232 4004)
		Fax:	(+264 65) 232 4085)
Human Resources Officer	Mrs. Jacqueline Nghidamwasha	*Tel:*	(+264 65) 232 4078)
		Fax:	(264 65) 232 4069)
Campus Administrator:	Mrs. Erastus Tulonga Beata	*Tel:*	(+264 65) 232 4009)
Systems Administrator:	Mr. Gerson Hailundu	*Tel:*	(+264 65) 232 4044)
Examinations Officer:	Mrs. Tekla Ndevashiya	*Tel:*	(+264 65) 232 4107)
Student Leadership Development Officer:	Mrs. Lovisa Amon	*Tel:*	(+264 65) 232 4093)
JEDS Cashier:	Mr. Joseph Lukas	Tel:	(+264 65) 2324104)

General enquiries regarding the School of Engineering and the Built Environment and qualifications offered by the School should be directed to:

The Faculty Officer
School of Engineering and the Built Environment
University of Namibia, Engineer, Jose Eduardo Dos Santos Campus
7501 Namundjembo Mengela Street
Ongwediva
P. O. Box 3624 Ongwediva Namibia
Telephone: (+264 65) 232 4004 Fax: (+264 65) 2324085 E-mail: pnshivute@unam.na

Enquiries regarding specific subjects and departments should be addressed to relevant Head of Department. (Tel: +26465 232 4000)

2.3.2 ACADEMIC DEPARTMENTS

DEPARTMENT OF CIVIL AND MINING ENGINEERING

Academic Programmes: Bachelor of Science in Civil Engineering (Honours)
Bachelor of Science in Mining Engineering (Honours)

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Academic Programmes: Bachelor of Science in Electronics and Computer Engineering (Honours)
Bachelor of Science in Electrical Engineering (Honours)

DEPARTMENT OF MECHANICAL AND METALLURGICAL ENGINEERING

Academic Programmes: Bachelor of Science in Mechanical Engineering (Honours)
Bachelor of Science in Metallurgical Engineering (Honours)

3 NATURE OF THE CURRICULUM OF BACHELOR OF SCIENCE IN ENGINEERING

3.1 INTRODUCTION

In October 2008, the University Senate approved a curriculum for degrees of Bachelor of Science in Engineering, consisting of eight programmes that cover the following disciplines: Civil Engineering, Computer Engineering, Electrical Engineering, Electronics Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering and Telecommunication Engineering. These programmes were launched in February 2009 when the School of Engineering and the Built Environment admitted its first intake of students. In February 2012, the School launched an additional programme, Bachelor of Science in Electronics and Computer Engineering.

Following the launch of the programmes, the School submitted its curriculum to the Namibia Qualifications Authority (NQA) for assessment towards registration on the National Qualifications Framework (NQF). The NQA Secretariat found that all nine curricula satisfy the requirements for Professional Bachelor Degrees at NQF Level 8. All Engineering qualifications offered by the School are registered on the National Qualification Framework with the Namibian Qualification Authority.

The same curriculum was submitted to the Engineering Council of South Africa for a desktop review aimed at assessing whether the curriculum met the requirements of the Engineering Council of Namibia's Standards for Professional Bachelor Degrees in Engineering. The ECSA desktop review concluded that the curriculum does meet the Standards of the Engineering Council of Namibia (ECN). One of the degree programmes, namely BSc in Electronics Engineering was also submitted to the National Council for Higher Education (NCHE) in Namibia for Pilot Accreditation. Whereas the NQA, ECSA and NCHE found the curriculum acceptable and meeting most of the targeted requirements, suggestions for further improvements were made. Meanwhile, the School has entered into collaboration with a number of German Universities, which have also suggested changes to the curriculum. In the light of suggestions from all the stakeholders, the School decided to review all its programmes with the aim of producing a revised curriculum that would eventually be accredited by the Engineering Council of Namibia, National Council for Higher Education and Engineering Council of South Africa.

In 2016, the Programme for Bachelor of Science in Metallurgical received full (5 years) accreditation, while the Bachelor of Science in Civil Engineering received conditional (3 years) from NCHE. Two more programmes namely Bachelor of Science in Mechanical Engineering and Bachelor of Science in Electronics and Computer Engineering went through the accreditation exercise with NCHE in 2016, while the remaining two programmes (Bachelor of Science in Electrical Engineering and Bachelor of Science in Mining Engineering) are expected to go through the accreditation process in 2017.

3.2 PURPOSE AND SUPPORT FOR THIS CURRICULUM

The **purpose of this curriculum** is to provide systematic university-level education and training towards the attainment of pre-defined Exit Level Learning Outcomes needed by the University of Namibia and recognized by Engineering Professional Bodies for the attainment of the Degree of Bachelor of Science in Engineering (BSc in Engineering) in the following disciplines: Civil Engineering; Computer Engineering; Electrical Engineering; Electronics Engineering; Mechanical Engineering; Metallurgical Engineering; Mining Engineering; Telecommunication Engineering; Electronics and Computer; and in any other Engineering discipline approved from time to time by Senate.

This curriculum enjoys **full support** from the Government of the Republic of Namibia (GRN), which considers it to be a precursor for the attainment of Vision 2030 with respect to producing key human resource in Engineering and technology. The support of GRN was manifested in the initial investment of about N$150 million made by the Government towards construction and establishment of Phase I (Mechanical Engineering and Administration Buildings, Students Hostels, Visitor Flats) of the School of Engineering and the Built Environment in Ongwediva Campus. The GRN will also fund the construction of Phase IV of the School (Electronics, Telecommunication and Electrical Engineering Buildings). Local industry and private individuals have also expressed support for this curriculum and have already made multi-million-dollar donations to the School. In addition, local industry is working in partnership with the School by providing opportunities for engineering students to carry out Industrial Attachment during vacation time. A number of local industries have also expressed wishes to carry out joint research with the School.

Foreign governments have also expressed their support towards education and training of engineers in Namibia. For example, the Government of India donated US$12.3 million towards the construction of Phase II of the School (Mining Engineering, Computer Engineering and Library Buildings). The Federal Republic of Germany, on the other hand, has donated Euro 13 million towards construction and equipping of Phase III of the School (Civil and Environmental Engineering Buildings). A number of international universities have signed memoranda of understanding with the University of Namibia to support training, research, academic exchange, student exchange and staff development at the School of Engineering and the Built Environment.

3.3 ESSENTIAL CURRICULUM REQUIREMENTS

The curriculum for the degrees of Bachelor of Science in Engineering consists of Extended Programs (=32BHVX, 32BHCX, 32BHEX, 32BHNX, 32BHTX and 32BHMX) plus four years of Engineering training spread over 8 semesters. The Extended Programs consist of Engineering and support modules that are meant for students who enter the Engineering Programs with 27 point from the 2 subjects in Advance Subsidiary with a "d" symbol from Mathematics, Pyhysics and or Checmistry and another 3 subjects from Ordinary level including English with a "C" symbol..

The First Year of Engineering (=32BHVI, 32BHCI, 32BHEI, 32BHNI, 32BHTI and 32BHMI) is common to all Engineering disciplines and is the entry point for students who completed secondary school and obtained the National Senior Secondary Certificate (NSSCAS) and obtained symbol "c" in Mathematics, Chemistry and Physics and 2 more subjects from either Ordinary level or NSSCAS including English with a "C" or "c " symbol.

In addition to having a common First Year, some common subjects have been incorporated in the Second Year of Engineering in order to share resources and eliminate duplication. Almost all subjects in the Third Year and Fourth Year of Engineering are discipline-specific. In order to provide hands-on experience, all students are required to undertake Industrial Attachment during their Fourth Year of Engineering.

3.4 REQUIREMENTS FOR ACCREDITATION

3.4.1 NQF CREDITS

The 8 semesters of the Bachelor of Science degree in Engineering have been structured using the UNAM degree format, while satisfying accreditation requirements of the Namibia Qualifications Authority (NQA), the Engineering Council of Namibia (ECN) and the Engineering Council of South Africa (ECSA) for a total of at least 560 NQF Credits and a minimum specified knowledge area content. The total NQF Credits are accumulated from Levels 5 to 8.

ECSA and ECN have adopted the South African Qualifications Authority (SAQA) standards, which require a four-year full-time professional degree programme to have at least **560 NQF Credits**. One credit is equal to **10 notional hours**. A Notional Hour is made up of **Delivery Time** (teaching time) plus **Learning Time** (individual private time in the learning process). For courses consisting of mainly lecturers, tutorials and laboratory work, 1 contact hour is equal to 2 notional hours because for every hour of lecture (every hour of delivery), a learner requires another hour of private study (learning time). At UNAM, a semester is made up of 16 weeks, made up of 14 weeks of lectures and 2 weeks of examinations. Subjects are classified as full module or half module, depending on contact time per week. A full module is made up of 56 lecture hours (i.e. 14 weeks x 4 hours of lecture per week) plus tutorials or practical sessions.

In this curriculum, a full module consists of 4 lecture hours plus 2 hours of tutorial (or 3 hours of practical) per week. The 4 lecture hours per week equal to 4 contact hours and the 2 hours of tutorial (or 3 hours of laboratory practical) are equivalent to an additional 1 contact hour. The delivery time for a full module is therefore 5 hours per week. Since for every one-hour delivery time there is one hour of learning, the number of notional hours per week is ten. As stated above, 10 notional hours are equivalent to 1 credit. Therefore, a full module earns 1 credit per week or 14 credits over a 14-week semester. In addition, during the calculation of credits, the time spent on continuous assessment and examinations must also be included. The three-hour examination plus continuous assessment for a full module translates into an additional 2 credits per semester. Therefore, a **full module** consists of **16 credits per semester**. A **half module** consists of **8 credits per semester**.

3.4.2 KNOWLEDGE AREA CONTENT

The minimum credits within five specified Knowledge Areas in an accredited Engineering degree programme that are recommended by ECN are shown in the table below. The table shows that an Engineering curriculum needs to have a balance of mathematics, basic sciences, engineering principles, Engineering design and synthesis, computing and IT as well as some complementary and discretionary studies. In particular, the combined content of Engineering principles, Engineering design and synthesis as well as computing and IT should be at least 50% of the overall curriculum.

Recommended Minimum Credits per Knowledge Area in a Professional Engineering Degree Programme

KNOWLEDGE AREA	MINIMUM CREDITS	MIN PERCENT CONTENT (%)
MATHEMATICAL SCIENCE	56	10
NATURAL SCIENCES	56	10
ENGINEERING SCIENCES	180	32
ENGINEERING DESIGN AND SYNTHESIS	72	13
COMPLEMENTARY STUDIES	56	10
SUBTOTAL (MINIMUM)	**420**	**75**
DISCRETIONARY (FOR REALLOCATION) – MAX	140	25
TOTAL	**560**	**100**

Complementary Studies consist of those disciplines outside of engineering sciences, basic sciences and mathematics, which are essential to the practice of Engineering and help broaden the student's perspective in the humanities and social sciences, thus enabling the student to understand the world in which Engineering is practised. Such studies include economics, management principles, impact of technology on society, effective communication, labour laws, laws of contracts etc.

Discretionary studies, on the other hand, are made up of optional studies taken from engineering principles, which assist students to understand their disciplines better. For example, students of mechanical Engineering may choose to study principles of electrical machines because they will need to use such machines in their mechanical designs.

3.4.3 EXIT LEVEL OUTCOMES

The curriculum for the degree of Bachelor of Science in Engineering prepares candidates for future registration as Professional Engineers by the Engineering Council of Namibia (ECN). In order for an Engineering curriculum to adequately prepare a person for registration as a Professional Engineer, certain competencies or **Exit Level Outcomes** have been defined by the Engineering Council of Namibia (ECN)[1] (and also by the Engineering Council of South Africa (ECSA)). The required Exit Level Outcomes are as follows:

1. **PROBLEM SOLVING**
   Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively.
2. **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**
   Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering to solve complex Engineering problems.
3. **ENGINEERING DESIGN**
   Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.
4. **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**
   Demonstrate competence to formulate and conduct investigations and experiments.
5. **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**
   Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.
6. **PROFESSIONAL AND TECHNICAL COMMUNICATION**
   Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences the community at large.
7. **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY**
   Demonstrate critical awareness of the sustainability and impact of engineering activity on the social, industrial and physical environment.
8. **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**
   Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.
9. **INDEPENDENT LEARNING ABILITY**
   Demonstrate competence to engage in independent learning through well-developed learning skills.
10. **ENGINEERING PROFESSIONALISM**
    Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.
11. **ENGINEERING MANAGEMENT**
    Demonstrate knowledge and understanding of Engineering management principles and economic decision making.

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1 ECN (2007), *Standards for Professional Bachelor Degrees in Engineering*, Windhoek: pg. 5-8.

4 REGULATIONS AND CURRICULUM FORMAT

The regulations outlined in this curriculum should be read in conjunction with the **General Information and Regulations Prospectus** of the University of Namibia.

4.1 DEGREE NAMES AND CODES

The School of Engineering and the Built Environment will, in the long run, offer courses that lead to the award of the following degrees plus any others that may be approved by Senate from time to time.

Bachelor of Science in Civil Engineering (Honours)	**(19BCVE)**
Bachelor of Science in Computer Engineering (Honours)	**(19BCME)**
Bachelor of Science in Electrical Engineering (Honours)	**(19BECE)**
Bachelor of Science in Electronics Engineering (Honours)	**(19BETE)**
Bachelor of Science in Electronics and Computer Engineering (Honours)	**(19BCEE)**
Bachelor of Science in Mechanical Engineering (Honours)	**(19BMEE)**
Bachelor of Science in Metallurgical Engineering (Honours)	**(19BMLE)**
Bachelor of Science in Mining Engineering (Honours)	**(19BMNE)**
Bachelor of Science in Telecommunication Engineering (Honours)	**(19BTCE)**
Bachelor of Science in Biomedical Engineering (Honours)	**(19BBME)**
Bachelor of Science in Chemical Engineering (Honours)	**(19BCHE)**
Bachelor of Science in Electrical Power Engineering (Honours)	**(19BEPE)**
Bachelor of Science in Industrial Engineering (Honours)	**(19BINE)**

4.2 PROGRAMMES ON OFFER IN 2024

(i)	Bachelor of Science in Civil Engineering (Honours)	**(32BHVI)** (19BCVE)
(ii)	Bachelor of Science in Electrical Engineering (Honours)	**(32BHEI)** (19BECE)
(iii)	Bachelor of Science in Electronics and Computer Engineering (Honours)	**(32BHCI)** (19BCEE)
(iv)	Bachelor of Science in Mechanical Engineering (Honours)	**(32BHNI)** (19BMEE)
(v)	Bachelor of Science in Metallurgical Engineering (Honours)	**(32BHTI)** (19BMLE)
(vi)	Bachelor of Science in Mining Engineering (Honours)	**(32BHMI)** (19BMNE)
(vii)	Bachelor of Science in Civil Engineering (Honours) - Extended	**(32BHVX)**
(viii)	Bachelor of Science in Electrical Engineering (Honours) - Extended	**(32BHEX)**
(ix)	Bachelor of Science in Electronics and Computer Engineering (Honours) - Extended	**(32BHCX)**
(x)	Bachelor of Science in Mechanical Engineering (Honours) - Extended	**(32BHNX)**
(xi)	Bachelor of Science in Metallurgical Engineering (Honours) - Extended	**(32BHTX)**
(xii)	Bachelor of Science in Mining Engineering (Honours) - Extended	**(32BHMX)**

4.3 ADMISSION REQUIREMENTS

4.3.1 GENERAL REQUIREMENTS

To register in the Bachelor of Science in Engineering degree programme, a candidate must hold a valid National Senior Secondary Certificate (NSSC) at NSSC-O level (IGCSE level), NSSC-H level, (HIGCSE level) or NSSCAS Level with passes in at least five subjects, which add up to at least 32 points, calculated using the specified UNAM scale. Equivalent qualifications are acceptable. The School of Engineering and the Built Environment may administer an entrance test when admission places are scarce.

4.3.2 MINIMUM ENTRY INTO ENGINEERING –EXTENDED PROGRAMME

The minimum entry requirement for admission into the Engineering - Extended Programme is 27 points in the best five subjects from grade 12:

(a) 2 Subjects (Mathematics, Physics /Chemistry) on NSSCAS level with an average grade of “d” in each subject or higher. 3 Subjects on Ordinary level including English with a “C” Symbol

(b) A score of “**3**” in Mathematics and in Physical Science (or “**3”** in Mathematics and **4** in Physical Science) plus a score of 4 or better in English at NSSC-H level (HIGCSE) or equivalent qualification. If English was not taken at NSSC-H, at least a “C” symbol in English at NSSC-O level will be required, **or**

(c) At least a “**B**” symbol in Mathematics and “**C**” symbol in Physical Science (or at least a “**C**” symbol in Mathematics and “**B**” symbol in Physical Science); plus a at least a “**C**” symbol in English at NSSC-O level (IGCSE level) or equivalent qualification, (Qualification obtained from Grade 12 before 2021) **or**

(d) Students doing the UNAM Foundation Programme are eligible for admission into Engineering - Extended Programme, provided they meet the minimum entry requirements.

4.3.3 MINIMUM ENTRY INTO THE FIRST YEAR OF ENGINEERING (=32BHVI, 32BHCI, 32BHEI, 32BHNI, 32BHTI AND 32BHMI)

The minimum entry requirements for admission into the **First Year of Engineering** are 32 points in the best five subjects as follows:

(a) Successful completion of the Pre- Engineering Programme, **or**

(b) Candidates must be in possession of a valid Namibian Senior Secondary Certificate (NSSCH) with a total of **32 points** in five subjects as follows:

~~(c)~~ A score of 2 or better in Mathematics and Physical Science and a score of 4 or better in English at NSSC-H level (HIGSCE level) or equivalent qualifications. If English was not taken at NSSC-H level, at least a "**C**" symbol in English at NSSC-O level will be required, **or**

(d) 3 subjects (Mathematics, Physics and Chemistry) on NSSCAS level with an average grade of "*c*" in each subject or higher.2 Subjects on NSSCO level with "C" average or higher, including English.

(e) Students who have completed the First Year of Science at UNAM with passes in Physics, Chemistry and in all Mathematics and Statistics modules maybe admitted to the First Year of Engineering provided they have at least a "**C**" symbol in English at NSSC-O level. This criterion will only be applied when there is capacity to admit.

Note: A Science student who has no Re-admission into the School of Science does not qualify for admission into the School of Engineering and the Built Environment.

4.3.3.1 Post-Secondary School Qualifications

(a) Holders of a Diploma in Engineering Programmes we offer

(b) Engineering at NQF Level 6

- A student who completed a Level 6 Diploma in **Engineering Programmes** will be admitted directly into Second Year of the BSc. in Engineering, provided that such a qualification is recognized by the Engineering Council of Namibia.
- Such a student may, however, be required to take some First-Year modules (in the BSc. in Engineering) when recommended by the Department.
- Foreign qualifications require an evaluation letter from the Namibian Qualification Authority (NQA) to be submitted.

(c) Holders of a Bachelor of Technology in Engineering at NQF Level 7

- A student who completed a Level 7 Bachelor of Technology in Engineering will be admitted directly into Third Year of the BSc. in Engineering, provided that their qualification is recognized by the Engineering Council of Namibia.
- Such a student may, however, be required to take some Second-Year modules (in the BSc. in Engineering) when recommended by the Department.

4.4 PROGRESSION

Qualified NSSC-O level candidates must join the Pre- Engineering Year and should normally complete this year successfully within two academic years before they can be admitted to the First Year of Engineering. Students who fail the Pre- Engineering Year may register for B.Sc. (Science) or in any other programme. NSSC-H level candidates who join the First year of Engineering directly from school will be required to do the prescribed University Core Modules, in addition to the other specified modules in the First Year of Engineering. Prospective candidates should note that meeting the minimum entry requirements does not necessarily ensure admission, as this depends on places available.

4.5 DURATION OF STUDY

The minimum duration for the Bachelor of Science (Engineering) degree programme is four (4) years. For students who require more time due to ill health or slow progression, the Bachelor of Science (Engineering) degree programme must be completed within six (6) years of full-time study for those who begin at Year 1 of Engineering or eight (8) years for those who begin with Pre-Engineering.

4.6 EXEMPTIONS

UNAM will give exemptions for equivalent modules taken at other tertiary institutions but the exemptions shall not exceed 50% of the modules in the Bachelor of Science (Engineering) degree programme. For detailed exemption rules, see the General Information and Regulations Prospectus of the University.

4.7 EXAMINATION REGULATIONS

For detailed examination and promotion rules see the University's **General Information and Regulations Prospectus**.

(i) For assessment purposes, all modules shall normally carry a component of Continuous Assessment and University Examination.

(ii) Continuous Assessment (CA) shall normally consist of **at least 2 Written Tests plus Assignments and/or Lab. Reports.** The CA Mark shall be made up of **60%** Written Tests and **40%** Assignments and/or Lab Reports for modules that are not 100% CA.

(iii) A candidate will be eligible to write a University Examination (UE) in a given module only if he/she has obtained the required Continuous Assessment Mark of **at least 40%** in that module except when the module is used to assess the Exit Level Outcomes (ELOS)

(iv) University Examinations will normally be administered at the end of the semester. Where **modular teaching** (block teaching) is used, examinations may be administered immediately after the completion of teaching.

(v) Full modules (16 credits) and three-quarter modules (12 credits) shall have **3-hour** examination papers. Half modules (8 credits) shall normally have **2-hour** examination papers.

(vi) The Final Examination Mark shall be made up of **50%** Continuous Assessment and **50%** University Examination, with the exception of certain modules Computer Science, where the Final Mark is made up of **60%** CA and **40%** UE.

(vii) Certain modules are assessed on the basis of 100% Continuous Assessment. This is indicated in the module description.

(viii) The Pass Mark in any module as determined by the Final Examination Mark is **50%** except when the module is used to assess the Exit Level Outcomes (ELOS)**.**

(ix) The minimum Continuous Assessment for examination-based modules in which an Exit Level Outcomes is assessed through the Continuous Assessment shall be 50% minimum to sit for the examination in order fulfil the requirements of the Engineering Council of Namibia.

(x) The sub-minimum examination mark for examination-based modules in which an Exit Level Outcome is assessed through the University Examination shall be 50% minimum in order fulfil the requirements of the Engineering Council of Namibia.

(xi) Or a sub-minimum passing mark of 50% in the University Examination in order fulfil the requirements of the Engineering Council of Namibia.

(xii) The minimum passing mark for 100% Continuous Assessment modules in which ELO are assessed shall be 60% in order to fulfil the requirements of the Engineering Council of Namibia

4.8 ACADEMIC ADVANCEMENT RULES

4.8.1 BACHELOR OF SCIENCE IN ENGINEERING– EXTENDED FIRST YEAR TO SECOND YEAR OF ENGINEERING

A student advances to the subsequent academic year of study when the following conditions are meet:

1. Bachelor of Science in Civil Engineering (Honours) - Extended

a. Year 1 to Year 2: At least 74 credits and all support modules. Of the 74 credits at least 50 must be non-core

2. Bachelor of Science in Electronics and Computer Engineering (Honours) - Extended

a. Year 1 to Year 2: At least 74 credits and all support modules. Of the 74 credits at least 50 must be non-core.

3. Bachelor of Science in Electrical Engineering (Honours) - Extended

a. Year 1 to Year 2: At least 74 credits and all support modules. Of the 74 credits at least 50 must be non-core.

4. Bachelor of Science in Mechanical Engineering (Honours) – Extended

a. Year 1 to Year 2: At least 74 credits and all support modules. Of the 74 credits at least 50 must be non-core.

5. Bachelor of Science in Metallurgical Engineering (Honours) – Extended

a. Year 1 to Year 2: At least 74 credits and all support modules. Of the 74 credits at least 50 must be non-core.

6. Bachelor of Science in Mining Engineering (Honours) – Extended

a. Year 1 to Year 2: At least 74 credits and all support modules. Of the 74 credits at least 50 must be non-core.

4.8.2 BACHELOR OF SCIENCE IN ENGINEERING– EXTENDED SECOND YEAR TO THIRD YEAR OF ENGINEERING

A student advances to the subsequent academic year of study when the following conditions are meet:

1. Bachelor of Science in Civil Engineering (Honours) - Extended

b. Year 2 to Year 3: All Year 1 credits and all support modules and at least 102 second year

2. Bachelor of Science in Electronics and Computer Engineering (Honours) - Extended

b. Year 2 to Year 3: All Year 1 credits and all support modules and at least 102 credits.

3. Bachelor of Science in Electrical Engineering (Honours) - Extended

b. Year 2 to Year 3: All Year 1 credits and all support modules and at least 102 credits.

4. Bachelor of Science in Mechanical Engineering (Honours) – Extended

b. Year 2 to Year 3: All Year 1 credits and all support modules and at least 102 credits.

5. Bachelor of Science in Metallurgical Engineering (Honours) - Extended

b. Year 2 to Year 3: All Year 1 credits and all support modules and at least 102 credits.

6. Bachelor of Science in Mining Engineering (Honours) – Extended

b. Year 2 to Year 3: All Year 1 credits and all support modules and at least 102 credits.

4.8.3 FIRST YEAR TO SECOND YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed at least 123 credits, of which at least 78 must be non-core. If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

2. Bachelor of Science in Electronics and Computer Engineering (Honours)

A student must have passed at least 123 credits, of which at least 78 must be non-core. If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

3. Bachelor of Science in Electrical Engineering (Honours)

A student must have passed at least 123 credits, of which at least 78 must be non-core. If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

4. Bachelor of Science in Mechanical Engineering (Honours)

A student must have passed at least 123 credits, of which at least 78 must be non-core. If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

5. Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed at least 123 credits, of which at least 78 must be non-core. If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

6. Bachelor of Science in Mining Engineering (Honours)

A student must have passed at least 123 credits of which at least 78 must be non-core. If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

4.8.4 SECOND YEAR TO THIRD YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed at least 117 credits (at least 75%) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

2. Bachelor of Science in Electronics and Computer Engineering (Honours)

The student must have passed all year one credits at least 126 credits (at least 75%)
of Year 2 to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

3. Bachelor of Science in Electrical Engineering (Honours)

A student must have passed : At least 120 credits (at least 75%) If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

4. Bachelor of Science in Mechanical Engineering (Honours)

A student **must** have passed all first-year credits. In addition, the student must have passed at least **117** credits of Year 2 to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

5. Bachelor of Science in Metallurgical Engineering (Honours)

A student **must** have passed all first-year credits. In addition, the student must have passed at least **111** credits of Year 2 to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

6. Bachelor of Science in Mining Engineering (Honours).

A student **must** have passed all **first** credits prescribed in the First Year. In addition, the student must have passed at least 123 credits (at least 75%) of Year 2 to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

4.8.5 THIRD YEAR TO FOURTH YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

Year 3 to Year 4: All first-year credits and at least 105 third year credits (at least 75%)

Bachelor of Science in Electronics and Computer Engineering (Honours)

Year 3 to Year 4: All year 1, year 2 credits, and at least 102 third year credits (at least 75%)

A student who fulfilled the re-admission regulations but could not advance to the next academic year must first register for all failed modules. Subject to pre-requisite and no timetable clashes, such a student may then add modules of the subsequent academic year, provided that the total number of registered credits does not exceed the prescribed number of credits of the current academic year by more than 20%.

2. Bachelor of Science in Electrical Engineering (Honours)

Year 3 to Year 4: All first-year credits and at least 96 third year credits (at least 75%)

A student who fulfilled the re-admission regulations but could not advance to the next academic year must first register for all failed modules. Subject to pre-requisite and no timetable clashes, such a student may then add modules of the subsequent academic year, provided that the total number of registered credits does not exceed the prescribed number of credits of the current academic year by more than 20%.

3. Bachelor of Science in Mechanical Engineering (Honours)

Year 3 to Year 4: All second-year credits and at least 102 third year credits

A student who fulfilled the re-admission regulations but could not advance to the next academic year must first register for all failed modules. Subject to pre-requisite and no timetable clashes, such a student may then add modules of the subsequent academic year, provided that the total number of registered credits does not exceed the prescribed number of credits of the current academic year by more than 20%.

5. Bachelor of Science in Metallurgical Engineering (Honours)

Year 3 to Year 4: All second-year credits and at least 105 third year credits

A student who fulfilled the re-admission regulations but could not advance to the next academic year must first register for all failed modules. Subject to pre-requisite and no timetable clashes, such a student may then add modules of the subsequent academic year, provided that the total number of registered credits does not exceed the prescribed number of credits of the current academic year by more than 20%.

6. Bachelor of Science in Mining Engineering (Honours)

Year 3 to Year 4: All first-year credits and at least 93 third year credits (at least 75%)
A student who fulfilled the re-admission regulations but could not advance to the next academic year must first register for all failed modules. Subject to pre-requisite and no timetable clashes, such a student may then add modules of the subsequent academic year, provided that the total number of registered credits does not exceed the prescribed number of credits of the current academic year by more than 20%.

4.8.6 ADDITIONS OF MODULES FROM THE SUBSEQUENT ACADEMIC YEAR

A student who fulfilled the re-admission regulations but could not advance to the next academic year must first register for all failed modules. Subject to pre-requisite and no timetable clashes, such a student may then add modules of the subsequent academic year, provided that the total number of registered credits does not exceed the prescribed number of credits of the current academic year by more than 20%.

4.9 MAXIMUM NUMBER OF CREDITS PER YEAR

1. Bachelor of Science in Civil Engineering (Honours)

First year:	164 credits
Second year:	198 credits (144 credits of second year plus 54 credits of first year)
Third Year:	168 credits (136 credits of third year plus 32 Credits of second year)
Fourth Year:	170 credits (140 credits of fourth year plus 30 Credits of third year)
Fifth Year:	112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

2. Bachelor of Science in Electronics and Computer Engineering (Honours)

First year:	160 credits
Second year:	191 credits (140 credits of second year plus 54 Credits of first year)
Third Year:	170 credits (140 credits of third year plus 30 Credits of second year)
Fourth Year:	170 credits (140 credits of fourth year plus 30 Credits of third year)
Fifth Year:	112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

3. Bachelor of Science in Electrical Engineering (Honours)

First year:	160 credits
Second year:	202 credits (148 credits of second year plus 54 credits of first year)
Third Year:	164 credits (132 credits of third year plus 32 Credits of second year)
Fourth Year:	169 credits (140 credits of fourth year plus 29 Credits of third year)
Fifth Year:	112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

4. Bachelor of Science in Mechanical Engineering (Honours)

First year:	164 credits
Second year:	190 credits (136 credits of second year plus 54 Credits for first year)
Third Year:	174 credits (144 credits of third year plus 30 Credits for second year)
Fourth Year:	172 credits (140 credits of fourth year plus 32 Credits for third year)
Fifth Year:	112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

5. Bachelor of Science in Metallurgical Engineering (Honours)

First year:	164 credits
Second year:	192 credits (140 credits of second year plus 52 Credits for first year)
Third Year:	175 credits (144 credits of third year plus 31 Credits for second year)
Fourth Year:	172 credits (140 credits of fourth year plus 32 Credits for third year)
Fifth Year:	112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

6. Bachelor of Science in Mining Engineering (Honours)

First year:	164 credits
Second year:	184 credits (132 credits of second year plus 52 Credits for first year)
Third Year:	178 credits (148 credits of third year plus 30 Credits for second year)
Fourth Year:	174 credits (140 credits of fourth year plus 34 Credits for third year)
Fifth Year:	112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

4.10 MINIMUM REQUIREMENTS FOR RE-ADMISSION

1. Bachelor of Science in Civil Engineering (Honours)

To be re-admitted to the School of Engineering and the Built Environment, a student must have successfully completed the following minimum number of credits as indicated below:

1. 49 credits (of which 24 must be non-core) by the end of the first year of registration
2. 164 credits by the end of the second year of registration
3. 281 credits by the end of the third year of registration
4. 403 credits by the end of the fourth year of registration
5. 501 credits by the end of the fifth year of registration
6. 596 credits by the end of the sixth year of registration

The programme must be completed after a maximum of 6 years of registration

A student will not be re-admitted into the School of Engineering and the Built Environment if he/she has not earned:

- All **164** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus **108** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus all **136** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

2. Bachelor of Science in Electronics and Computer Engineering (Honours)

To be re-admitted to the School of School of Engineering and the Built Environment, a student must have successfully completed the following minimum number of credits as indicated below:

1. 55 credits (of which 24 must be non-core) by the end of the first year of registration
2. 200 credits by the end of the second year of registration
3. 354 credits by the end of the third year of registration
4. 468 credits by the end of the fourth year of registration
5. 548 credits by the end of the fifth year of registration
6. 600 credits by the end of the sixth year of registration

A student will not be re-admitted into the School of Engineering and the Built Environment if he/she has not earned:

- All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus **131** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

3. Bachelor of Science in Electrical Engineering (Honours)

To be re-admitted to the School of School of Engineering and the Built Environment, a student must have successfully completed the following minimum number of credits as indicated below:

1. 49 credits by the end of the first year of registration
2. 164 credits by the end of the second year of registration
3. 284 credits by the end of the third year of registration
4. 497 credits by the end of the fourth year of registration
5. 557 credits by the end of the fifth year of registration
6. 592 credits by the end of the sixth year of registration

The programme must be completed after a maximum of 6 years of registration

- All **164** prescribed Year 1 credits plus at least **148** credits of Year 2 plus **106** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **148** prescribed Year 2 credits plus all **132** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

4. Bachelor of Science in Mechanical Engineering (Honours)

To be re-admitted to the School of Engineering and the Built Environment, a student must have successfully completed the following minimum number of credits as indicated below:

1. 49 credits (of which 24 must be non-core) by the end of the first year of registration
2. 164 credits by the end of the second year of registration
3. 281 credits by the end of the third year of registration
4. 403 credits by the end of the fourth year of registration
5. 501 credits by the end of the fifth year of registration

A student will not be re-admitted into the School of Engineering and the Built Environment if he/she has not earned:

- All **164** prescribed Year 1 credits plus all **136** prescribed Year 2 credits plus **115** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.

- All **164** prescribed Year 1 credits plus all **136** prescribed Year 2 credits plus all **144** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

5. **Bachelor of Science in Metallurgical Engineering (Honours)**

To be re-admitted to the School of Engineering and the Built Environment, a student must have successfully completed the following minimum number of credits as indicated below:

1. 48 credits (of which 24 must be non-core) by the end of the first year of registration
2. 164 credits by the end of the second year of registration
3. 275 credits by the end of the third year of registration
4. 401 credits by the end of the fourth year of registration
5. 499 credits by the end of the fifth year of registration
6. 592 credits by the end of the sixth year of registration

The programme must be completed after a maximum of 6 years of registration

- All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus **116 credits** of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus all **144** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

6. Bachelor of Science in Mining Engineering (Honours)

To be re-admitted to the School of Engineering and the Built Environment, a student must have successfully completed the following minimum number of credits as indicated below:

1. 49 credits (of which 24 must be non-core) by the end of the first year of registration
2. 164 credits by the end of the second year of registration
3. 287 credits by the end of the third year of registration
4. 399 credits by the end of the fourth year of registration
5. 499 credits by the end of the fifth year of registration
6. 596 credits by the end of the sixth year of registration

The programme must be completed after a maximum of 6 years of registration

- All **164** prescribed Year 1 credits plus all **132** prescribed Year 2 credits plus all **148** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

4.11 CRITERIA FOR GRADUATION

A student can graduate with the degree of **Bachelor of Science in Engineering (Honours)** in a given discipline only if he/she has earned the **Total credits per qualification on NQF Credits** prescribed in the curriculum and has successfully completed **all required Industrial Attachment** sessions. The specified minimum NQF Credits include **30** Credits of Research and 34 Credits of Design Project during Semester 8 of study.

5 CURRICULUM COMPILATION

The curriculum for the degree of Bachelor of Science in Engineering (Honours) is made up of the following components:

5.1 EXTENDED PROGRAMME) (32BHVX, 32BHCX, 32BHEX, 32BHNX, 32BHTX AND 32BHMX)
UNIVERSITY CORE:

U3683AL Academic Literacy II
U3403FS Skills Portfolio
U3583AL Academic Literacy I
U3583DD Digital Literacy
U3420CN National and Global Citizenship

SCHOOL CORE:

All modules specified in the approved curriculum

5.2 YEAR 1 OF ENGINEERING (32BHVI, 32BHCI, 32BHEI, 32BHNI, 32BHTI AND 32BHMI)
5.3 COMMON TO ALL ENGINEERING DISCIPLINES

5.4 YEAR 2 OF ENGINEERING (2BHVI, 32BHCI, 32BHEI, 32BHNI, 32BHTI AND 32BHMI)
SCHOOL CORE:

I3611IM Engineering Mathematics III
I3641NM Engineering Mechanics II
I3612IM Engineering Mathematics IV
I3661IE Engineering Economics
I3620IE Entrepreneurship
I3640IW Workshop Practice
I3661IE Engineering Economics
I3620IE Engineering Entrepreneurship

DISCIPLINE SPECIFIC MODULES

All modules specified in the approved curriculum for a given Engineering discipline.

5.5 YEAR 3 OF ENGINEERING

SCHOOL CORE:

I3821IR Research Methods and Experimental Design
I3762VW Technical Writing

DISCIPLINE SPECIFIC MODULES:

All modules specified in the approved curriculum for a given Engineering discipline.

5.6 YEAR 4 OF ENGINEERING

I3801IA Industrial Training (six weeks in June/July or in December/January)

SCHOOL CORE MODULES:

I3862IE Engineering Ethics and Practice
I3882IP Project Management

DISCIPLINE SPECIFIC MODULES

All modules specified in the approved curriculum for a given Engineering discipline.
NB: When choosing a field of study, students must take into account specific requirements of their discipline and all pre-requisites and co-requisites requirements.

6 CODE STRUCTURE AND ABBREVIATIONS

The code structure employed in this curriculum is as follows:
[TEGT, TMEE, TCEE, TCME, TETE, TTCE etc.] [3] [5 – 8] [full or half] [1 or 2]

T	First Letter T represents the School of Engineering and Information Technology
S	First Letter S represents the School of Science
EGT	School Core Modules
MEE, CEE, CME, ETE, MLE, TCE, MNE …	Engineering Discipline Letter Codes
3	Bachelor Degree Programme
5 - 8	NQF Levels
Full or Half	Module type, even numbers (2, 4, 6) for half, odd numbers for full module, 8 or 9 for ¾ modules (12 credits). Also 9 is for modules with 4, 30 or 34 credits.
1 or 2	Semester

Abbreviations:

SEBE	School of Engineering and the Built Environment
L	Lecture
T	Tutorial
PS	Practical Session or Laboratory Session
IE	Engineering and Technology course codes
IV	Civil Engineering course codes
IC	Electronics and Computer Engineering course codes
IE	Electrical Engineering course codes
IN	Mechanical Engineering course codes
IT	Metallurgical Engineering course codes
IM	Mining Engineering course codes
TTC	Telecommunication Engineering course codes
IM	Mathematics course codes
IPHY	Physics course codes
ICHM	Chemistry course codes
U	University core modules

7 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS) - EXTENDED

7.1 NATURE OF EXTENDED PROGRAMME

Eligible candidates will be admitted into a Pre- Engineering Year in which they will mainly study the basic sciences, i.e. Physics, Chemistry, Mathematics, Statistics and Computer skills, as well as English Communication and Study Skills, English for Academic Purposes and Contemporary Social Issues. On successful completion of the Pre- Engineering Year, students will be admitted into the First Year of Bachelor of Science in Engineering.

Summary Table for Modules in the Bachelor of Science in Civil Engineering Honours – Extended

YEAR 1 OF (32BHVX) BACHELOR OF SCIENCE IN CIVIL ENGINEERING HONOURS – EXTENDED 96 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Civil Engineering	I3500VI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Civil Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Mathematics support I	I3401MS	4	0	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Physics for Engineers Support I	I3421PS	4	0	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Chemistry for Engineers Support	I3441CS	4	0	None
Total credits 1st Semester BSc Civil Engineering				**44**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Engineering Mathematics support II	I3402MS	4	0	(None)/**None**
2	Physics for Engineers II	I3582NP	5	12	I3581NP
2	Physics for Engineers Support II	I3422PS	4	0	None
Total credits 2nd Semester BSc Civil Engineering			**28**		

YEAR 2 OF (32BHVX) BACHELOR OF SCIENCE IN CIVIL ENGINEERING HONOURS – EXTENDED 136 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Civil Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Drawing	I3530ID	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Engineering Economics	I3661IE	6	8	None
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
Total credits 1st Semester BSc Civil Engineering				**52**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Statistics for Engineers	I3582IS	5	12	I3511IM
2	Fundamentals of Electrical Engineering	I3522EE	5	8	I3511IM
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM,** I3611IM
Total credits 2nd Semester BSc Civil Engineering				**60**	

7.2 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS) -NORMAL

7.3 DEGREE NAME: BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS) 32BHVI

7.4 AIM

The aim of the programme for the degree of Bachelor of Science in Civil Engineering (Honours) is to produce Graduate Engineers with knowledge, skills and technical abilities in civil Engineering and who can competently work in design, structural analysis, construction management, infrastructure and transport planning, transport Engineering, water systems Engineering and public health Engineering; thus providing the potential for further professional training towards the requirements for registration as Professional Civil Engineers.

7.5 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Civil Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study (semester **I** and **II)** is common to all Engineering disciplines. From Year 2 to Year 4 (semesters **III** to **VIII**), students mainly take Civil Engineering modules. Semester VIII is fully dedicated to Research and Design Projects and thus there are no taught modules in this semester.

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Sessions. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some Assignments and Lab Reports, where applicable.

YEAR 1 OF (32BHVI BACHELOR OF SCIENCE IN CIVIL ENGINEERING – 164 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Civil Engineering	I3500VI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Civil Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Drawing	I3530ID	5	16	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
Total credits 1st Semester BSc Civil Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Physics for Engineers II	I3582NP	5	12	(I3521NP)
2	Materials Science	I3592IS	5	12	None
2	Fundamentals of Electrical Engineering	I3522EE	5	8	(I3511IM)
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	(I3511IM)
Total credits 2nd Semester BSc Civil Engineering				**68**	

YEAR 2 OF (32BHVI) BACHELOR OF SCIENCE IN CIVIL ENGINEERING – 156 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	U3583AL
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Civil Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) I3511IM
1	Engineering Economics	I3661IE	6	8	None
1	Computer Programming I	I3691CP	6	12	(I3551CC)

1	Introduction to Engineering Geology	I3641MG	6	8	None
1	Strength of Materials	I3681VM	6	12	(I3532NM)
1	Theory of Structures I	I3691VS	6	12	(I3532NM)
Total credits 1st Semester BSc Civil Engineering				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics IV	I3612IM	6	16	(I3611IM) **I3512IM**
2	Fluid Mechanics I	I3692NF	6	12	(I3532NM)
2	Building Materials	I3682VB	6	12	(I3572IS)
2	Surveying for Engineers	I3692VS	6	12	(I3511IM)
2	Theory of Structures II	I3682VS	6	12	(I3651VM; I3611VS)
Total credits 2nd Semester BSc Civil Engineering				**64**	

YEAR 3 OF (32BHVI) BACHELOR OF SCIENCE IN CIVIL ENGINEERING – 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Structural Design I	I3791VD	7	12	I3691VS, **I3681VM**
1	Urban Engineering	I3771VU	7	16	I3692NF**, I3692NF**
1	Construction Management	I3721VC	7	8	None
1	Hydrology for Engineers	I3741VH	7	8	I3692NF
1	Transportation Engineering I	I3791VT	7	12	I3582IS
1	Water Treatment	I3781VW	7	12	I3511NC
Total credits 1st Semester BSc Civil Engineering				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Technical Writing	I3762VW	7	8	U3683AL
2	Hydraulics and Hydro-Engineering	I3852VH	8	16	I3692NF
2	Structural Design II	I3792VD	7	12	I3691VS, **I3681VM**
2	Environmental Engineering	I3822VE	8	8	None
2	Geotechnical Engineering I	I3782VG	7	12	I3681VM, I3641MG
2	Transportation Engineering II	I3752VT	7	16	I3771VU, **I3582IS**
Total credits 2nd Semester BSc Civil Engineering				**72**	

YEAR 4 OF (32BHVI) BACHELOR OF SCIENCE IN CIVIL ENGINEERING – 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
	Society and the Engineer	TEGT3821	8	8	TEGT3742
1	Project Management	TEGM3881	8	12	TEGT3761
1	Structural Engineering	TCVS3811	8	16	TCVS3761 TCVD3792
1	Road Pavement and Geometric Design	TCVD3871	8	16	TCVD3682
1	Railways and Public Transport Systems	TCVD3881	8	12	TCVD3682
1	Wastewater and Solid Waste Management	TCVI3881	8	12	TCVD3782 TCVI3622
Total credits 1st Semester BSc Civil Engineering				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Research Project	TCVR3892	8	30	TCVR3892
2	Civil Engineering Design Project	TCVD3890	8	34	All 3rd Year Courses
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total credits 2nd Semester BSc Civil Engineering				**64**	

Total credits for BSc in Civil Engineering (Honours) **<u>600</u>**

7.6 DETAILED COURSE CONTENTS FOR BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS)

7.6.1 YEAR 1 OF (32BHVI) BACHELOR OF SCIENCE IN CIVIL ENGINEERING

7.6.1.1 YEAR 1 CORE SEMESTER

Module Title:	**SKILLS PORTFOLIO**
Module Code	U3403FS
NQF Level	5
Notional Hours	N/A
Contact hours	N/A
Additional learning requirements	None
NQF Credits	0
Prerequisite	None
Semester Offered	Core
Module Coordinator and Contact Details	-

Module Purpose
The purpose of this module is to determine, develop and maintain individual students' academic motivation, needs and strengths for effective learning ensuring academic success.
Overarching Learning Outcome
Apply skills relevant to their academic journey at the University in terms of successful attainment of professional and personal goals.
Specific Learning Outcomes
On completing the module students should be able to:
1. Apply motivational theories to demonstrate positive attitudes in their professional and academic life.
2. Identify and manage needs and factors that may negatively impact their academic work including the design of action plans to motivate and guide them.
3. Identify and make use of the different learning styles to promote learning in a more efficient manner using various study methods and skills.
4. Manage time effectively
5. Design and make use of various test taking and examination preparation strategies.
6. Identify and use tools to improve and maintain Mental Health and wellbeing.
7. Apply the dynamics of interpersonal communication.
8. Manage their finances.
9. Identify violence as a social problem in the Namibian context to manage and prevent the occurrence thereof in their life.
10. Recognize the importance of skills training and upgrading in career planning and development to improve their classroom experiences.
11. Create a career plan, set clear, realistic and attainable career goals and engage in activities to enhance their CVs.

Module Content
UNIT 1: Academic Planning and Goal Setting
Individual Needs and Values; Steps in Reaching a Personal Vision; Proactive Approach Towards Learning; Self-Regulated Learning; Personal and Academic Goal Setting; Receptiveness to Learning; Exploring Self-Development and Self- Awareness.
UNIT 2: Attitude and Motivation
Understanding Motivation; Personal Attitudes, Behaviours and Interests; Self-Reflective Process; Approaches to Dealing with Negative Factors; Class Attendance and Participation; Procrastination; Self-Reliance; Discipline; Accountability; Healthy Habits.
UNIT 3: Learning styles
Understanding Personal Approaches to Learning; Dynamics of the Learning Process; Learning Styles and Strategies.
UNIT 4: Study Methods and Skills
Study Habits and Strategies; Learning Styles and Techniques; Effective Study Methods and Skills; Note Taking; Memory and Reading Skills; Critical Thinking.
UNIT 5: Time Management
Effective Time Management; Planning; Decision-making; Prioritization; Setting Boundaries; Time for Self – care; Procrastination.
UNIT 6: Assessment Preparation
In class exercise; Test and Examination preparation; Organizing academic workload; Setting daily study goals; Staying physically active; Study groups.
UNIT 7: Mental well-being
Understanding mental health; Signs and indicators of poor mental health; commonly experienced mental health challenges; psychosocial stressors; Seeking professional help; Coping strategies.
UNIT 8: Interpersonal Communication
Effective Communication Skills; Verbal and Non-Verbal Communication; Listening Skills; Problem Solving; Assertiveness; Negotiation Skills; Practicing Empathy in Communication; Self-Confidence; Receptiveness to Feedback; Building Trust; Teamwork; Leadership; Public Speaking Skills.
UNIT 9: Financial matters and management
Financial Literacy; Budgeting; Available Finance Options and Assistance; Managing Financial Resources.
UNIT 10: Student Violence
Types of Violence; Individual Roles in Violence; Myths, Forms; Consequences of Violence; Prevention Measures; Seeking for Help.
UNIT 11: Career Planning and Development
Defining and Selecting Career Goals; Career Exploring Different Strategies; Soft Skills Training.

Learning and Teaching Strategies/Activities
The course will be facilitated through, but not limited to, the following learning activities:
- Online teaching: Self-study on theoretical foundations and concepts of the Skills Portfolio module
- Discussion forums (peer review): reflecting on own contexts, experiences and sharing perspectives
- Inquiry: carrying out research to explore and understand scenarios and problems relating to self
- Portfolio writing: writing reflective learning journals related to the Skills Portfolio module

Student Assessment Strategies
- 100% continuous assessment
- Reflective journal on each unit (portfolio)

Learning and Teaching Enhancement Strategies
- Student – lecturer evaluations, conducted twice a year
- Moderation of assessment tools

Learning Resources
[1] Feldman, R. S. and Chick, S. (2005) Power learning: Strategies for Success in Higher Education and Life. Toronto: Mc Graw-Hill Ryerson Limited.
[2] Light, R. J. (2001). Making the most out of College: Students Speak their Minds. Cambridge, Mass: Harvard University Press.
[3] Tracy, E. (2002). The student's guide to exam success. Philadelphia: Open University Press
[4] Toft, D. (2005). Mastering Student Guide to Academic Success. Boston: Houghton Mifflin Company.

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Module Title: ACADEMIC LITERACY I (First year students with NSSCO A, B, C and NSSAS a, b, c, d in English 1st and 2nd language).

Module Code	U3583AL
NQF Level	5
Notional Hours	80
Contact hours	Core Semester: 2 Lectures + 1 Tutorial / Week.
Semester	1: 2 Lectures / Week.
Semester	2: 2 Lectures / Week.
Additional learning requirements	None
NQF Credits	8
(Co-requisites)/ Pre-requisite	(None)
Semester Offered	0, 1 and 2

Module Purpose
The purpose of this module is to introduce students to academic literacy practices in a university setting.
Overarching Learning Outcome
Students should be able to apply the skills learnt from this module to enable them to cope with academic reading, listening, speaking and writing demands at the university level.

Specific Learning Outcomes
1. On completing the module students should be able to:
2. Compose an academic essay.
3. Apply appropriate study skills in academic meaning systems.
4. Practice academic integrity to avoid plagiarism.
5. Apply features of academic writing and other academic conventions in own writing.
6. Use patterns of text organisation to academic writing.
7. Edit and proofread own and others' work.
8. Summarise main ideas or relevant parts of texts.
9. Read and critique academic texts.
10. Apply appropriate reading comprehension strategies.
11. Illustrate the correct use of academic register in speaking and writing.
12. Use information from listening materials to complete writing and speaking tasks.
13. Participate in oral presentations on academic subjects using technology.

Module Content
The module will cover study skills, reading, listening, speaking, writing, referencing, language usage and text organisation.

Contribution to Exit Level Outcome
Professional and technical communication (Course Outcomes 1 - 12).

Learning and Teaching Strategies/Activities
1. The module will be facilitated through the following teaching and learning activities:
2. Blended Lectures: comprising face-to-face and online.
3. Face-to-face consultations.
4. Tutorials.
5. Oral presentations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA).

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**DIGITAL LITERACY**
Module Code	U3583DD
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial/ week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) Prerequisite	None
Semester Offered	Core
Module coordinator and Contact Details	Mr Erkkie Haipinge ehaipinge@unam.na Tel: +264 612064906

Module Purpose

The purpose of this module is to equip students with competencies to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment and entrepreneurship.

Overarching Learning Outcome

Apply digital literacy skills for effective learning across the curriculum and for successful attainment of their personal and professional goals.

Specific Learning Outcomes

On completing the module students should be able to:
1. Use ICT-based devices, basic productivity software, a web browser and search engines, email and other digital communication services
2. Carry out digital productivity activities such as download and upload materials to the internet or cloud or institutional shared spaces, and use digital tools to fit learning
3. Discover, organise and manage relevant digital information using relevant search engines, indexes or tag clouds, and evaluate digital information trustworthiness and relevance
4. Access and make sense of messages in a range of digital media, and appreciate how digital messages are designed
5. Design new digital materials, make decisions and solve problems and adopt new digital tools for learning
6. Participate in a range of digital communication media, work in digital teams and projects, and participate in a range of online networks
7. Identify, choose and participate in digital learning opportunities
8. Manage and maintain digital profiles suitable for different networks that consider digital reputation

Module Content

Digital Proficiency: ICT-based devices (laptops, tablets, smartphones, desktop computers, digital instruments and equipment); a mouse, keyboard, touch screen, voice control and other forms of input; screens, audio headsets and other forms of output; digital capture devices; University digital learning systems and a range of personal digital services such as social media, cloud storage services, sharing sites **Digital Productivity:** Basic productivity software (text editing, presentation, spreadsheets, image editing); email and other digital communication services; Internet or cloud or institutional shared spaces for organising, managing and backing up digital files; software/apps and services suitable for learning-related tasks; digital tools fit learning and managing learning time. **Information Literacy:** search engines, indexes or tag clouds; wikis, blog posts, scholarly journals, e-books and the open web; file spaces and folders, bookmarks, reference management software and tagging; copyright, and digital citizenship issues. **Data and Media Literacy:** Digital data using spreadsheets and other media; data security and privacy; digital media messages – text, graphics, video, animation, audio and multimedia. **Digital Creation and Innovation:** digital materials (video, audio, stories, presentations, infographics); new digital tools for learning in digital settings. **Digital Communication, Collaboration and Participation**: digital communication; differences between media, norms of communicating in different spaces; false or damaging digital communications; collaborative tools and online environments; online networks. **Digital Learning and Development:** digital learning opportunities; digital learning resources; digital tools/materials for organising, planning and reflecting on learning (mind-mapping, note-taking, e-portfolio/ learning journal/ blog). **Digital Identity and Wellbeing:** online profiles for different networks (personal, professional, academic); digital reputation; managing personal data and privacy; digital CV or portfolio of work; digital technologies for personal development; online etiquette; wellbeing and safety online; internet addiction; cyberbullying and other damaging online behaviour.

Contribution to Exit Level Outcome:

- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4 and 6)

Learning and Teaching Strategies/Activities

- **Lectures**: presentation on concepts and other theoretical foundations of Digital Literacy
- **Discussion forums:** reflecting on own contexts and sharing perspectives
- **Collaborative learning:** group learning and activities carried as part of projects
- **Inquiry:** carrying out of research to explore and understand scenarios and problems
- **Projects:** carry out projects on digital literacy
- **Presentations and demonstrations:** presentation of outcomes of projects (products, processes, impact)
- **Portfolio writing:** writing reflective learning journals related to digital literacy

Student Assessment Strategies

- **Collaborative assessment tasks**
  - Digital productivity: *cloud based collaborative digital media creation using cloud platforms*
  - Project: Digital communication, collaboration and participation/ Digital Wellbeing
- **Individual assessment tasks**
  - Assignment: information literacy assignment
  - Test x 2
- **Practical**
  - Digital proficiency
  - Data and Media literacy
- **No written examination**

Learning and Teaching Enhancement Strategies

- **Student feedback:** feedback from students using focused feedback instruments
- **Peer feedback:** student feedback on peer evaluation of each other's collaboration, participation and contribution
- **Self-evaluation:** quizzes and students' reflective journal/ portfolio on their own learning
- **Learning analytics:** use of learning management tools on student participation and online learning activities, and analyse assessment performance

Prescribed Learning Resources

Textbook

[1] Schwartz, M., Bali, M., Blocksidge, K., Brown, C., Caines, A., Dermody, K., and Peters, J. (2020). *Digital Citizenship Toolkit*. Retrieved from https://pressbooks.library.ryerson.ca/digcit/ (online version); https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/3/Digital-Citizenship-Toolkit-1598899274.pdf (PDF version) https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/2/Digital-Citizenship-Toolkit-1598899308.epub (eBook)

Digital Resources

[1] JISC. (2019). Jisc digital capabilities framework: The six elements defined. Retrieved from https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf

[2] JISC. (2017). Digital capabilities framework. Retrieved from https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF

[3] Joint Research Centre (European Commission). (2019). *The Digital Competence Framework 2.0*. Retrieved from https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

[4] Carretero, S., Vuorikari, R., and Punie, Y. (2017). The digital competence framework for citizens. *Publications Office of the European Union*. Retrieved from http://svwo.be/sites/default/files/DigComp%202.1.pdf

Course resources (videos and SCORM package)

[1] Microsoft. (2021). *Microsoft digital literacy courses and resources (videos and SCORM packages)*. Available at https://www.microsoft.com/en-us/digital-literacy

[2] Microsoft. (2021). *Microsoft digital literacy: Teaching guides*. Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWBupo

[3] OER Commons. (2021). *Digital Literacy (learning objects)*. Retrieved https://www.oercommons.org/curated-collections/347

Issue Date: September 2023
Next Revision: September 2028

Module Title:	NATIONAL AND GLOBAL CITIZENSHIP
Module Code	U3420CN
NQF Level	5
Notional Hours	20
Contact hours	Up to 1 contact lecture period per week for 6 Weeks
Mode of Delivery	Blended: Face to face and Online
Additional learning requirements	Each student will be required to work on a personal project which will include a site visit.
NQF Credits	2
(Co-requisites) /Prerequisite	None (University Core Module)
Semester Offered	Core Semester
Module coordinator and Contact Details	Dr Romanus Shivoro, rshivoro@unam.na; Ext. 3378

Module Purpose

The purpose of this Module is to equip UNAM students with knowledge to understand the interconnectedness of local and global issues. Students will become acquainted with perspectives on, global citizenship, globalization and civic engagement. The module will enable students to reflect on issues affecting their communities and the world by providing a platform where students can meet and learn from one another and from external sources of information. It will guide students to determine how they can contribute to bring positive changes in their communities in relation to the Sustainable Development Goals. Furthermore, it will provide knowledge and understanding of cultural diversity and intercultural communication to enable students to become thoughtful stewards in a globalized world.

Overarching Learning Outcome

Students demonstrate understanding of global citizenship and initiate action towards the betterment of local, national and global conditions, as informed and responsible citizens with a civic duty in their personal and professional lives.

Specific Learning Outcomes

On completing the module students should be able to:

1. Explain the importance of the National Constitution;
2. Express understanding of National and Global Citizenship;
3. Participate in community engagement activities as part of community upliftment;
4. Express understanding of globalization;
5. Apply intercultural communication skills; and
6. Interpret SDGs to initiate personal action towards contribution of their achievement.

Module Content

UNIT 1: Constitution and its Importance

What is a constitution; Functions of a constitution; What it contains; Constitution and democracy

UNIT 2: Global Citizenship

The meaning of global citizenship; Importance of global awareness; World issues of concern to global citizens.

UNIT 3: Civic Engagement

What do we mean by civic engagement; Dimensions of civic engagement; Indicators of civic engagement;
Promoting civic engagement.

UNIT 4: Globalization

Understanding globalization; Cultural construction of neoliberal globalization; Major players; Major domains;
Major Issues; Futures of Globalization

UNIT 5: Intercultural Communication

Dealing with difference; Levels of culture; Stereotypes and generalizations; Intercultural communication Processes

UNIT 6: Sustainable Development Goals and individual action

Introduction to SDGs; Contributing to achievement of SDGs through action

Learning and Teaching Strategies/Activities

Student learning in this module will be supported by provision of subject knowledge; engaging students in class discussions, and individual awareness and action portfolios. It will expose students to real life situation through formal lectures, guest lectures, experiential activities such as engaging local civic organizations; Students will engage in active and participatory learning in which they generate ideas and share their knowledge on a topic. Material will include journal articles, videos, PowerPoint presentations, as well as handouts for students' reflection.

Student Assessment Strategies

Continuous assessment of 100% - Assessment will be done by completing online pop-up quizzes; and developing their online portfolios of personal action as response to tasks assigned in class.

Learning and Teaching Enhancement Strategies

1. Strategies will include: Continuous Module Review, and Lecturer/student evaluations.
2. Student progress will be monitored by observing class participation during live lectures, and submission of feedback material. Including online portfolios.

Recommended Learning Resources

1. Adler, R.P and Goggin, J. (2005). What do we mean by Civic Engagement? A Journal of Transformative Education. 3 (3) 236 – 253
2. Bennett, M.J (1998). Intercultural Communication: A current Perspective. In Milton J. Bennett (Ed.) Basic Concepts of Intercultural Communication: Selected Readings. Yarmouth: ME Intercultural Press
3. Green, M. (2012). Global Citizenship: What are we talking about and why does it matter. NAFSA Association of International Education
4. International IDEA (2014). What is a Constitution? Principles and Concepts. Constitution-building Primers.
5. Perception Change Project. 170 Daily Actions to Transform our World. United Nations Office in Geneva
6. Ritzer, G. (Ed.)(2007). The Blackwell Companion to Globalization. Blackwell Publishing: USA
7. United Nations. Transforming our World: the 2030 Agenda for Sustainable Development. UNDP

Issue Date: September 2023
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7.6.1.2 YEAR 1 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS I
Module Code	I3511IM
NQF Level	5
Notional Hours	120
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites) /Pre-requisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Students should be able to apply the basic principles of engineering mathematics to determine the equations of lines and planes in Cartesian and polar coordinates, analyse matrices, sequences, series and functions and to solve differential equations.
Specific Learning Outcomes
1. On completing the module students should be able to:
2. Solve basic mathematics and engineering problems using vectors and matrices.
3. Calculate eigenvalues and eigenvectors of matrices and relate them to engineering solutions.
4. Transform functions (Cartesian/polar), sketch and name some polar graphs.
5. Use various mathematical functions and apply them to engineering.
6. Apply trigonometry in solving mathematical and engineering problems.
7. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
8. Manipulate sequence and series of numbers.
9. Define, interpret complex numbers and to perform elementary complex numbers algebra.

Module Content
Lines and Planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersection of lines and planes. Matrix Algebra: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms. Sequences and series of numbers: Introduction to sequences and series. Absolutely convergent series, tests for convergence. Power series. Radius of convergence and interval of convergence. Functions: Limits and continuity of functions: limit at a point, improper limit and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions. Polar coordinates/Graphs: Definition of polar coordinates, relate Cartesian and polar coordinates, sketch and name different types of polar graphs. Differentiation: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimisation, related rates. Implicit differentiation, the chain rule, differentiation of algebraic functions. Integration: Anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, basic integration techniques, integration of trigonometric functions. Introduction to complex numbers: Definition of complex numbers and the complex plane, complex number representation on argand diagrams, complex number algebra. Demoivre's theorem.

Contribution to Exit Level Outcomes
1. Problem solving (Course Outcomes 1, 2, 3, 5, 6, 7 and 8).
2. Application of scientific and engineering knowledge (Course Outcomes 2, 3, 4, 5 and 6).
3. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities
1. The module will be facilitated through the following teaching and learning activities:
2. Lectures.
3. Tutorials.
4. Face-to-face consultations.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination.
2. The Continuous Assessment will be made up of the following assessment activities:
3. Tests (at least 2): 30%.
4. Assignments (tutorials, quizzes): 20%.
5. Examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
- To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

The evaluation and improvement of the quality and standards of teaching and learning will be by:

1. Internal and/or external moderation of examination scripts and marked examination scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Bird, J. (2017). Engineering Mathematics. 8th Edition, Routledge.
2. Stroud, K.A., and Booth, D.J. (2013). Engineering Mathematics. 5th Edition. Macmillan International Higher Education.
3. Stewart, J., Clegg, D.K., and Watson, S. (2020). Calculus: early transcendentals 6th Edition. Cengage Learning.
4. Stewart, J., Redlin, L., and Watson, S. (2015). Precalculus: Mathematics for calculus 7th Edition. Cengage Learning.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT I**
Module Code	I3401MS
NQF level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Prerequisite	None
Semester Offered:	1

Module Purpose

The purpose of this module is to consolidate school curriculum computation skills whilst creating a wider context in which students can contextualise mathematical knowledge.

Overarching Learning Outcome

Consolidate numeracy and problem solution skills in a wide range of mathematics fundamentals.

Specific Learning Outcomes

Upon completion of this module, a student should be able to

1. Explain and conduct deductive arguments involving sets and relations.
2. Identify and correlate intervals.
3. Solve systems of linear equations methodically.
4. Handle matrix calculus.
5. Identify types of real valued functions.
6. Compute the domain and range of a real valued function.
7. Assess properties of real-valued functions.

Module Content:

Number system: Natural, integers, rational, irrational, real and complex numbers. Sets: cardinal number, operations on a set (equality, intersection, union, relative compliment, de Morgan's law, power set, application of cardinality (inclusion-exclusion formula), Cartesian products, ordered pairs and relations), intervals and inequalities. Solving equation and inequalities: linear and quadratic equation, inequalities involving two variables. System of linear equations: Matrices and matrices operations (addition, subtraction, multiplication, associativity, distrutivity, determinant, invertible, Gaussian row and column operations, rank, solution to system of linear equations). Real-valued function: definition, relation, domain and range, injective, bijective, inverse, odd and even, piecewise defined, graphs. Coordinates system: polar, polar graph, cylindrical, cylindrical graph.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS I**
Module Code	I3581NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	12
(Co-requisites) / Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of Physics as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to prepare students to apply fundamental Physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:

1. Do unit conversions
2. Solve problems regarding one and two dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gasses.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.
10. Demonstrate abilities to communicate ideas and facts using equations, graphs and principles.

Module content
Measurements and Units: Instruments and Uncertainty, Standards and Units. Kinematics: One Dimensional Motion, Vectors, Projectile Motion, Circular Motion, Relative Motion. Dynamics: Newton's Laws of Motion, Newton's Law of Gravitation, Free-Body Diagrams, Friction. Work, Energy and Power. Momentum: Collisions, Impulse, Centre of Mass. Rotational Dynamics: Rolling Motion, Torque, Rotational Inertia and Energy, Angular Momentum. Planetary Motion: Kepler's Laws of Planetary Motion. Elasticity: Hooke's Law. Fluids: Pressure, Buoyancy, Fluid Dynamics: Flow Rates, Equation of Continuity and Bernoulli's Equation. Heat and Thermodynamics: Thermal Expansion, Ideal Gas, Specific Heat, Heat Capacity, Latent Heat, Calorimetry, Heat Transfer: Laws of Thermodynamics, Entropy, Enthalpy, Gibbs Free Energy.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching methods
The course will be facilitated through the following teaching learning activities:

1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment

1. Students will be assessed through continuous assessments activities and a final examination.
2. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments (tutorials, quizzes, lab and field reports): 20%
b. Tests (At least 2 tests): 30%
c. The final examination (1 x 3-hour paper): 50%

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources

1. Young, H. D. and Freedman, R. A. (2020) University Physics with Modern Physics in SI Units, Pearson Education Limited, Harlow, United Kingdom.
2. Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
3. Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT I**
Module Code	I3421PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	Entry requirements
Semester Offered	1

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course.

Overarching Learning Outcome
Solve problems, in single-particle mechanics, Newtonian gravity, fluids, and heat.
Specific Learning outcomes
On completing the module students should be able to:

1. Employ units, do unit conversions, express uncertainties use significant figures, use vectors in 2 dimensions.
2. Solve basic problems regarding one and two-dimensional kinematics.
3. Apply Newton's laws of motion and energy principles to a variety of basic problems in dynamics.
4. Discuss and solve simple problems in rotational kinematics and dynamics.
5. Discuss the principles of waves and sound.
6. Solve basic problems in statics, Newtonian gravitation, fluids, heat, and gasses.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Measurement and estimation; Kinematics in 1D; Kinematics in 2D; Vectors; Dynamics/Newton's Laws; Circular motion; Gravitation; Work and Energy; Linear Momentum; Rotational Motion; Static Equilibrium; Fluids; Oscillation and Waves; Sound; Temperature and Kinetic Theory; Heat; The Laws of Thermodynamics.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/quizzes (at least 2 assignments/quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS**
Module Code	I3511NC
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorials or 1 Practical session/Week
NQF Credits	16
(Co-requisites) / Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of chemistry as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to equip students with firm grasp of fundamental chemistry principles which are applicable in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:

1. Describe the fundamental techniques used for chemical analysis in industrial processes.
2. Explain the basic concept of batteries and fuel cells and their applications.
3. Describe the processing of high polymers and their applications.
4. Explain different methods for water analysis and purification.
5. Describe different ways of dealing with pollution and managing solid waste.

Module content
Spectroscopic techniques and Applications: Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet and Visible and Raman spectroscopy. Electrochemistry: Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and ΔS). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system. Battery Technology; Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life. Basic requirements for commercial batteries. Construction, working and applications of: $Zn-Ag_2O$, Ni-Cd, Zn-air and Lithium-ion battery. Fuel Cells- Differences between battery and a fuel cell, Classification of fuel cells - based on type of fuel, electrolyte and temperature. Construction, working and applications of solid oxide fuel cell. Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method), Alkalinity -determination, Determination of dissolved oxygen, Determination of chemical oxygen demand, Boiler scales-formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis. Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methods). Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapour deposition. Polymers; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (BunaS, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. Environmental Chemistry; Air Pollution, Water Pollution, Radioactive Pollution, Solid Waste Management, Green Chemistry.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching methods
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
3. Assignments (tutorials, quizzes, lab and field reports): 20%
4. Tests (At least 2 tests): 30%
5. The final examination (1 x 3-hour paper) 50%

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources
1. Mukhopadhyay, Raghupati, and Sriparna Datta. Engineering chemistry. New Age International Pvt Limited, Publishers, 2008.
2. Agarwal, Shikha. Engineering chemistry: Fundamentals and applications. Cambridge University Press, 2019.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS SUPPORT**
Module Code	I3441CS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	None
Semester Offered	1

Module Purpose
To introduce the student to general chemistry, lay the foundation of basic facts necessary for further studies in Chemistry and acquaint students with safety rules and regulations in a chemical laboratory.

Overarching Learning Outcome
Apply and interpret knowledge on basic facts in Chemistry for further studies.

Specific Learning outcomes
On completing the module students should be able to:
1. Use scientific notation and significant figures when doing all calculations
2. Define and explain the mass number (A), atomic number (Z) and isotope and also state the symbol for an isotope given its mass number and atomic number.
3. Define the terms molar mass, relative molecular mass (Mr) and relative atomic mass (Ar) and carry out calculations involving these.
4. Define and explain the terms empirical formula and molecular formula and also to determine the empirical and molecular formulae of a given compound.
5. Use balanced chemical equations to obtain information about the amounts of reactants and products.
6. Prepare dilute solutions from concentrated stock solutions and solve solution stoichiometry problems.
7. Describe and explain data from experiments to distinguish between strong and weak acids and bases.
8. Differentiate between oxidation and reduction reactions and balance redox reactions by the half-reaction method (acid and basic medium).
9. Apply quantum theory to predict the electron configuration of elements and explain the variation of properties across the periodic table.
10. Explain the structure and bonding in molecules and ions and draw their Lewis structures.
11. Apply Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) to describe molecular geometry as well as physical and chemical properties of some compounds.

Module Content
Introduction: Matter, Measurement and Molecules; Stoichiometry: Calculations with Chemical Formulae and Equations; Aqueous Reactions and Solutions Stoichiometry; Electronic Structure of Atoms; Periodic Properties of the Elements and Relationships Among Elements; Basic Concepts of Chemical Bonding; Intermolecular Forces; Basic Molecular Geometry and Bonding Theories; Gases.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments/quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Brown T. L., LeMay H.E, Bursten B.E., Murphy C., Woodward P., Langford S., Sagatys D. and George A. (2014). Chemistry: The Central Science. (3rd Ed.). Pearson Australia. Australia
2. Chang, R. (2010). Chemistry. (10th Ed.) McGraw Hill Higher Education. New York. ISBN:978-0-07

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING DRAWING**
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 L + 1 P and/or 1T
Additional learning requirements	None
NQF Credits	16
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1 and 2

Module Purpose
The purpose of this module is to enable students visualise, create and interpret engineering drawings in two and three dimensions to meet the industrial demands of modern technology by the application of geometrical and engineering methods and make detail drawings with full dimensions in line with ISO standards.
Overarching Learning Outcome
Students should be able to apply the basic skills of technical drawing to represent engineering objects, section technical objects and to produce assembly drawings.
Specific Learning Outcomes
On completing the module students should be able to:
1. Use standard equipment for technical drawing.
2. Sketch engineering components free hand or with the aid of drawing equipment.
3. Present engineering components as drawings in orthographic and isometric projections.
4. Use sections, interpenetration, and development to produce clear engineering drawings.
5. Produce parts and assembly drawings of various engineering components.
Module Content
Foundations of representing technical bodies: drawing equipment, drawing formats, types of lines, construction geometry, simplified representations, scales, lettering, title block, elaboration of part drawings, Principle of orthographic projection, sectioning, dimensioning. Isometric and oblique representations. Sections, Interpenetrations, and developments: cones, cylinders, pyramids. Free-hand techniques: Introduction to free-hand sketching of machine parts. Assembly drawing.

Contribution to Exit Level Outcome
1. Engineering design (Course Outcomes 4 and 5).
2. Engineering methods, skills, and tools, including information technology (Course Outcomes 1 and 3).
3. Professional and technical communication (Course Outcomes 2, 3, 4 and 5).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Tests (at least 2): 60%.
2. Assignments (at least 4): 40%.

Criteria for passing the module
- To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of test papers and scripts.
2. Peer review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Parker, M.A., and Pickup, F. (1992). Engineering drawing with worked examples. Vol. 1, 3rd Edition.
2. Simmons, C.H., Maguire, D.E., and Phelps, N. (2020). Manual of engineering drawing: British and International Standards. 5th Edition. Butterworth-Heinemann.
3. Yarwood, A. (1994). Technical Drawing with Design. Macmillan.
4. Madsen, D.A. and Madsen, D.P. (2016). Engineering drawing and design. Cengage Learning.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	COMPUTING FUNDAMENTALS
Module Code	I3581CC
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1

Module Purpose

This course aims to introduce students to general computer literacy, the basic principles of problem-solving using computers, advanced Microsoft Excel skills for data analysis, computer programme planning, basic data communication and computer networks and the basic skills on modern web development tools. It also introduces students to the basic tools and environments needed for machine learning programming.

Overarching Learning Outcome

Students should be able to discuss basic computer working environments, modern web development tools, develop a simple computer-based problem-solving plan and solve engineering problems using advanced spreadsheets and related tools.

Specific Learning Outcomes

1. On completing the module students should be able to:
2. Relate with computers under the Windows and Linux operating environment for information processing and presentation.
3. Recall basic features of common computer hardware architectures.
4. List the basic communication architecture of a computer.
5. Show algorithms for solving basic problems using flowcharts and pseudocode.
6. Recall advanced spreadsheet tools and functions.
7. Match basic web applications using modern web development tools and frameworks to simple real-life problems.
8. Define basic concepts of networking.

Module Content

Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored programme concept. Von-Neumann architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. Computer Arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types). Introduction of computer operating environment Windows and UNIX based systems. Computer Architecture: The design and structure of a computer. Information Processing and Data Analysis tools: Equations and Formulae Creation, Diagram Creation and Editing, PowerPoint Presentations Creation Advanced Spreadsheets Skills. Computer Programme Planning. Flowcharts and Pseudocode Introduction to Computer Networking: Basics of Communication Systems and Computer Networks. Web Developments: Front-End Web Development, Web Page Styling and Website logic development with scripting languages such as JavaScript. Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Introduction to Data Science Tools: Installation and basic use of Anaconda and Jupyter Notebooks

Contribution to Exit Level Outcome

1. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 5 and 6).
2. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5 and 6).

Learning and Teaching Strategies/Activities

1. The module will be facilitated through the following teaching and learning activities:
2. Lectures.
3. Tutorials.
4. Group mini project.
5. Face-to-face consultations wherever necessary.
6. A special hands-on demonstration that may involve an expert from outside.

Student Assessment Strategies

1. Students will be assessed through Continuous Assessment (CA) as follows:
2. Assignments (tutorials, quizzes, reports, practical assignments): 20%.
3. Tests (at least 2 tests): 50%.
4. Semester mini project (prototype oral presentation and development report): 30%.

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Prescribed Textbook(s).
2. Online links.
3. Lecture notes and videos.
4. On-site and/or online video laboratory demonstrations.

Issue Date: September 2023
Next Revision: September 2028

7.6.1.3 YEAR 1 SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS II**
Module Code	I3582IM
NQF Level	5
Notional Hours	120
Contact hours	3Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) /	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Students should be able to solve simple engineering problems using matrices, calculus, differential equations, integral transforms, Fourier series and Fourier transforms.

Specific Learning Outcomes

On completing the module students should be able to:

1. Calculate eigenvalues and eigenvectors and relate them to engineering solutions.
2. Solve calculus problems using integration by parts and the reduction formula technique.
3. Apply calculus to trigonometric functions to solve mathematical and engineering problems.
4. Solve engineering problems using 1st order and 2nd order differential equations.
5. Define and analyse Fourier series of real-valued functions.
6. Use Laplace and Fourier transforms in solving differential equations.

Module Content

Further Matrix Algebra: eigenvalue-eigenvector problems; Hermitian and unitary matrices; Quadratic forms. Further Integration: Integration by parts technique. Integration by substitution. Integration of trigonometric functions. Integration of powers of trigonometric functions. Integration of trigonometric functions by substitution. Reduction formula. Application of integration: areas, volumes of revolution, etc. Differential Equations: Meaning and solutions of differential equations. First order ordinary differential equations (separable, homogenous, Exact and linear types) and their applications. Solutions of second order linear ordinary differential equations with constant coefficients; initial or boundary value problems using the methods of undetermined coefficients and variation of parameters. Integral Transforms: Laplace Transforms (LT), Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st and 2nd order ordinary differential equations. Fourier Series and Transforms: Fourier series. Fourier sine and cosine series. Introduction to Fourier transforms and its applications in solving boundary value problems.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 1, 2, 3, 4, 5 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5 and 6).
3. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5 and 6).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies

1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
2. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments (tutorials, quizzes): 20%.
b. Tests (at least 2): 30%.
c. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.

3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Ross, S.L. (1991). Introduction to Ordinary Differential Equations. 4th Edition, John Wiley and Sons.
2. Kreyszig, E. (2020). Advanced Engineering Mathematics. 10th Edition, John Wiley and Sons.
3. Bird, J. (2017). Engineering Mathematics. 8th Edition, Routledge.
4. Stroud, K.A. and Booth, D.J. (2020). Engineering Mathematics. 8th Edition, Red Globe Press.
5. Stewart, J., Clegg, D.K., and Watson, S. (2020). Calculus: Early Transcendentals. 9th Edition, Cengage Learning.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT II**
Module Code	I3402MS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(**Co-requisites) /Prerequisite**	None
Semester Offered:	2

Module Purpose

The purpose of this module is to equip students with an intuitive grasp of the behaviour of a real-valued function as well as the analytical techniques to test their intuition.

Overarching Learning Outcome

Gather sufficient information about the behaviour of a real valued function to sketch its graph with accuracy.

Specific Learning Outcomes

Upon completion of this module, a student should be able to

1. Employ the exact definitions of limit and continuity.
2. Use various differentiation techniques and assess differentiability.
3. Apply those tools to study local extrema, end behaviour, and asymptotic behaviour of function graphs.
4. Use integration to compute the area below a curve.
5. Handle complex numbers.

Module Content:

Solving equation: Exponentials and logarithms. Graph of a function: polynomial, rational, exponential, logarithmic, trigonometric functions. Limit of a function: definition, continuity, differentiation, sum, product, quotient, chain rules, examples from the engineering sciences. Integration: Definition and basic properties of the Riemann integral, the Fundamental Theorem of calculus, integrals of simple function, substitution rule and integration by parts; applications to the computation of areas and (rotational) volumes.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. B. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING DRAWING**
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 L + 1 P and/or 1T
Additional learning requirements	None
NQF Credits	16
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1 and 2

Module Purpose

The purpose of this module is to provide students with a basic introduction to computer-aided drawing, with a focus on AutoCAD software, to enable them to visualise, create and interpret engineering drawings to meet the industrial demands of modern technology by the application of geometrical principles and engineering methods through computer-aided tools.

Overarching Learning Outcome

Students should be able to use AutoCAD software to produce engineering drawings.

Specific Learning Outcomes

On completing the module students should be able to:

1. Competently use commands and symbols in the computer drawing environment.
2. Create or use standard objects to make engineering drawings with AutoCAD.
3. Merge text and dimensions with drawings generated from AutoCAD.
4. Make layouts and plot drawings created by AutoCAD.
5. Create three-dimensional objects.

Module Content

Introduction to AutoCAD: setting up the drawing environment; using commands and system variables; using coordinate systems; Working in two-dimensional space: creating objects; drawing with precision; controlling the drawing display; editing methods; using layers and object properties; adding text to drawings; creating dimensions; using blocks and external references; managing content with AutoCAD design centre; creating a layout to plot; plotting (model and paper spaces). Working in three-dimensional space: creating three-dimensional objects using solid primitives, and from 2D profiles; editing of 3D objects. Practical exercises.

Contribution to Exit Level Outcome

Engineering design (Course Outcomes 1, 2, 3, 4 and 5).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations.
4. Practical exercises.
5. Design software applications.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) activities as follows:

1. Assignments (at least 4 assignments): 20%.
2. Tests (at least 2 tests): 60%.
3. Mini project: 20%.

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of test papers, project reports and scripts.
2. Peer-review of course outlines and teaching.

3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and mini project

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Wohlers, T. (2010). Applying AutoCAD 2010 Edition.
2. Lecture Notes.
3. Design Software: AutoCAD.

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Module Title:	**PHYSICS FOR ENGINEERS II**
Module Code	I3582NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	12
(**Co-requisites) /Prerequisite**	Physics A for Engineers
Semester Offered	2

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of Physics as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to prepare students to apply fundamental Physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:
1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.
5. Demonstrate entry-level general laboratory skills including elementary data analysis.
6. Demonstrate abilities to communicate ideas and facts using equations, graphs and principles

Module content
Electrostatics: Electric charge, Current and Current Density, Electric field, Electric Potential, Resistance and Resistivity, Capacitance and Dielectrics. Magnetostatics: Biot-Savart law, Magnetic field, Magnetic materials, Motion of a Charged Particle in a Magnetic Field, Magnetic force, Ampere's Law; Torque and Magnetic Moments; Electromagnetic Induction: Electromagnetic Force (EMF), Faraday's Law of Electromagnetic Induction, Lenz's Law, Fleming's Right Hand Rule, Inductance and Mutual Inductance. Vibrations and Waves: Simple harmonic motion, Oscillations, Wave Motion, Types of Waves, Standing Waves and Resonance. Sound: intensity of Sound, interference of Sound Waves, Doppler's Effect. Light and Optics: Reflection, Refraction and Diffraction, Snell's Law, Lenses, Lens Equation. Radioactivity: types of radioactivity.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching methods
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes, lab and field reports): 20%
b. Tests (At least 2 tests): 30%
3. The final examination (1 x 3-hour paper): 50%

Criteria for passing the course:
- To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources
1. Young, H. D. and Freedman, R. A. (2020) University Physics with Modern Physics in SI Units, Pearson Education Limited, Harlow, United Kingdom.
2. Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
3. Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT II**
Module Code	I3422PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Pre-requisites	Entry requirements
Semester Offered	2

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course. This course focuses on Electricity and Magnetism, Optics and Radioactivity

Overarching Learning Outcome
Solve problems in electricity and magnetism, optics, and radioactivity.

Specific Learning outcomes
On completing the module students should be able to:
1. Discuss and solve basic problems on electric field and magnetic field.
2. Find currents and resistances in simple electric circuits.
3. Analyse DC and AC circuits involving capacitors, resistors, and inductors.
4. Resolve problems involving electromagnetic induction.
5. Solve simple problems in geometrical optics and nuclear physics.
6. Explain concepts pertaining to radioactivity and the effects of radiation.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Electric charge and electric field; Electric Potential; Electric Currents; DC Circuits; Magnetism; Electromagnetic induction; Electromagnetic waves; Geometric optics; Light; Radioactivity; Effects and Use of Radiation.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
4. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
5. Tests (at least 2 tests): 60%

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Module Title:	MATERIALS SCIENCE
Module Code	I3592IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Pre-requisite (	(None)
Semester Offered	2

Module Purpose
The purpose of this module is to enable the students to understand the relationship between the structure and properties of the materials used in engineering.
Overarching Learning Outcome
Students should be able to describe the characteristics of engineering materials and apply the knowledge from this module to make good engineering decisions in choosing the right materials for a particular job.
Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the molecular and crystal structure of materials.
2. Perform calculations on elemental diffusion in metals.
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams.
4. Describe the various phase transformations in the Fe-Fe3C phase system and associated microstructures.
5. Explain how materials properties depend on structure and crystal defects.
6. Demonstrate practical basic skills in metallography and report writing.
7. Explain the relationship between Materials Science and the Fourth Industrial Revolution.

Module Content
Materials for Engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; Solidification, Crystalline Imperfections and Diffusion in solids; Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. Properties of Materials: review of Mechanical, Electrical, Optical and Thermal properties of materials. Mechanical properties of materials: Stress and Strain, Tensile testing, True stress and True strain, Deformation modes; Yield and Fracture, Hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. Real-world applications of Engineering materials: Functional Materials and Devices; The Relationship between Materials Science and the Fourth Industrial Revolution. Basic criteria for the selection of materials for engineering applications.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3 and 4).
2. Application of scientific and engineering knowledge (Course Outcomes 2, 3, 4 and 5).
3. Investigations, experiments and data analysis (Course Outcome 6).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Laboratory demonstrations.
4. Face-to-face consultations wherever necessary.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
2. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes, laboratory and field reports): 20%.
b. Tests (at least 2 tests): 30%.
3. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.
Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Callister, W. D., Rethwisch, D. G. (2018). Materials Science and Engineering: An Introduction, 10th Edition, Wiley and Sons.
2. Askeland, D.R. and Wright, W.J. (2018). Essentials of Materials Science and Engineering. 4th Edition. Cengage Learning.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Module Code	I3522EE
NQF Level	5
Notional Hours	80
Contact hours	3 Lectures + 1 Tutorial or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to give all engineering students an understanding of the basic principles of electrical circuits and networks. The module further aims at introducing common technical vocabulary.
Overarching Learning Outcome
Students should be able to analyse basic electrical circuits using the established laws and theorems of electrical circuit analysis.
Specific Learning Outcomes
On completing the module students should be able to:
1. Distinguish between real and ideal voltage and current source.
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving of DC circuits.
3. Apply the principles of circuit analysis to series and parallel R, L, C circuits.
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information.
5. Describe the principles of a transformer and the basic AC generator and DC motors.
6. Conduct basic circuit analysis using appropriate CAD software (MATLAB, MultiSIM, etc.).

Module Content
Introduction: SI Unit and notations, Basic Electric Circuit (resistance, voltage and current). Resistance: Resistor coding, Series and parallel resistor networks, Y and delta resistor networks. Sources: Voltage and Current sources, dependent and independent sources, source transformations. DC Circuit Analysis Techniques: Ohm's law, Power and Energy, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, DC Circuit Theorems: Superposition Theorem, Thevenin's and Norton's Theorem, Maximum power transfer theorem. Capacitors: Capacitance, capacitors in series and parallel, Capacitor charging and time constant. Inductors: Inductance and mutual inductance. AC Voltage: AC voltage generation, AC Resistive circuit, AC capacitive circuit, AC inductive circuit. Electrical Machine Basics: Basics principles of transformers, AC generators, DC motors, three phase voltage generation and mathematical expression. Basics of circuit simulation using CAD software.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3 and 4).
2. Engineering design (Course Outcome 4).
3. Investigations, experiments and data analysis (Course Outcome 4).
4. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3 and 4).
5. Engineering methods, skills and tools, including information technology (Course Outcome 5).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. At least 2 quizzes and at least 2 laboratory reports: 40%.
2. Tests (at least 2 tests): 60%.

Criteria for passing the module

- To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of project reports and test scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Boylestad R. (2015). Introductory Circuit Analysis. 13th Edition, Pearson Education, USA.
2. Alexander C. and Sadiku M. (2016). Fundamentals of Electric Circuits, 6th Edition, McGraw Hill.
3. Hughes E. (2016), Electrical and Electronic Technology, 12th Edition, Pearson Education.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MECHANICS I**
Module Code	I3582NM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3581NP Physics for Engineers I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to equip the students with the knowledge to analyse system of forces on engineering components and to develop an approach to solving engineering problems.

Overarching Learning Outcome
Students should be able to analyse effect of forces on systems and structural bodies.

Specific Learning Outcomes
On completing the module students should be able to:

1. Express force operations and force systems using vectors.
2. Apply the laws of static equilibrium of forces.
3. Produce a free body diagram from a specified engineering problem.
4. Analyse trusses using the method of joints and method of sections.
5. Apply the principles of static and kinetic friction in solving engineering problems.
6. Calculate and plot bending moment and shear force distributions in beams.
7. Determine the centroid and moment of inertia for plane and composite cross-sectional areas.

Module Content
Systems of forces and moment forces: coplanar forces, addition of forces, couples and moments, resultants and equivalent systems; Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions; Equilibrium in three dimensions; Forces in submerged surfaces; Distributed forces: centroids and centre of gravity; Friction: dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction; Beams: shear forces and shear force diagrams; bending stresses and bending moment diagrams; Analysis of forces in a truss: method of joints and method of sections. Laboratory demonstrations.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 1, 2, 3, 4, 5 and 6).
2. Investigations, experiments and data analysis (Course Outcome 7.
3. Application of scientific and engineering knowledge (Course Outcomes 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.
4. Laboratory demonstrations.
5. Field trips.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (at least 4 assignments): 10%.
    b. Tests (at least 2 tests): 30%.
    c. Laboratory demonstration and report: 10%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Soutas-Little, R.W. and Inmand, D.J. (1999). Engineering Mechanics Statics. Prentice-Hall, Inc.
2. Meriam, J.L., Kraige, L.G., and Bolton, J.N (2019). Engineering Mechanics: Statics. 9th Edition, John Wiley and Sons.
3. Hibbeler, R.C. (2016). Engineering Mechanics: Statics. 14th Edition, Pearson Prentice Hall.
4. Shames, I.H. (1966). Engineering Mechanics Statics. 2nd Edition, Volume 1, Prentice-Hall.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**STATISTICS FOR ENGINEERS**
Module Code	I3582IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the concept of probability theory, statistical modelling and inference in engineering.
Overarching Learning Outcome
Students should be able to apply the principles of probability in sampling, data analysis and representation.
Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the theory of probability.
2. Analyse data using probability distribution and densities.
3. Use principles of sampling distribution and densities.
4. Apply linear regression and correlation to a set of data.
5. Apply analysis of variance to solve engineering problems.
6. Analyse data using R or python software.

Module Content

Probability: Theory (Random experiments, Random events), conditional probability and Bayes theorem, mathematical expectation and decision making. Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, uniform, Gamma, Beta and Weibull. Sampling Distributions: Mean, variance, inferences concerning mean and proportions: point and interval estimations, parametric tests, nonparametric tests. Regression and Correlation: Simple and multiple linear regressions, correlation. The Logistic regression model. Analysis of Variance: Completely randomised and randomised block designs, multiple comparisons. Introduction to Data Analysis with R: Laboratory 1: Measures of Central Tendency: mean, median, and other quantiles, mode. Saving and using graphics, etc. Laboratory 2: Measuring Variability: variance and standard deviation, median, Interquartile Range, coefficient of variation, covariance and correlation of variables. Laboratory 3: Measuring symmetry: skewness, kurtosis, etc. Frequency distributions: histograms, bar charts, pie charts, box plots, line graphs, scatterplots.

Contribution to Exit Level Outcome

1. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4 and 5).
2. Investigations, experiments and data analysis (Course Outcomes 4, 5 and 6).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations.
4. Computer laboratory demonstrations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment will be made up of the following assessment activities:
2. Assignments (laboratory assessment): 20%.
3. Tests (at least 2 tests): 30%.
4. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Navidi, W. (2019). Statistics for Engineers and Scientists. 5th Edition, McGraw Hill.
2. Devore, J.L. (2020). Probability and Statistics for Engineering and the Sciences, 9th Edition, Cengage.
3. Chatterjee, S. (2012). Regression Analysis by Example, 5th Edition, John Wiley and Sons.

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Next Revision: September 2028

7.6.2.1 YEAR 2 CORE SEMESTER

Module Title:	ACADEMIC LITERACY II
Module Code	U3683AL
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Pre-requisite	**U3583AL Academic Literacy I**
Semester Offered	0

Module Purpose

The purpose of this module is to teach students to navigate with ease the demands of academic study in their respective faculties. This module will help hone students' research, presentation writing and reading skills as demanded by different university disciplines. The module is also aimed at sharpening students' critical and analytical thinking skills. The module encourages a bridge between theory and real-life scenarios.

Overarching Learning Outcome

Students should be able to effectively communicate in academic discourse.

Specific Learning Outcomes

On completing the module students should be able to:

1. Communicate effectively in a computer-mediated environment.
2. Communicate effectively in various discursive modes and situations.
3. Read and comprehend academic texts.
4. Read and critique academic texts.
5. Produce short researched essays.
6. Synthesise information from different texts into a coherent text.
7. Correct error related to functional grammar, spelling, punctuation.
8. Proofread written work/using online systems to assist with proofreading and editing.
9. Write for specific purposes.
10. Make and substantiate arguments.
11. Distinguish different types of reasoning in academic texts.
12. Use technology to give oral academic presentations.

Module Content

The module is designed for students enrolled in a bachelor's degree course, which requires them to undertake basic research, read specific academic material, produce specific writing and give academic presentations. The module teaches academic reading, speaking, listening and writing skills.

Contribution to Exit Level Outcome

Professional and technical communication (Course Outcomes 1 - 12).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Blended Lectures: comprising face-to-face and online.
2. Face-to-face consultations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA).

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). Academic literacy. 2nd Edition. Cape Town: Juta and Company (Pty) Ltd.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING ENTREPRENEURSHIP**
Module Code	I3620IE
NQF Leve l	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	0

Module Purpose
The purpose of this module is to enable the students to understand the concept of entrepreneurship and innovation in the engineering field and the different aspects that make an entrepreneur.

Overarching Learning Outcome
Students should be able to conduct a feasibility study for a proposed business, prepare a business development plan and to discuss the concepts and theories of entrepreneurship and innovation.

Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the concept of entrepreneurship.
2. Describe key attributes of entrepreneur.
3. Carry out a feasibility study and draw up a business development plan.
4. Discuss the process of innovation (transformative and incremental) and product development.
5. Relate economic challenges and business creation.
6. Describe the procedures followed in starting a new business venture including some regulations guiding the process.
7. Explain the risk management process.
8. Discuss the theory of motivation and its application to entrepreneurship.
9. Discuss the roles of strategic business and marketing management in entrepreneurship.
10. Explain the importance of change management theory in entrepreneurship.

Module Content
Entrepreneurship: concept of entrepreneurship, characteristics of an entrepreneur, examples of good local and international entrepreneurial ventures, feasibility studies and business plan development and its components, government policies and regulations for starting new business ventures. Entrepreneurship opportunities in Engineering: innovative ideas and process of innovation, transformative and incremental innovations, innovation and business development, product development process and market research. Risk management: types of risk, risk management process, risk control and mitigation, risk response. Change management: Importance of change management, group dynamics and communication. Strategic business management: Management functions, strategic planning and management, resource management plan. Strategic marketing management: Marketing functions, marketing mix, innovative marketing, competitor analysis.

Contribution to Exit Level Outcome
1. Sustainability and impact of engineering activity (Course Outcome 3).
2. Engineering Management (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Assignments: 20%.
2. Tests (at least 2 tests): 50%.
3. Written reports: 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Nieuwenhuizen, C. and Nieman, G. (2018). Entrepreneurship: A South African Perspective 4th Edition, Van Schaik Publishers.
2. Sibanda, M. (2021). Nuts and Bolts, Strengthening Africa's Innovation and Entrepreneurship Ecosystems. Tracey McDonald Publishers.
3. Bota, T. (2019). Entrepreneurship and how to establish your own business. 6th Edition, Juta Legal and Academic Publishers.

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Module Title:	**WORKSHOP PRACTICE**
Module Code	I3640IW
NQF Level	6
Notional Hours	80
Contact hours	3 Practical Sessions / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	0

Module Purpose

The purpose of this module is to enable the students understand the fundamentals of engineering profession and engineering workshop practices.

Overarching Learning Outcome

Students should be able to discuss the steps involved in engineering problem solving and to apply these steps in the fabrication engineering components and structures such as walls and electric circuits in an engineering workshop.

Specific Learning Outcomes

On completing the module students should be able to:

1. Work collaboratively in a team setting and use modern engineering tools and practices.
2. Discuss general safety procedures applicable to engineering workshops.
3. Describe specific hand tools used in engineering workshops.
4. Construct basic wall structures using brickwork, cement, and mortar.
5. Differentiate between a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Fabricate a prescribed wooden component using the principles of carpentry.
11. Perform simple plumbing and pipe fitting exercises.
12. Describe the general operation of air-conditioning and refrigeration systems.

Module Content

Safety procedures applicable to engineering workshops: Safety equipment; Protective clothing; Signage. Use of workshop hand tools. Principles and practices of: Masonry and brickwork; Machining Operations (cutting, drilling, turning, milling, shaping); Sheet metal and fitting; Welding fabrication; Auto mechanics; Electrical wiring and installation; Soldering and de-soldering of electronic components; Carpentry and woodwork; Plumbing and pipe fitting; Refrigeration and air-conditioning systems and their installation. Workshop demonstration.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 3, 5 and 10).
2. Engineering methods, skills and tools, including information technology (Course Outcomes 1- 12).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Seminars.
2. Tutorials.
3. Laboratory demonstrations.
4. Supervised practical use of hand tools and machine tools.
5. Fabrication of simple components using various workshops and tools.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) activities as follows:

1. At least 5 laboratory reports: 40%.
2. Fabricated components: 60%.

Criteria for qualifying for the Examination

No examination.

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of project reports and test scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Moaveni, S. (2007). Engineering Fundamentals: An Introduction to Engineering. Cengage Learning, 4th Edition.
2. Holtzapple, M. and Reece, W. (2002). Foundations of Engineering. 2nd Edition, McGraw Hill Education.

Issue Date: September 2023
Next Revision: September 2028

7.6.2.2 YEAR 2 SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Module Code	I3611IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(**Co-requisites)**	(I3512IM Engineering Mathematics II)
Pre-requisite	I3511IM Engineering Mathematics I
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Students should be able to solve based and advanced engineering problems using vector calculus, functions of several variables, analytic functions, and power series.
Specific Learning Outcomes
On completing the module students should be able to:
1. Apply differential vector calculus to solve mathematical and engineering problems.
2. Apply functions of several variables in solving engineering problems.
3. Approximate solutions to 2nd order differential equations using power series.
4. Describe the basis for complex analysis in engineering problem solving.
5. Apply the residual theorem to engineering problems.

Module Content
Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binomial, torsion, curvature. Functions of several variables: limits, continuity, derivatives, differentials, the Jacobian, matrix and determinants, composite functions, higher order derivatives. Applications: optimisation on surfaces, constrained optimisation. The gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Power Series and their applications: Power series. Radius of convergence and interval of convergence. Power series representation of functions, Taylor and Maclaurin series, the Binomial theorem. Power series solutions to ODEs with variable coefficients. Analytic Functions: Complex functions, derivatives, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem, and evaluation of complex integrals.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3, 4 and 5).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2 and 3).
3. Engineering methods, skills, and tools, including information technology (Course Outcomes 1, 2, 3,4 and 5).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
   a. Tests (at least 2 tests): 30%.
   b. Assignments (tutorials, quizzes): 20%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Ross, S.L. (1984). Differential Equations. 3rd Edition, John Wiley and Sons.
2. Thomas, G.B. and Finney, R.L. (1995). Calculus and Analytical Geometry. 9th Edition, Addison Wesley.
3. Kreyszig, E. (2020). Advanced Engineering Mathematics. 10th Edition, Wiley.
4. Stroud, K.A. and Booth, D.J. (2020). Advanced Engineering Mathematics. 6th Edition, Red Globe Press.
5. Stroud, K.A. (1990). Further Engineering Mathematics. 2nd Edition, Palgrave Macmillan.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING ECONOMICS**
Module Code	I3661IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the students to key economic concepts and how they are applied in the different sectors of the economy and specifically in engineering.
Overarching Learning Outcome
Students should be able to apply the concepts and theories of micro- and macro- economics to analyse capital projects and calculate the depreciation of assets.
Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the fundamentals of microeconomics.
2. Apply the concept of time value of money.
3. Apply investment analysis techniques for projects (NPV, ROR, IRR, CBA, Payback Period, etc.).
4. Apply depreciation methods on assets for valuation.
5. Discuss the fundamentals of macroeconomics.
6. Apply financial accounting principles in engineering projects.
7. Discuss the principles of marketing engineering products.

Module Content
Microeconomics: economic concepts, economic problems, demand and supply, consumer choice and demand theory, production functions, production costs, profit maximisation. Time value of money: time value of money, investment analysis (NPV, ROR, IRR, ROI, CBA, etc.), depreciation methods (straight line, reducing balance, sum of digits). Macroeconomics: inflation and deflation, business cycle, monetary and fiscal policies, unemployment, international trade. Financial accounting: product costing, cost accounting, financial statements, and budgeting. Introduction to marketing: marketing principles.

Contribution to Exit Level Outcome
Engineering Management (Course Outcomes 3, 6 and 7).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
    a. Tests (at least 2 tests): 30%.
    b. Assignments: 20%.
2. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

1. Goodwin, N., Harris, J., Nelson, J.A., Roach, B. and Torras, M. (2020). Principles of Economics in Context. 2nd Edition, Routledge.
2. Mohr, P. (2015). Economics for South African Students. 5th Edition, Van Schaik Publishers.

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Module Title:	**COMPUTING FUNDAMENTALS I**
Module Code	I3691CP
NQF Level	6
Notional Hours	150
Contact hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	None
Prerequisite	I3551CC Computing Fundamentals
Semester Offered	1

Module Purpose:
The course aims to equip students with general principles of programming, skills, theories, and techniques for computer programmes design and solutions.

Overarching Learning Outcome
Design and analyse computer programme.

Specific Learning Outcomes
On completing the module students should be able to:

1. Design algorithms and data structures for solving mathematical and engineering problems using pseudo code, flowcharts, and related tools.
2. Differentiate different programming paradigms (structural, functional and object-oriented).
3. Discuss the concept of compiled and interpreted languages.
4. Use different data types in the design of programmes.
5. Apply arithmetic, logical and bitwise operations on different data types in programming.
6. Compile computer programmes in different integrated development environments.
7. Apply and test the three basic programming structures (Sequential, Decision and Looping) using specific programming languages (e.g., MATLAB, Python, C, etc.)

Module Content:
Programme design: programming problem definition, programme requirements elicitation and analysis, specification development, design methods, design tool (pseudo code, flow charts etc.).
Programming Paradigms: Structural, functional and object-oriented programming concepts.
Introduction to programme compilation and interpretation: Definition and differences between compiled and interpreted languages, Compilation process, Execution of compiled code, Interpretation process, Examples of compiled and interpreted language, Advantages and disadvantages of each type of languages.
Introduction to programming: variables, operators, data types, iteration, branching
Data Structures: Arrays, lists, stack and queues, structures and enumeration/hash maps.
Fundamental concepts of programming: Data types, variables, programme flow control (decisions and loops), string manipulation, functions, data structures and their operations

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 5)
5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Four lecture periods per week for 12 weeks
- One tutorial or one practical session per week for 12 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.
- Special soft skills lecture that may be done on-site or via video demos.

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
2. The Continuous Assessment will be made up of the following assessment activities:
a) Assignments (tutorials, quizzes, reports, practical assignments): 20%
b) Tests (At least 3 tests): 50%
c) Semester Mini project (prototype, oral presentation and development report): 30%

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student's evaluation
3. Regular review of the course content
4. Face-to-face consultations
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Prescribed Learning Resources
[1] Cay Horstmann, Rance Necaise; Python for Everyone, Second Edition, Wiley, 2016.
[2] William J. Palm III; Introduction to MATLAB for Engineers, Third Edition, Mc Graw Hill, 2011.
[3] Gregg Perry and Dean Miller; C Programming Absolute Beginner's Guide, Third Edition, Pearson, 2014.

Issue Date: September 2023
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Module Title:	**INTRODUCTION TO ENGINEERING GEOLOGY**
Module Code	I3641MG
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Team project report
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1

Module Purpose
This module aims to impart the students with knowledge of the principles of geology that are necessary for engineering applications.
Overarching Learning Outcome
Students should be able to discuss the structure of the earth, the formation, chemical composition, and mechanical properties of common rocks.

Specific Learning Outcomes
On completing the module students should be able to:
1. Define basic geological and geophysical concepts and terminology.
2. Identify and classify common minerals, rocks and soils and understand their significance to different types of engineering projects.
3. Describe the composition and properties of common minerals and rocks.
4. Relate the nature of the interior of the earth and the plate tectonic theory.
5. Discuss surface geological processes such as weathering and soil formation.
6. Discuss internal geological processes (e.g., faults, earthquakes, volcanoes) and how they affect engineering activities.
7. Discuss key aspects of hydrogeology.
8. Examine ore or more geological engineering problems and present an oral and/or written report.

Module Content
Mineralogy: Physical and chemical properties of rock forming minerals, clay minerals, their structure and properties. Petrology: Composition and identification of common igneous, sedimentary, and metamorphic rocks; Engineering geological investigations; Design of underground structures; Classification of rock masses; Stability problems and support measures for tunnels; Underground openings and slopes. Internal Geological Processes: The nature of the interior of the earth; Plate tectonic theory. Surface Geological Processes: Rock weathering and soil formation; Erosion and denudation; Sediment transport and deposition; The rock cycle in the context of plate tectonic theory. Introduction to Hydrogeology: Introduction to the water cycle; Climate change; Geohydrology; Aquifers; Darcy's law; pumping tests and their purposes. Practical work on geological map interpretation: Horizontal strata and how

it affects engineering structures; dipping strata and how it affects engineering projects such as road cuts; foundations; underground and surface mining; 3-Point problems; Geological map interpretation. Field and Laboratory Demonstrations: Practical work involving the identification of common minerals and rocks.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 2 and 8).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
3. Investigations, experiments, and data analysis (Course Outcomes 2 and 8).
4. Engineering methods, skills, and tools, including information technology (Course Outcome 8).
5. Professional and technical communication (Course Outcome 8).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Laboratory demonstrations.
3. Face-to-face consultations wherever necessary.
4. Tutorials.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments: 20%.
b. Tests (at least 2 tests): 20%.
2. Team project report: 10%.
3. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Price, D.G. (2009). Engineering Geology: Principles and Practice. Springer.
2. Lisle, R.J., Brabham, P., and Barnes, J.W. (2011). Basic Geological Mapping. 5th Edition, Wiley.

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Module Title:	**STRENGTH OF MATERIALS**
Module Code	I3681VM
NQF Level	6
Notional Hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3582NM Engineering Mechanics I)
Pre-requisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the fundamental concepts of stress and strain and the geometrical properties of plane sections. This foundational module equips the student with fundamental knowledge of structural analysis and design.
Overarching Learning Outcome
Students should be able to analyse stresses and strains in 1-, 2- and 3-dimensional planes, determine the geometrical properties of plane sections and discuss material failure.

Specific Learning Outcomes

On completing the module students should be able to:

1. Analyse the state of stress and strain in one-, two-and three-dimensional planes.
2. Execute the transformation of stresses in two- and three- dimensional planes.
3. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
4. Analyse the geometrical properties of plane sections.
5. Solve problems involving shear stresses and shear flow in beams and thin-walled open sections.
6. Analyse stresses and strains due to bending, torsion, and thermal effects.
7. Describe the failure theories of materials and use them in the prediction of failure.
8. Analyse the buckling loads of struts subjected to various end conditions.
9. Relate stresses in thin cylinders and spheres subjected to internal pressure.
10. Test the mechanical properties and sectional properties of materials.

Module Content

Stresses and strains in one-dimension: introduction to stresses and strains; direct tensile test; Hooke's law and Modulus of Elasticity; ductility; Normal stress and strain; Poisson's ratio; Thermal stresses and strains; Axially loaded bars, composite bars, axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars; Shear stresses and strains; Modulus of rigidity. Stresses and strains in two and three dimensions: analysis of two- and three-dimensional state of stress; transformation of stresses and strains; principal stresses and maximum shear stresses; analysis of two and three-dimensional state of strain; Mohr's circle of stress and strain; Volumetric strain; Bulk modulus. Geometrical characteristics of plane sections: centroids of simple and complex areas; second moment of area; polar moment of area; section modulus; parallel axes theorem; perpendicular axes theorem. Bending and shear stresses in beams: theory of beam bending; composite beams; shear stress distribution due to bending. Combined bending and direct stresses in structural members. Unsymmetrical bending. Shear stress in thin-walled open sections. Shear centre. Material failure: failure theories of materials; Creep; Fatigue; Fracture; Stress concentration. Elastic instability: buckling of struts. Simple torsion: pure torsion of circular bars; shear stress and shear strain in shafts; torsional rigidity; torsion of hollow shafts. Stresses in thin cylinders and spheres: thin cylindrical and spherical shells subjected to internal pressure; hoop stress; longitudinal stress. Laboratory demonstrations: direct tensile test; elastic modulus/ductility; torsion; fracture; stress concentration; buckling of struts.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6 and 8).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).
3. Investigations, experiments, and data analysis (Course Outcome 10).
4. Engineering methods, skills, and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment (50%) will be made up of the following assessment activities:

a. Laboratory reports: 20% of CA.

b. Assignments: 20% of CA.

c. 2 Tests: 60% of CA.

2. End-of-semester examination: (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Khurmi, R.S., and Khurmi, N. (2019). A Textbook of Strength of Materials. S Chand Publishing.
2. Stephens, R.C. (2013). Strength of Materials: Theory and examples. Elsevier.
3. Timoshenko, S. (2004). Strength of Materials, Part 1: Elementary Theory and Problems, 3rd Edition. CBS Publishers.

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Module Title:	THEORY OF STRUCTURES I
Module Code	I3691VS
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3582NM Engineering Mechanics I)
Pre-requisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the students to the fundamentals of structural analysis. The module focuses on the analysis of statically determinate structures, the plotting of bending moment, shear force and influence line diagrams for various structures and structural elements and the calculation of deflections in structures. The use of computers in the analysis of statically determinate structures is also taught.

Overarching Learning Outcome
Students should be able to analyse shear forces, bending moments and deflections in statically determinate structures.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe and determine the degree of indeterminacy of any structure.
2. Analyse statically determinate structures: beams, cables, arches frames and trusses.
3. Analyse statically determinate structures and draw their corresponding axial, shear force and bending moment diagrams using manual and computer methods.
4. Sketch the influence lines for statically determinate beams and trusses.
5. Use computers to analyse statically determinate structures.
6. Analyse the deflection of structures and structural elements.

Module Content
Introduction to structural analysis: Conditions of equilibrium; external and internal structural indeterminacies. Structural analysis of statically determinate structures: beams; cables; arches; frames; trusses. Bending moment, axial and shear force diagrams: beams; frames. Influence line diagrams for statically determinate structures: beams; trusses. Computer-based methods for analysis of statically determinate structures. Displacement of beams: double integration and Macaulay's methods; moment-area methods; conjugate beam method; Castigliano's theorem; virtual work method. Laboratory demonstrations: beam deflections (cantilever, simply supported). Computer laboratory demonstrations: use of software to analyse forces, moments, and deflections in statically determinate structural elements.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5 and 6).
3. Engineering methods, skills, and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5 and 6).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations (computers and physical testing).

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment (50%) will be made up of the following assessment activities:
a. Assignments: 20% of CA.
b. Laboratory reports: 20% of CA.
c. 2 Tests: 60% of CA.
2. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Ghali, A., Neville, A.M., and Brown, T.G. (2017). Structural Analysis: A Unified Classical and Matrix Approach, 7th Edition, CRC Press.
2. Kassimali, A. (2019). Structural Analysis. 6th Edition, Cengage Learning.

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7.6.2.3 YEAR 2 SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Module Code	I3612IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3611IM Engineering Mathematics III)
Pre-requisite	**I3512IM Engineering Mathematics II**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Students should be able to solve advanced engineering problems using differential equations and numerical methods.
Specific Learning Outcomes
On completing the module students should be able to:
1. Solve systems of first order linear differential equations using the LT and the matrix approach.
2. Define, classify, and solve partial differential equations analytically.
3. Apply integral calculus to functions of several variables and describe Green's theorem.
4. Describe the principal of numerical methods and computational linear algebra.

Module Content
Systems of Linear Differential Equations: Homogeneous and nonhomogeneous systems and their methods of solutions: The Laplace Transform method and the matrix methods (eigenvalue-eigenvector approach). Partial Differential Equations: Partial differential equations classification; elliptic, parabolic, and hyperbolic. Neumann, Dirichlet boundary conditions of PDEs. Method of separation of variables to the heat and wave equations; vibrations of a stretched elastic string fixed at both ends. Integral Calculus of Functions of Several Variables: Double, triple, and iterated integrals, Line integrals in the plane, Green's Theorem, Independence of path, Surface integral, Divergence theorem, Stoke's theorem, Irrotational and solenoidal fields, Physical and engineering applications. Numerical Methods: Zeros of functions, Polynomial interpolation and least squares approximation, numerical differentiation, and integration. Numerical solution of first order ordinary differential equations and boundary value problems.
Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3 and 4).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3 and 4).
3. Engineering methods, skills, and tools, including information technology (Course Outcomes 1, 2, 3 and 4).
Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes): 20%.
b. Tests (at least 2 tests): 30%.
2. Examination (1 x 3-hour paper): 50%.
Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Ross, S.L. (1984). Differential Equations. 3rd Edition, John Wiley, and Sons.
2. Thomas, G.B. and Finney, R.L. (1995). Calculus and Analytical Geometry. 9th Edition, Addison Wesley.
3. Kreyszig, E. (2020). Advanced Engineering Mathematics. 10th Edition, Wiley.
4. Stroud, K.A. and Booth, D.J. (2020). Advanced Engineering Mathematics. 6th Edition, Red Globe Press.
5. Stroud, K.A. (1990). Further Engineering Mathematics. 2nd Edition, Palgrave Macmillan.

Module Title:	**FLUID MECHANICS I**
Module Code	I3692NF
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3582NM Engineering Mechanics I)
Pre-requisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to introduce students to the science of fluid mechanics. Students will gain an understanding of the mechanisms of fluid flow.

Overarching Learning Outcome

Students should be able to describe the properties of fluids and analyse pressure, velocity, friction, and losses in hydraulic systems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Describe properties of fluids and conditions for relative equilibrium in fluids.
2. Categorise one-dimensional mass and momentum conservation and applications of the continuity equation and the Bernoulli's equation.
3. Demonstrate skills for flow measurements in laboratory demonstrations.
4. Solve general hydraulic systems with respect to energy changes (pressure, velocity), pipe friction, and local hydraulic losses.

Module Content

Introduction to fluid mechanics; properties of fluids (density, viscosity, vapour pressure); fluid equilibrium; units. Fluid Statics: The governing differential equations; pressure distributions, manometric pressure measurement; fluids in relative equilibrium; forces on submerged surfaces; buoyancy. One-dimensional flows with inertia: 1-D mass conservation (Continuity equation); 1-D momentum conservation (Bernoulli equation); total head diagrams; flow measurement; Flow states: laminar vs turbulent, steady vs unsteady, uniform vs non-uniform, continuous vs discontinuous, sub-critical vs super-critical. Hydraulic systems: Energy changes in systems; pipe friction (continuous hydraulic energy losses: laminar and turbulent friction factors, Moody diagram); local hydraulic energy losses: loss coefficients and applications. Laboratory demonstrations: 1. Hydrostatics, 2. Fluid dynamics: Discharge determination, 3. Fluid dynamics: Energy shares in a pressurised system (pressure and velocity dependencies) and 4. Fluid dynamics: Determination of continuous and local hydraulic losses.

Contribution to Exit Level Outcome

1. Application of scientific and engineering knowledge (Course Outcomes 2 and 4).
2. Investigations, experiments, and data analysis (Course Outcome 3).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations, experiment documentation.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (at least 3 assignments): 10%.
b. Laboratory reports: 20%.
c. Tests (at least 2 tests): 20%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Finnemore, E.J. and Franzini, J.B. (2013). Fluid Mechanics with Engineering Applications. 10th Edition, McGraw Hill Education.
2. Çengal, Y.A., and Cimbala, J.M. (2013). Fluid Mechanics: Fundamentals and Applications, 3rd Edition, McGraw Hill Education.
3. Bansal, R.K. (2005). A Textbook of Fluid Mechanics and Hydraulic Machines. 10th Edition, Laxmi Publications.
4. Kothandaraman, C.P., and Rudramoorthy, R. (2011). Fluid Mechanics and Machinery, 3rd Revised Edition, New Academic Science.

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Module Title:	**BUILDING MATERIALS**
Module Code	I3682VB
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Site visits: campus and construction sites. Group presentations and posters.
NQF Credits	12
(Co-requisites)	(I3572IS Materials Science)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the science and key properties of various construction materials and their use in civil engineering applications. The module specifically introduces students to the nature, properties (physical, chemical, mechanical), manufacture and other important characteristics of common materials used in civil engineering.
Overarching Learning Outcome
Students should be able to select appropriate materials for use in civil engineering applications based on their mechanical and non-mechanical properties and environmental conditions.

Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the manufacture of common building materials.
2. Describe the chemical and mechanical properties of common building materials and their inter-relationships.
3. Articulate the relationships between the chemical and mechanical properties of materials and their selection and specification in construction.
4. Contrast various material production, testing techniques and standards.
5. Contrast recent developments in material technology with respect to design development and production.
6. Identify and discuss common material deterioration mechanisms in practice.
7. Examine the properties of common building materials and report on the findings.

Module Content

Introduction: overview of engineering properties of materials; test methods and specifications for materials in construction. Timber: mechanical properties of timber; effects of moisture on mechanical properties; manufacture and processing of timber; timber safety - pyrolysis (burning of timber) and pyrolysis prevention. Metals: overview of metals and their properties. Steel: manufacture; properties of carbon steel; selection and testing of structural and reinforcing steels; steels for concrete reinforcement; steel corrosion and ways of preventing corrosion. Aluminium: manufacture; key mechanical properties; applications; advantages and disadvantages. Clays and lime: chemical and mechanical properties of clays and lime; application of lime and clays in construction. Aggregates: physical and mechanical properties; aggregate properties affecting performance of concrete and bitumen mixtures such as, mineralogy, gradation, shape, strength, etc. Cement: manufacture; types of binders; cement chemistry and hydration; handling. Concrete: composition and production of concrete; concrete mix design; fresh and hardened properties; concrete testing; special concretes. Masonry: bricks and blocks; manufacture; mechanical properties. Bitumen and Asphalt: mechanical behaviour of bitumen; asphalt grading methods; bitumen mixture design methodologies. Other materials: rubber; glass; sealants and coatings; polymers and composites; dry-building materials. Modern developments in construction materials: nanotechnology; quality control. Laboratory demonstrations: timber (failure, grading); metals (elastic modulus); clay and lime (organic matter test); aggregate properties (physical properties); concrete (mix design vs properties); Asphalt (bitumen testing); composites.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 3 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes, 2, 3, 4, 6 and 7).
3. Investigations, experiments, and data analysis (Course Outcome 7).
4. Engineering methods, skills, and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
5. Professional and technical communication (Course Outcome 7).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures (including guest lecturers).
2. Laboratory demonstrations.
3. Face-to-face consultations wherever necessary.
4. Tutorials.
5. Site visits (campus and actual construction sites).

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment (50%) will be made up of the following assessment activities:
   a. Laboratory reports: 10% of CA.
   b. Assignments: 20% of CA.
   c. Tests (at least 2 tests): 40% of CA
2. Group presentations and posters: 30% of CA.
3. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Mamlouk, M. S. and Zaniewski, J. P. (2018). Materials for Civil and Construction Engineers. 4th Edition, Pearson Education Limited.
2. Grahame, K. E., Cranford, S. W., Shillaber, C. M. and Eckelman, M. J. (2020). Essentials of Civil Engineering Materials. 1st Edition, Cognella Academic Publishing.
3. Sivakugan, N., Gnanendran, C. T., Tuladhar, R. and Kannan, B. M. (2018). Civil Engineering Materials. 1st Edition, Cengage Learning.
4. SANS 3001-AG1: 2014. Civil Engineering Test Methods Part AG1: Particle Size Analysis of Aggregates by Sieving, South African Bureau of Standards.
5. SANS 3001-AG5: 2015. Civil Engineering Test Methods Part AG5: Sand equivalent value of fine aggregates, South African Bureau of Standards.
6. SANS 3001-AG12: 2016. Civil Engineering Test Methods Part AG12: Soundness of Aggregates (Magnesium Sulphate method), South African Bureau of Standards.

7. SANS 3001-AG20: 2014. Civil Engineering Test Methods Part AG20: Determination of the Bulk density, Apparent density and Water Absorption of Aggregate particles retained on the 5 mm sieve for Road construction materials, South African Bureau of Standards.
8. SANS 3001-AG23: 2014. Civil Engineering Test Methods Part AG23: Particle and Relative densities of Aggregates, South African Bureau of Standards.
9. SANS 3001-AS20: 2011. Civil Engineering Test Methods Part AS20: Determination of the Soluble Binder Content and Particle Size Analysis of an Asphalt Mix, South African Bureau of Standards.
10. SANS 3001-AS22: 2014. Civil Engineering Test Methods Part AS22: Determination of the binder content of mixtures used in bituminous slurry seals, South African Bureau of Standards.
11. SANS 3001-CO3-1: 2014. Civil Engineering Test Methods Part CO3-1: SANS 3001-AS22: 2014. Civil Engineering Test Methods Part AS22: Determination of the binder content of mixtures used in bituminous slurry seals, South African Bureau of Standards.

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Module Title:	**SURVEYING FOR ENGINEERS**
Module Code	I3692VS
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / 1 Practical Session / Week
Additional learning requirements	Survey camp (1 week)
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to develop an understanding of the basic principles of surveying including the traditional measurements and representation as well as modern techniques such as global positioning.
Overarching Learning Outcome
Students should be able to conduct construction-related surveying using common surveying instruments and perform their associated precision computations.
Specific Learning Outcomes
On completing the module students should be able to:
1. Perform a basic levelling field survey to accurately establish heights for control points.
2. Use survey data to compute adjusted elevations for the control points and determine relative precision estimates.
3. Apply data corrections and reductions from TSI distance and angle measurements.
4. Apply basic trigonometric formulae to compute planar coordinates of survey control points by traverse, intersection, and resection methods.
5. Apply formulae for setting out horizontal and vertical curves (i.e., railroads, highways, etc.).
6. Decipher orbital attributes (and characteristics) and signal structure of GPS technology for point positioning.
7. Compute geodetic coordinates from GPS pseudo-range measurements.
8. Generate a digital topographical map using terrestrial and space-based surveying technologies.
9. Conduct construction surveying using a variety of surveying equipment.

Module Content
Introduction to surveying: surveying fundamentals and mathematics; theory of measurement errors; observation and reduction of observations. Surveying and Measurements: overview of statistical concepts; Measurement correction and instrument calibration; Electronic Distance Measuring Instrument. Heighting/elevations: height determination; differential levelling; trigonometric levelling; Orthometric Height; Levelling computation and adjustments; Profiles. Geodetic Datums and Coordinate Geometry: Geodetic surfaces; Geodetic datums and coordinate systems; Basics of map projections for surveying and mapping; Computations in rectangular coordinates. Surveying Measurements: distance measurements and corrections; Angles, azimuth, and bearings. Surveying Coordinate System: Geodetic surfaces and datums; Computation of departures and latitude; Coordinate computations. Traverse and Survey Control: Geodetic control for mapping; Traverse adjustment; Traverse adjustment computation; Triangulation (Intersection and Resection). Horizontal Curves and Vertical Curves: Geometry and formulae. Global Positioning System (GPS): Introduction to GPS; Operation and systems; GPS measurements; surveying with GPS. Photogrammetry: introduction to Remote Sensing; EM Spectrum and its properties; Principles of Photogrammetry; Aerial Imaging Systems and Data Acquisition; Photogrammetric data processing. Geographic Information System (GIS): Introduction; Data and structure and format; Geospatial data base. Terrestrial Mobile and Space-based Mapping: Technology and data processing software; Mapping applications in engineering and construction. Application of Surveying to Construction Engineering: equipment and measurements; Construction surveying procedures; Highway curves; Horizontal control surveying; Road construction surveying; Surveying of pipelines, tunnels, culvert, bridge and building construction surveying. Computer and laboratory demonstrations: field surveying, GPS, GIS.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).
2. Application of scientific and engineering knowledge (Course Outcomes 5, 6 and 9).

3. Investigations, experiments, and data analysis (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).
4. Engineering methods, skills, tools, and information technology (Course Outcome 9).
5. Individual, team, and multidisciplinary working (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorial.
3. Demonstrations.
4. Face-to-face consultation wherever necessary.
5. Field work/survey camp (1 week during holidays).

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) as follows:

1. Tests (at least 3): 45%.
2. Assignments (at least 4): 20%.
3. Project report: 35%.

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Landman, K. Hunter T. and Jackson J. (2013). An Introduction to Engineering Surveying, Juta and Company Ltd.
2. Uren, J., and Price, W. (2006). Surveying for Engineers, 4th Edition, Palgrave Macmillan.
3. Schofield W. and Breach M. (2011): Engineering Surveying. 6th Edition, Spon Press.
4. Walker, J., and Awange, J. (2020). Surveying for Civil and Mine Engineers, Springer.

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Module Title:	THEORY OF STRUCTURES II
Module Code	I3682VS
NQF Level	6
Notional Hours	120
Contact hours	4 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3651VM Strength of Materials AND I3611VS Theory of Structures I)
Pre-requisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to teach advanced principles and methods of structural analysis and the application of these principles and methods in the analysis of statically indeterminate structures.

Overarching Learning Outcome

Students should be able to analyse statically indeterminate structures, plates, and shells and to analyse vibrations in SDOF and MDOF systems manually and using computers.

Specific Learning Outcomes

On completing the module students should be able to:

1. Differentiate between statically determinate and indeterminate structures.
2. Analyse statically indeterminate structures using various methods: force, displacement and matrix methods.
3. Sketch the influence line diagrams of statically indeterminate beams, frames and trusses.
4. Analyse vibrations in SDOF and MDOF structural systems.
5. Discuss the fundamental structural differences between plates and shells and their application in civil engineering.
6. Use computers to analyse statically indeterminate structures.

Module Content

Review of statics: principle of indeterminacy and static stability of plane frames and trusses. Analysis of statically indeterminate structures (beams, frames and trusses): force method; displacement methods. Influence lines for statically indeterminate structures:

Beams; frames; trusses. Matrix methods of structural analysis: flexibility method; stiffness method. Introduction to plates and shells. Introduction to structural dynamics: vibration in SDOF and MDOF systems. Computer-based structural analysis of indeterminate structures. Laboratory demonstrations: computer simulations (2 laboratories); influence lines (manual vs. computer plots); vibrations/dynamics.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3, 4 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3 and 4).
3. Engineering methods, skills and tools, including information technology (Course Outcomes 2, 3, 4, 5 and 6).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Computer laboratory demonstrations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment (50%) will be made up of the following assessment activities:
a. Assignments: 20%.
b. Laboratories: 20%.
c. Tests (at least 2): 60%.
2. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Ghali, A., Neville, A.M., and Brown, T.G. (2017). Structural Analysis: A Unified Classical and Matrix Approach, 7th Edition, CRC Press.
2. Kassimali, A. (2019). Structural Analysis, 6th Edition, Cengage Learning.

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7.6.3.1 YEAR 3 SEMESTER 1

Module Title:	STRUCTURAL DESIGN I
Module Code	I3791VD
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	Mini-design projects
NQF Credits	12
(**Co-requisites)**	(I3691VS Theory of Structures I)
Pre-requisite	**I3681VM Strength of Materials**
Semester Offered	1

Module Purpose
The purpose of this module is to equip students with knowledge of the behaviour of reinforced concrete and the analysis and design of reinforced and pre-stressed concrete structural elements to SANS standards. The module also introduces the students to the use of computer software in the analysis and design of reinforced and prestressed concrete structural elements to SANS standards.

Overarching Learning Outcome
Students should be able to design reinforced and pre-stressed concrete structural elements according to the relevant SANS standards.
Specific Learning Outcomes
On completing the module students should be able to:

1. Appraise historical and modern structural design philosophies.
2. Appraise major regional and international reinforced and pre-stressed concrete design codes.
3. Apply the limit state design philosophy in the design of reinforced and pre-stressed concrete structural elements.
4. Apply computer programmes in the design and detailing of RC structural elements.
5. Calculate stresses and loss of pre-stress forces in pre-stressed concrete structural elements.
6. Test the moment capacity of reinforced and unreinforced concrete structural elements and appraise their performance and merits.

Module Content
Theory of reinforced concrete (RC): review of the physical and mechanical properties of concrete and reinforcing bars; stress blocks. Limit state design philosophy of RC: application of SLS and ULS to RC design; Loads/actions on structures; Building codes of practice. Design and detailing of RC structural elements: beams; slabs; columns; foundations. Introduction to pre-stressed concrete design: types of pre-stressing; determination of stresses; tendon profiles; pre-stress losses. Laboratory demonstrations: beam bending; maximum moment. Computer software applications: analysis, design and detailing of RC and pre-stressed concrete structures and structural elements using AutoCAD and Prokon or STAAD.Pro.
Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 3 and 4).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4 and 5).
3. Engineering design (Course Outcomes 3, 4 and 5).
4. Investigations, experiments and data analysis (Course Outcomes 6).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 3, 4 and 5).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures (including guest lecturers).
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Structures laboratory demonstrations.
5. Computer laboratory demonstrations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment (60%) will be made up of the following assessment activities:
   i. 3 Mini-design projects (slabs and beams, columns and foundations): 60% of CA.
   ii. 2 Tests: 40% of CA.
2. End-of-semester examination (1 x 3-hour paper): 40%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain:
1. A minimum Continuous Assessment (CA) mark of 50%.
2. An average of 50% in the mini-design projects.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50% in the end-of semester examination.
2. The final mark will be made up of 60% Continuous Assessment (CA) and 40% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. SANS 10100-1: 2000, The Structural Use of Concrete, Part 1: Design. South African Bureau of Standards.
2. SANS 10100-2: 2014, The Structural Use of Concrete, Part 2: Materials and the Execution of Work. South African Bureau of Standards.
3. Parrot, G. (2009). Reinforced Concrete Design to SANS 10100-1:2000, Shades Technical Publications.
4. Kong, F.K., and Evans, R.H. (2013). Reinforced and Prestressed Concrete, 3rd Edition, Springer.
5. Reynolds, C.E., Steedman, J.C., and Threlfall, A.J. (2007). Reinforced Concrete Designer's Handbook, 11th Edition, E and FN Spon.

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Module Title:	**URBAN ENGINEERING**
Module Code	I3771VU
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week or Field trip
Additional learning requirements	Field trips: construction sites of water, sewer and storm water reticulation systems and municipal construction sites (new extensions/locations complete with amenities such as streetlights, kerb-level solid waste bins, right of way, etc.).
NQF Credits	16
(Co-requisites)	(I3692VS Surveying for Engineers)
Pre-requisite	**I3692NF Fluid Mechanics**
Semester Offered	2

Module Purpose

The purpose of this module is to impart the student to be competent to assess the impact of engineering activity on society and the environment, and bring into engineering analysis and design considerations of the impact of technology on society, ergonomics for a given society and the personal, social, and cultural values of those affected by engineering activity. It will also equip students with knowledge of the design, planning and operation of infrastructure for urban water supply, storm water evacuation and wastewater reticulation networks.

Overarching Learning Outcome

Students should be able to critique the impact of technology on society, with specific emphasis on urban water design, planning and operation, for water supply, storm water and sewerage reticulation and to design and simulate water and wastewater network using computer-aided modelling.

Specific Learning Outcomes

On completing the module students should be able to:

1. Correlate population growth with development trends and apply the methodology used in infrastructure planning to interpret civil engineering drawings.
2. Effectively use engineering economics analysis to arrive at the most optimum project (economic analysis) e.g., present value analysis, annuities, cost benefit ratios and internal rate of return.
3. Use optimisation theories/approaches in making decisions in which projects to invest e.g., using the Linear Programming Problems (LPP) and LiPS (Linear Programme Solver) among others.
4. Outline water supply systems and codes pertaining to water supply and classify design and construction of water distribution networks.
5. Categorise and determine water quality determinants, water quality standards and techniques and instrumentations used for water quality control.
6. Summarise water quality control, quality assurance systems and leakage control.
7. Discuss design and analysis of urban drainage systems and networks.
8. Outline computer simulations of water and wastewater networks.

Module Content

Infrastructure planning: demographics; urbanisation/urban planning; demand for infrastructure; cost and affordability; standards; social aspects and participatory approaches; land-use and infrastructure interaction: demand-driven approaches and development impact approaches. Physical infrastructure: Introduction to common infrastructure services for water, hydrology, transportation, buildings, wastes, urban and the built environment. Systems approach: System dynamics and feedback loops; Modelling environmental systems through life-cycle assessment, decision making strategies and the environment. LPP and LiPS (Linear Programme Solver) on different projects (water, transport, community infrastructure, futuristic structures (AI, 4th and 5th IR); engineering economics: (PW, Annuities, Cost Benefit Ratios, Internal Rate of Return). Water Supply: Importance of water supply to communities, water demand, water drawing; elevation, adduction, storage legislation and codes. Distribution network: Design and construction of pipelines, water facilities in buildings, unaccounted for water and leakage control. Urban drainage: wastewater sources, variations, combined and separate collection systems, vacuum collectors. System simulation: Application of Simulation software to basic Water supply and Drainage networks (e.g., WATERCAD, SEWERCAD, STORMCAD, EPANET).

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 4, 5 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5 and 6).
3. Engineering design (Course Outcomes 4, 5, 6 and 7).
4. Investigations, experiments and data analysis (Course Outcomes 6 and 7).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
6. Sustainability and impact of engineering activity (Course Outcomes 3, 4, 5 and 6).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials and demonstrations.
3. Field trips.
4. Self-study and group work.
5. Case studies.
6. Mini-project – intended to impact learning through "Flip learning" approach.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
   i. 4 Assignments (tutorials, quizzes, laboratory and field reports): 10%.
   ii. Tests (at least 3 tests): 20%.
   iii. Mini design-projects: 30%.
2. End-of-semester examination (1 x 3-hour paper): 40%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 50%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 60% Continuous Assessment (CA) and 40% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Goodman, A.S. and Hastak, M. (2015). Infrastructure Planning, Engineering and Economics. 2nd Edition, McGraw Hill Education.
2. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. (1985). Environmental Engineering. McGraw Hill.
3. ReVelle, C. and McGarity, A.E. (Editors). (1997). Design and Operation of Civil and Environmental Engineering Systems. John Wiley and Sons.
4. CSIR Building and Construction Technology. (2005). Guidelines for Human Settlement Planning and Design: The Red Book.
5. Trifunović, N (2020). Introduction to Urban Water Distribution. 2nd Edition. UNESCO-IHE Lecture Note Series, CRC Press.
6. Butler, D., Digman, C.J., Makropoulos, C. and Davies, J.W. (2018). Urban Drainage. 4th Edition, CRC Press.

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Module Title:	CONSTRUCTION MANAGEMENT
Module Code	I3721VC
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to provide the students with fundamental knowledge of how construction projects are developed, organised and executed. The module also teaches the basics of how to make project investment and financing decisions.

Overarching Learning Outcome
Students should be able to plan, develop, organise and execute construction projects cost effectively using common construction management software and other tools.

Specific Learning Outcomes
On completing the module students should be able to:

1. Apply the basic concepts of construction management such as types and functions of management, project participants, life-cycle stages of projects, project delivery methods, types of contracts, and bidding.
2. Read and understand engineering drawings and other contract documents of real life construction projects.
3. Prepare early (preliminary) and detailed cost estimates for construction projects.
4. Breakdown the project into work activities using the Work Breakdown Structure (WBS) and the Master Specification format and establish the logical relationship among activities.
5. Draw network diagrams for construction projects using the Critical Path Method (CPM), Activity on Arrow (AOA) and Activity on Node (AON) networks.
6. Estimate activity durations (early start, early finish, late start, late finish, total float, and free float) and schedule the project using the CPM and the bar chart (Gantt chart) scheduling techniques.
7. Evaluate the various options of project financing and perform cash flow analysis.
8. Use specialised software such as MS Excel, Microsoft Project and/or Primavera for data management, project scheduling, resource levelling, and resource allocation.
9. Communicate effectively while working on construction projects.

Module Content
Introduction: Basic concepts of construction management such as types and functions of management, project participants, life-cycle stages of projects, project delivery methods, types of contracts, and bidding Project. Interpreting engineering drawings: Read and understand engineering drawings and other contract documents of real life construction projects; Converting engineering drawings to bill of quantities. Contract Strategy: Types of construction contracts; Level of management; Design, construction; Maintenance; Operation that will be required from different parts of the supply chain, and the extent these services will be integrated; Determination of risk levels for key players. Project estimating and scheduling: Principles of estimating and scheduling for the construction industry; Engineer's preliminary and final estimates quantity take off and cost and duration of major items related to a construction project-using manual and computer techniques. Project planning methods and work control: Breakdown the project into work activities using the Work Breakdown Structure (WBS) and the Master Specification format and establish the logical relationship among activities; Draw network diagrams for construction projects using the Critical Path Method (CPM), Activity on Arrow (AOA) and Activity on Node (AON) networks; Methods and quantitative tools used to effectively plan, organise, and control construction projects: CPM, project planning, Gantt's diagram. Bill of quantities: Legislation for works contracts; Tender document preparation and tender evaluation. Project Financing: Evaluate the various options of project financing and perform cash flow analysis. Tools for Data Management and Resources allocations: Specialised software for data management (Excel, Microsoft Project and/or Primavera for data management); Project scheduling; Resource levelling and resource allocation. Work Safety. Quality control principles.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 3, 4, 5, 6, 7).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 4, 5, 6 and 8).
3. Engineering design (Course Outcome 5, 6).
4. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7 and 8).
5. Engineering professionalism (Course Outcome 9).
6. Engineering management (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures (including guest lectures).
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Case studies.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Tests (at least 2 tests): 40%.
2. Reports: 30%.
3. Assignments: 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of project reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Twort, A.C., and Rees, J.G. (2004). Civil Engineering Project Management, 4th Edition, Elsevier.
2. Levy, S.M. (2017). Project Management in Construction. 7th Edition, McGraw Hill Education.
3. Sears, S.K., Sears, G.A., Clough, R.H., Rounds, J.L. and Segner, R.O. (2015). Construction Project Management: A Practical Guide to Field Construction Management. 6th Edition, Wiley.
4. Pierce Jr., D.R. (2013). Project Scheduling and Management for Construction. 4th Edition, RSMeans.
5. Halpin, D.W., Senior, B.A. and Lucko, G. (2017). Construction Management. 5th Edition, Wiley.
6. Mubarak, S. (2019). Construction Project Scheduling and Control. 4th Edition, Wiley.
7. Holm, L. and Schaufelberger, EJ. (2021). Construction Cost Estimating. 1st Edition, Routledge.
8. Schaufelberger, J.E. and Holm, L. (2017). Managing of Construction Projects: A Constructor's Perspective. 2nd Edition, Routledge.

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Module Title:	**HYDROLOGY FOR ENGINEERS**
Module Code	I3741VH
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	Field trips: river gauging station, weather station and observation wells for ground monitoring.
NQF Credits	8
(Co-requisites)	None
Pre-requisite	(I3692NF Fluid Mechanics)
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to acquire appropriate competence in the understanding of hydrology, e.g. the water cycle, its components and concepts to deal with the water resource.

Overarching Learning Outcome
Students should be able to apply the concepts of engineering hydrology to measure precipitation, evaporation, transpiration and discharge and to model hydrological processes.

Specific Learning Outcomes
On completing the module students should be able to:

1 Summarise the hydrological cycle and describe the methods for determination of evaporation and transpiration.
2 Distinguish modelling floods (numerical simulation) and measuring stream flow (stage-discharge ratio).
3 Critique the processes that lead to soil erosion, sediment transport and sedimentation.
4 Appraise the methods for flow measurement and hydrological modelling.
5 Evaluate early warning systems for floods.
6 Critique the process of hydrological data archiving, retrieval and use.
7 Investigate the process of "ground truthing" hydrological data.

Module Content

Hydrological cycle: water resources; rainfall processes and data; precipitation record analysis; precipitation distribution; spatial information from local measurements of precipitation; determination and measurement of evaporation and transpiration; Infiltration calculation and modelling; flood frequency determination and analysis; run-off characteristics (hydrograph, stage-discharge rating cure); unit hydrograph analysis; time-area routing; soil erosion and sediment production. Flow measurement: stream flow measurement and analysis. Stream and river flow simulation: introduction to HEC-RAS software; Groundwater characteristics and groundwater flow detection. Water management: Floods and droughts; Hydrological modelling. Laboratory demonstrations: Weather station (data collection and interpretation); Discharge characteristics (developing a stage-discharge rating curve). Computer applications: use of HEC-RAS software.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcome 1).
2. Application of scientific and engineering knowledge (Course Outcomes 2, 3, 4, 5 and 6).
3. Investigations, experiments and data analysis (Course Outcomes 3 and 4).
4. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 3, 4, 6 and 7).
5. Sustainability and impact of engineering activity (Course Outcomes 1 and 3).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations, experiment documentation.
5. Computer software simulations (HEC-RAS).
6. Field trips.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments: 10%.
   ii. 3 Tests: 30%.
   iii. 2 laboratory reports: 10%.
2. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Chin, D. (2012). Water Resources Engineering. 3rd Edition, Pearson.
2. Gupta, S.K. (2011). Modern Hydrology and Sustainable Water Development. Wiley-Blackwell.
3. Maidment, D.R. (1993). Handbook of Hydrology. McGraw Hill.
4. Shaw, E.M., Beven, K.J., Chappell, N.A. and Lamb, R. (2017). Hydrology in Practice. 4th Edition. CRC Press.

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Module Title:	TRANSPORTATION ENGINEERING I
Module Code	I3791VT
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	Traffic count surveying on site
NQF Credits	12
(Co-requisites)	None
Pre-requisite	(I3582IS Statistics for Engineers)
Semester Offered	1

Module Purpose:
The purpose of this module is to provide students with a sound theoretical understanding of the fundamentals of traffic engineering.

Overarching Learning Outcome
Students should be able to apply the fundamentals of traffic engineering to conduct traffic studies, design signalised intersections, model traffic and conduct traffic performance analysis of road networks, intersections and public transport infrastructures.

Specific Learning Outcomes
On completing the module students should be able to:

1. Design traffic studies, collect and assess traffic data including speed, volume and travel time.
2. Apply traffic flow models and shockwave theory to quantify characteristics of vehicular flow, including road capacity.
3. Design optimum traffic signal timings that are safe for vehicles and pedestrians to use for different road classes.
4. Apply level of service concepts to determine LOS for selected highway segments.
5. Apply the four-step travel demand modelling method in the planning of transport networks.
6. Understand the role of public transport, non-motorised transport and universal access principles in transport systems design and sustainability.
7. Apply modern software tools for network representation, traffic simulation, estimate traffic delay and LOS for signalised and signalised intersections.

Module Content
Introduction to Traffic Engineering and Traffic Studies: Fundamentals of traffic analysis and traffic flow theories; Travel time studies; parking studies; access management. Intersection Design: Basic principles of intersection design, control and signalisation; Fundamentals of signal design and timing including computer applications. Capacity and Level of Service: Capacity and Level of Services for segments and signalised intersection including software applications; Traffic operations and planning for urban street networks. Transport planning: Travel behaviour principles; Demand, supply and equilibrium; Travel demand forecasting and Traffic Impact Assessment - trip generation, trip distribution, mode choice, traffic assignment; Elasticity of demand; Urban transport networks; Network development and classification. Public Transport (PT) and NMT: PT - Modes and intermodal transport; Operational planning. NMT - NMT facilities and human walking behaviour and universal accessibility. Laboratory demonstrations: traffic counts; computer applications (traffic flow theory, capacity and LoS, traffic safety).

Contribution to Exit Level Outcome
1. Problem Solving (Course Outcomes 1, 2, 3, 4 and 5).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4 and 5).
3. Engineering design (Course Outcomes 4 and 5).
4. Investigations, experiments and data analysis (Course Outcomes 3 and 7).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 4, 5 and 7).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures (including guest lecturers).
2. One tutorial or one laboratory demonstration session per week for 14 weeks.
3. Weekly consultation sessions.
4. A group design project at the end of the module.
5. At least one field trip.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes, laboratory and field reports): 5%.
   ii. Tests (at least 2 tests): 30%.
   iii. Design project (oral presentation and design report): 15%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Garber, N. J. and Hoel, L. A. (2020). Traffic and Highway Engineering. 5th Edition [SI Edition], Cengage Learning.
2. CSIR Building and Construction Technology. (2005). Guidelines for Human Settlement Planning and Design: The Red Book.

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Module Title:	**WATER TREATMENT**
Module Code	I3781VW
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1 Practical Session / Week or Field trip
Additional learning requirements	Field trips: water treatment facilities (including but not limited to desalinisation and/or defluoridation plants).
NQF Credits	12
(Co-requisites)	**(**I3511NC Chemistry for Engineers)
Pre-requisite	(None)
Semester Offered	1

Module Purpose

The purpose of this module is to enable students to develop competencies in the evaluation of water characteristics, determine the best treatment processes, and design the treatment facilities in an environmentally acceptable manner.

Overarching Learning Outcome

Students should be able to simulate and design environmentally-friendly water treatment, recovery and sludge disposal processes.

Specific Learning Outcomes

On completing the module students should be able to:

1. Appraise water pollution parameters.
2. Demonstrate abilities to assess and recommend chemical requirements for water treatment.
3. Correlate the water treatment technologies and distinguish between the different technology levels.
4. Implement theoretical fundamentals of different water treatment processes.
5. Simulate and design for environmentally friendly water treatment, recovery and disposal of sludge from water treatment plants.
6. Design all unit operations (processes) pertaining to standard water treatment.
7. Deduce the size of special water treatment plants e.g., desalinisation, defluoridation, groundwater recovery and treatment units, etc.

Module Content

Introduction: Sources of Water; Water pollutants (health risks and environmental aspects). Quantity of water: Per capita demand; Design period; Population forecast; Fluctuation in demand. Water Quality Monitoring: Water quality determination; Analysis, guidelines and standards; Water sample preservation and storage, analytical instrumentation and techniques; Quality control, quality analysis and monitoring; Statistical analysis of water quality data; Contemporary issues in water quality; Surface water characterisation (physical, chemical and biological); Water quality criteria and standards. Water treatment: Standards and guidelines (e.g. WHO, IWA); Water treatment (Objectives, Coagulation, Flocculation, Sedimentation, Dissolved air flotation, Filtration (RSF and SSF), Aeration/Gas Transfer, Disinfection, Desalination, Defluoridation and Stabilisation). Laboratory demonstrations: Water quality tests; Water characteristics tests: faecal coliform. Computer simulations: use of appropriate water treatment software. Field trips to water treatment plants.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
3. Engineering design (Course Outcomes 2, 3 and 4).
4. Investigations, experiments and data analysis (Course Outcomes 5, 6 and 7).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 3, 4 and 5).
6. Sustainability and impact of engineering activity (Course Outcomes 3, 5 and 7).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Laboratory demonstrations.
4. Field trips.
5. Report and presentation.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following activities:
   i. Assignments (Tutorials, quizzes, laboratory and field reports): 10%.
   ii. Test (at least 2 Tests): 20%.
   iii. Mini design projects: 20%.
2. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Crittenden, J.C., Trussel, R.R., Hand, D.W., Howe, K.J. and Tchobanoglous, G. (2012). MWH'S Water Treatment: Principles and Design. 3rd Edition. John Wiley and Sons.
2. Viessman Jr., W., Hammer, M.J., Perez, E.M. and Chadik, P.A. (2013). Water Supply and Pollution Control. 8th Edition, Pearson India Education.
3. Hammer Sr., M.J. and Hammer Jr., M.J. (2015). Water and Wastewater Technology. 7th Edition, Pearson India.

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7.6.3.2 YEAR 3 SEMESTER 2

Module Title:	TECHNICAL WRITING
Module Code	I3762VW
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(U3683AL Academic Literacy II)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with skills based in theory relating to professional and technical writing.
Overarching Learning Outcome
Students should be able to communicate effectively and professionally - orally and through audio-visual means - and to write good technical documents individually and in teams.
Specific Learning Outcomes
On completing the module students should be able to:
1. Produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. Communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates and complying with constraints on document format.
3. Adapt content and rhetorical strategies according to audience and purpose for each document.
4. Select appropriate, credible sources to support the claims, findings or recommendations made in technical documents.
5. Incorporate ideas from source material, including images and figures.
6. Create and deliver technical briefings tailored to specific audiences, purposes and media.
7. Explain ethical considerations applicable to technical communication in engineering and computer sciences.

Module Content
Introduction: academic vs technical communication; introduction to a various technical and business writing theories and practices designed to be applicable to the production of business communication in the real world. Technical writing: fundamentals of good business/technical writing, including protocols for business letters, memoranda, electronic mail, good and bad messages; persuasive messages and formal reports and proposals. Technical reports: planning, structure, style and language for purpose and audience; effective graphical support. Professional Oral communication: structure, style and language; academic and professional discourse; group presentations to industry professionals. Posters and e-portfolios.
Contribution to Exit Level Outcome
Professional and technical communication (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Face-to-face consultations wherever necessary.
3. Case studies.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Assignments: 20%.
2. Group oral presentations: 10%.
3. Individual reports: 40%.
4. Tests (at least 2): 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.
Learning and Teaching Enhancement Strategies
1. Internal and external moderation of project reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
English, J. (2013). Professional Communication: Deliver effective written, spoken and visual messages. 3rd Edition, Juta Academic.

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Module Title:	HYDRAULICS AND HYDRO-ENGINEERING
Module Code	I3852VH
NQF Level	8
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	Field trips: dams, canals, water intakes, hydropower plants, culvert, bridges and "fords" or drifts.
NQF Credits	16
(Co-requisites)	(I3652NF Fluid Mechanics)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to enable students to acquire appropriate competence in understanding the concepts and procedures in hydro-engineering.

Overarching Learning Outcome
Students should be able to analyse and design hydraulic structures.

Specific Learning Outcomes
On completing the module students should be able to:
1. Appraise fluid properties and applications of Continuity and Bernoulli equations to fluids.
2. Distinguish the characteristics flow in fluids (laminar vs turbulent, steady vs unsteady, uniform vs non-uniform, continuous vs discontinuous, sub-critical vs super-critical).
3. Compare and contrast the flow characteristics of pressurised flow and open channel flow.
4. Analyse and design basic fluid machinery (turbines, pumps) and explain the effects of water hammer and cavitation.
5. Appraise free surface flows, including flows in spillways and stilling basins.
6. Examine open channel flows through the use HEC-RAS simulation software.
7. Critique outflow characteristics (free and influenced by the downstream side).
8. Design common hydraulic structures such as culverts, dams, canals etc.
9. Evaluate micro-, mini-, and small-to-medium hydropower stations.

Module Content
Review of Fluid Mechanics: Fluid properties; Hydrostatics; Hydrodynamics (Bernoulli equation, force, momentum, flux equation, continuity equation; ideal flow patterns, streamlines, flow nets; real flow, laminar and turbulent flow, boundary layers and drag). Flow resistance in pressurised and open channel flow; dimensional analysis and models. Fluid machinery. Design of pumps. Variable pressure flows. Water hammer. Open channel flow: characteristics; numerical simulation by the software HEC-RAS; Application of the software HEC-RAS to open channel flows. Overflow over hydraulic structures and outflow underneath gates (free and influenced). Flow resistance in channels; Flows with uniform regiments. Damper systems. Flow through spillways and stilling basins. Disturbed flows (bridges and culverts); Phenomenon of the hydraulic jump and stilling basin design; Basic design of other hydraulic structures: Spillways, weirs, culverts, dams, reservoirs, canals, irrigation schemes. Laboratory demonstrations: Fluid dynamics in pressurised systems: Determination of energy shares in a pressurised flow and measurement of hydraulic losses (pressure term); Determination of outflow and overflow coefficients; Hydraulic jump; Determination of sub- and supercritical water depths and velocities, Froude-number, conjugate depths and length of a hydraulic jump; Computer applications (HEC-RAS).

Contribution to Exit Level Outcome
1. Problem solving (Course Outcome 1).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
3. Engineering design (Course Outcomes 4 and 8).
4. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 3, 4 and 6).
5. Sustainability and impact of engineering activity (Course Outcomes 1 and 3)

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations, experiment documentation.
5. Computer laboratory demonstrations (e.g. HEC-RAS, Mike 11, Mike 12, Flow 2D).

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
    i. Assignments: 10%.
    ii. 3 Tests: 30%.
    iii. 2 laboratory reports: 10%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3- hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Tanchev, L. (2014). Dams and Appurtenant Hydraulic Structures. 2nd Edition, Taylor and Francis.
2. Roberson, J.A., Cassidy, J.J. and Chaudhry, M.H. (2013). Hydraulic Engineering. 2nd Edition, Wiley India.
3. Nalluri, C. and Featherstone, R.E. (2008). Civil Engineering Hydraulics. Blackwell Publishing.

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Module Title:	**STRUCTURAL DESIGN II**
Module Code	I3792VD
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	Two (2) mini-design projects
NQF Credits	12
(Co-requisites)	(I3691VS Theory of Structures I)
Pre-requisite	**I3681VM Strength of Materials**
Semester Offered	2

Module Purpose
The purpose of this module is to develop an understanding of the behaviour, analysis and limit state design of structural steel and timber elements to appropriate SANS standards. The module also introduces the students to the use of computer software in the analysis and design of structural steel and timber structural elements to SANS standards.

Overarching Learning Outcome
Students should be able to design structural steel and timber elements according to the appropriate SANS codes of practice.

Specific Learning Outcomes
On completing the module students should be able to:

1. Appraise and distinguish between the application of the limit state design philosophy to structural steel and structural timber elements.
2. Design structural steel tension and compression members.
3. Design structural steel beams and girders.
4. Design structural steel beam-columns.
5. Design structural steel connections and joints.
6. Design of structural timber tension and compression members.
7. Design of structural timber beams.
8. Design of structural timber joints and connections.
9. Compare computer software output to hand calculations in the design of structural steel and timber members and connections.

Module Content
Theory of Structural Steel: Review of the production, physical and mechanical properties of steel. Limit State Design Philosophy of Structural Steel: serviceability limit states and ultimate limit states as applied to structural steel structures. Design of Structural Steel Members: tension members; compression members; Beams and girders; Beam-columns; Connections (bolts, welds, column-base plates). Design of Bracing, trusses and Lattice Girders. Theory of Structural Timber: Review of the production, physical and

mechanical properties of structural timber. Limit State Design Philosophy of Structural Timber: Serviceability limit states and ultimate limit states as applied to structural timber structures. Design of Structural Timber Members: Beams; Columns; Joists; Connections. Laboratory demonstrations: testing of steel and timber joints and connections. Computer software applications: use of Prokon, STAAD.Pro, ABAQUS and AutoCAD.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 2, 3, 4, 5, 6, 7 and 8).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).
3. Investigations, experiments and data analysis (Course Outcome 9).
4. Engineering design (Course Outcomes 2, 3, 4, 5, 6, 7, 8 and 9).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures (including guest lecturers).
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Structures laboratory demonstrations.
5. Computer laboratory demonstrations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment (60%) will be made up of the following assessment activities:
    i. 2 Mini-design projects (design of steel structures and design of timber structures): 60% of CA.
    ii. Tests (at least 2): 40% of CA.
2. End-of-semester examination (1 x 3-hour paper): 40%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 50%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 60% Continuous Assessment (CA) and 40% End-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. SANS 10163-1: 2003 The Structural Use of Timber, Part 1: Limit-States Design. South African Bureau of Standards.
2. SANS 10162-1: 2011 The Structural Use of Steel, Part 1: Limit-States Design of Hot-Rolled Steelwork. South African Bureau of Standards.
3. SANS 10162-2: 2011 Structural Use of Steel: Part 2: Cold-Formed Steel Structures. South African Bureau of Standards.
4. SANS 10160-1: 2011 Basis of Structural Design and Actions for Buildings and Industrial Structures, Part 1: Basis of Structural Design, South African Bureau of Standards.
5. SANS 10160-2: 2011 Basis of Structural Design and Actions for Buildings and Industrial Structures Part 2: Self-Weight and Imposed Loads. South African Bureau of Standards.
6. SAISC. (2016). Southern African Steel Construction Handbook, 8th Edition, Southern African Institute of Steel Construction.
7. Mahachi, J. (2013). Design of Structural Steelwork to SANS 10162, 3rd Edition.
8. de Clercq. H. (2012). Structural Steel Connections. Southern African Institute of Steel Construction.

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Module Title:	ENVIRONMENTAL ENGINEERING
Module Code	I3822VE
NQF Level	8
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / 1 Practical Session / Week or Field trip
Additional learning requirements	Field trips: sanitary landfill, open dumps, transfer stations, building rubble dumping facilities, environmental protected areas (e.g. game parks, national parks), ground water protected areas etc.
NQF Credits	8
(Co-requisites)	None
Pre-requisite	(None)
Semester Offered	2

Module Purpose
The purpose of this module is to develop the competence of students in the theory and law of environmentally sound and proper waste treatment and management processes including Environmental Impact Assessment (EIA).

Overarching Learning Outcome
Students should be able to design the processes for solid waste treatment, sludge treatment and disposal, process train selection and to conduct environmental impact assessment (EIA).

Specific Learning Outcomes:
On completing the module students should be able to:

1. Evaluate the techniques for Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA) and Social Impact Assessment (SIA).
2. Critique the principles of forecasting and evaluation techniques.
3. Appraise the laws governing waste disposal.
4. Examine key elements of waste management problems.
5. Design sanitary landfills and transfer stations.
6. Design and conduct an EIA for a small project such as a water well, landfill, wind or solar-powered water project.
7. Evaluate potential leachate from landfill.
8. Develop a suitable methodology for conducting a Life Cycle Analysis of a process or a product.
9. Analyse the impact of waste disposal engineering solutions in an economic and societal context.
10. Implement the techniques, skills and modern engineering tools necessary for engineering practice in solid waste management.

Module Content
Environmental Impact Assessment: Environmental monitoring and auditing; environmental institutions, sources, characteristics and effects of environmental contaminants; environmental pollution and degradation in Southern Africa. Characterisation of solid wastes, sources, quantities, characteristics. Solid waste collection, transportation systems and storage. Ultimate disposal systems. Design of landfills: site selection, environmental impact assessment of waste disposal (spreadsheets for determining areas and volumes of sanitary landfills); Design with geosynthetics for solid waste landfills. Treatment of solid waste for energy production. Production of biogas from semi-solid waste. Waste amount, types and composition. Transfer stations Life cycle analysis. Waste processing. Recycling of different waste fractions. Thermal waste treatment. Biological waste treatment. Agricultural waste and sewage sludge. Land filling and disposal. Industrial and special wastes. Vermin technology as bioremediation of soils etc. Laboratory demonstrations: solid waste characterisation, visit to a sanitary landfill, leachate measurements (percolation tests); computer applications (spreadsheets of fill volumes and areas, Modified Leopold Matrix).

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 2, 3, 4, and 7).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
3. Engineering design (Course Outcomes 5 and 6).
4. Engineering methods, skills and tools, including information technology (Course Outcomes, 1, 4, 5, 7, 8 and 10).
5. Sustainability and impact of engineering activity (Course Outcomes 1, 3, 4, 7, 8, 9 and 10).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Self-study.
3. Laboratory demonstrations: wastewater laboratories and computer laboratories.
4. Case studies.
5. Role plays.
6. Presentations.
7. Excursions.
8. Projects.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. 3 Assignments: 30%.
2. 3 Tests: 30%.
3. Mini project report, presentation and field reports: 40%

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and laboratory/field reports.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Tchobanoglous, G., Theisen, H. and Vigil, S.A. (2014). Integrated Solid Waste Management: Engineering Principles and Management Issues. 1st Edition, McGraw Hill India.
2. Kreith, F. and Tchobanoglous, G. (2002). Handbook of Solid Waste Management. 2nd Edition. McGraw Hill Education.
3. LaGrega, M.D., Buckingham, P.L. and Evans, J.C. (2015). Hazardous Waste Management. 2nd Edition, Medtech.
4. Wentz, C.A. (1995). Hazardous Waste Management. 2nd Edition, McGraw Hill.
5. CSIR Building and Construction Technology. (2005). Solid Waste Management. Guidelines for Human Settlement Planning and Design: The Red Book.
6. Cairney, T. and Hobson, D.B. (Editors). (1998). Contaminated Land: Problems and Solutions. 2nd Edition, CRC Press.
7. Stearns, R.A. (1982). Measuring Productivity in Residential Solid Waste Collection Systems. Proceedings of the GRCDA International Seminar and Equipment Show, 1980, in Residential Solid Waste Collection, GRCDA, Pp. 3-1/3-19.
8. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. (1985). Environmental Engineering. McGraw Hill.
9. ReVelle, C. and McGarity, A.E. (Editors). (1997). Design and Operation of Civil and Environmental Engineering Systems. John Wiley and Sons.
10. Roe, D., Dalal-Clayton, D.B. and Hughes, R. (1994). A Directory of Environmental Assessment Guidelines. IIED London and IUCN and World Resources.
11. Wood, C. (2002). Environmental Impact Assessment: A Comparative Review. Prentice Hall.

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Module Title:	**GEOTECHNICAL ENGINEERING I**
Module Code	I3782VG
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / 1 Practical Session / Week or Field trip
Additional learning requirements	Site visits: campus and construction sites
NQF Credits	12
(Co-requisites)	(I3682VB Strength of Materials AND I3641MG Introduction to Engineering Geology)
Pre-requisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to provide students with basic understanding of physical and mechanical properties of soil, together with knowledge of basic engineering procedures to identify factors controlling soil behaviour and methods to determine soil properties. Students will acquire basic knowledge in engineering design of geotechnical systems.

Overarching Learning Outcome
Students should be able to discuss basic concepts in soil mechanics and determine the geotechnical properties of soils in a laboratory.

Specific Learning Outcomes
On completing the module students should be able to:
1. Demonstrate ability to classify soils and determine its suitability for use in a design of structures.
2. Demonstrate ability to solve basic geotechnical problems using the effective stress concept.

3. Develop an understanding of basic principles of flow and soil permeability through porous media.
4. Explain distribution of stresses in soils and be able to compute stresses due to point, line, and circular loads.
5. Apply consolidation properties of soils to settlement problems frequently encountered in civil engineering.
6. Demonstrate the ability to analyse the response of soil under external loading using shear strength parameters.
7. Demonstrate ability to conduct basic soil laboratory experiments and to collect, analyse, interpret, and present data.
8. Demonstrate basic understanding of geosynthetics and their application in civil engineering structures.

Module Content

Origin and formation of soil: definitions, soil origin and structure, grain size and consistency, soil classification systems, soil compaction, soil phase relationships. Overview of Geosynthetics: introduction to geosynthetics (types, functions and characteristics), geosynthetic properties and testing methods. Principles of Effective stress: principle of effective stress and its importance; total and effective stress, pore water pressure, effects of seepage stresses on effective stresses within soils, pressure distribution diagrams. Soil Hydraulics and Seepage: permeability or flow of water in the soil, anisotropic conditions, seepage theory and flow nets, field permeability testing; piping, filters systems to control piping, geosynthetic filters and drains and techniques to control seepage. Distribution of applied stresses: Boussinesq equation, vertical stresses increase, point loads, circular loads, strip loads, Maxwell and Fadum charts. Consolidation and Settlement: one-dimensional settlement theory, consolidation process and terminology, settlement calculations, allowable deformation, use of prefabricated vertical drains to accelerate soil consolidation. Shear strength of soil: Mohr's circles, Mohr-Coulomb failure criterion, peak and residual strength parameters, laboratory strength tests, stress-strain response of soils, in-situ strength tests, addition of tensile strength to soil with geosynthetics. Laboratory demonstrations: soil classification (sieve analysis, hydrometer test, Atterberg Limits), soil compaction, permeability tests.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 1, 2, 4, 5 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 2, 3, 4, 5 and 6).
3. Investigations, experiments, and data analysis (Course Outcomes 1 and 7).
4. Engineering methods, skills, tools, and information technology (Course Outcomes 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations.
5. Site visits (campus and actual construction sites).

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment will be made up of the following assessment activities:
   i. Laboratory reports: 10%.
   ii. Assignments (tutorials, quizzes): 20%.
   iii. Tests (at least 2 tests): 20%.
2. End-of-semester examination: 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Budhu, M. (2015). Soil Mechanics Fundamentals, 1st Edition, John Wiley and Sons Ltd.
2. Das, B. M. (2013). Fundamentals of Geotechnical Engineering, 3rd Edition. Chris Carson.
3. Das, B. M. and Sobhan, K. (2018). Principles of Geotechnical Engineering, 9th Edition, Cengage Learning.
4. Knappett, J. A. and Craig, R. F. (2012). Craig's Soil Mechanics, 8th Edition, Spon Press.
5. Sutton, B.H.C. (1986). Solving Problems in Soil Mechanics, Longman Scientific and Technical.
6. Whitlow, R. (2001). Basic Soil Mechanics. 4th Edition, Pearson Prentice Hall.

7. Smith, I. (2014). Smith's Elements of Soil Mechanics. 9th Edition. Wiley-Blackwell.
8. SANS 3001-GR1: 2013. Civil Engineering Test Methods Part GR1: Wet Preparation and Particle Size Analysis, South African Bureau of Standards.
9. SANS 3001-GR2: 2011. Civil Engineering Test Methods Part GR2: Dry Preparation and Dry Particle Size Analysis of Gravels and Sands, South African Bureau of Standards.
10. SANS 3001-GR3: 2014. Civil Engineering Test Methods Part GR3: Particle Size Analysis of Material Smaller than 2 mm (Hydrometer Method), South African Bureau of Standards.
11. SANS 3001-GR10: 2011. Civil Engineering Test Methods Part GR10: Determination of the One-Point Liquid Limit, Plastic Limit, Plasticity Index and Linear Shrinkage, South African Bureau of Standards.
12. SANS 3001-GR20: 2010. Civil Engineering Test Methods Part GR20: Determination of the Moisture Content by Oven-Drying, South African Bureau of Standards.
13. SANS 3001-GR30: 2015. Civil Engineering Test Methods Part GR30: Determination of the Maximum Dry Density and Optimum Moisture Content, South African Bureau of Standards.
14. Head K. H. (2006). Manual of Soil Laboratory Testing. 3rd Edition, Whittles Publishing.

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Module Title:	**TRANSPORTATION ENGINEERING II**
Module Code	I3752VT
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	Field Trips on geometric design
NQF Credits	16
(Co-requisites)	(I3771VU Urban Engineering)
Pre-requisite	I3582IS Statistics for Engineers
Semester Offered	2

Module Purpose:
The purpose of this module is to equip students with an advanced knowledge of transportation engineering crucial to achieving the safe and efficient movement of people and goods.

Overarching Learning Outcomes
Students should be able to plan and determine road routes, road geometric design and road safety, managing travel and design modelling systems, transport economics and ITS.

Specific Learning Outcomes
On completing the module students should be able to:

1. Apply design standards and fundamentals of road engineering to determine routes.
2. Design vertical and horizontal road alignments, cross-sections and intersections.
3. Apply road safety systems and concepts in the design of roads.
4. Apply travel behavioural demand and modelling principles to road design, travel demand management and ITS.
5. Conduct transport economic analysis of transport infrastructures.
6. Apply modern software tools for road design and simulation.

Module Content
Geometric Design of Roads: Road route determination; Human factors and vehicle movement, movement equations; Vertical and horizontal alignment design; Cross-section and intersection design; Parking design; Intersection design; Local and international standards; Road drainage and traffic calming measures. **Road safety:** Road safety audits; Safety standards and their application in transport infrastructure projects; Systems and forgiving road design approaches. **Management:** Travel demand management, traffic and road design management (Traffic Management Systems and Road Management Systems); Introduction to ITS and emerging mobility trends – ITS applications, ITS infrastructure, electric mobility, Autonomous driving, Mobility-as-a-Service (MaaS) and resilience of transportation systems. **Transport Economics:** Evaluation of transport projects; User pricing and payment tools. **Laboratory demonstrations:** computer software/applications (design and simulation); field trip/site visit.

Contribution to Exit Level Outcome
1. Problem Solving (Course Outcomes 1, 2, 3, 4 and 5).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3 and 4).
3. Engineering design (Course Outcomes 2 and 4).
4. Investigations, experiments and data analysis (Course Outcome 3 and 6).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 4 and 6).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Four lecture periods per week for 14 weeks (including guest lectures).
2. Two tutorials and/or one laboratory demonstration per week for 14 weeks.
3. Weekly consultation sessions.
4. Course project at the end of the module.
5. At least one field trip.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
    i. Assignments (tutorial tests, laboratory demonstrations and field reports): 10%.
    ii. Main Tests (at least 3 tests): 30%.
    iii. Course project (oral presentation and report): 20%.
2. End-of-semester examination (1 x 3-hour paper): 40%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain:
1. A minimum Continuous Assessment (CA) mark of 50%.
2. A minimum of 50% in the design project.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 60% Continuous Assessment (CA) and 40% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Garber, N.J. and Hoel, L.A. (2020). Traffic and Highway Engineering, Fifth Edition [SI Edition], Cengage Learning.
2. CSIR Building and Construction Technology. (2005). Guidelines for Human Settlement Planning and Design: The Red Book.
3. Roads Authority of Namibia. (2014). Geometric Design Manual. 1st Edition, Windhoek, Namibia.
4. Road Traffic Management and Cooperation. (2012). South African Road Safety Audit Manual. Pretoria, South Africa. Available at: https://www.nra.co.za/download/145/may-2012/4269/road-safety-audit-manual-may-2012.pdf.
5. Committee of State Road Authorities. (1988). Technical Recommendations for Highways for Geometric Design of Rural Roads, TRH 17. Pretoria, South Africa. Available at: https://www.nra.co.za/download/100/technical-recommendations-for-highways/3151/trh17-1988-geometric-design-of-rural-roads.pdf.

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7.6.4 YEAR 4 OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING

7.6.4.1 YEAR 4 SEMESTER 1

Module Title:	SOCIETY AND THE ENGINEER
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week plus field trip
Credits	8
Assessment	Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: Engineering societies and registration procedure for different/Engineering disciplines. General principles of Engineering ethics: statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. Engineering Council of Namibia (ECN): its establishment and role as a regulating body. Engineering coding and standardisation. Introduction to the study of law: basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. Laws of arbitration. Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. Health and safety at the workplace. Impact of Engineering activity social, economic, cultural, environmental and sustainability.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:

1. Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 4 and 5 (Law), 7 (health and safety), 8)
2. Engineering Professionalism (Course Outcomes 1, 2, 3, 6)

ECN Exit Level Outcome(s) Assessed:

1. ENGINEERING PROFESSIONALISM
   Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

1. Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitutes satisfactory performance?

After consideration of the 3 term papers, 3 tests and 3 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of “Engineering Professionalism” in a manner that is considered: “not satisfactory”, “satisfactory” or “Excellent”. The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group project plus presentation, 2 Tests, 4 assignments/case studies)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Identification and scheduling of project resources, resource allocation, project flow charts, critical path planning and reports evaluation. Managing medium to large scale Engineering projects: inception to completion, appropriate contacts; general conditions of contract for Engineering works. Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. Managing community-based development projects: the implications of information technology and globalization on Engineering works Interdisciplinary team project that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team

Contribution to Exit Level Outcome:

1. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
2. Individual, Team and multi-discipline Working (Course Outcomes 7)
3. Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

1. Individual, team and multidisciplinary working
2. Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments
3. Engineering management
4. Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

1. Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.
2. To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.
3. ECN Exit Level Outcome 8 - INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student’s ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitutes satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of “Individual, Team and Multidisciplinary Working” in a manner that is considered: “not satisfactory”, “satisfactory” or “excellent”. In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - ENGINEERING MANAGEMENT

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student’s knowledge and understanding of

Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitutes satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "Engineering Management" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent". In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**STRUCTURAL ENGINEERING**
Code	TCVS3811
NQF Level	8
Contact Hours	4L + 1T/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) making 30%, presentation (10%) and report (10%); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TCVS3762 Design of Steel and Timber Structures and TCVD3792 Reinforced and Pre-stressed Concrete Design

Content: Relationship between architectural forms and structural systems. Composite design and construction in steel and reinforced concrete. Plastic methods of structural analysis: Beams and frames. Limit analysis for slabs: Yield line analysis and the simple strip method for slabs. Structural analysis and design of buildings: Gravity loads; Lateral loads. Lifts, shafts, and shear walls. Introduction to computational packages: ANSYS, SAP, ETABS, STAD.Pro, etc. Overview of special structures: Design of retaining walls; Water tanks and reservoirs. Modern structural systems. Introduction to industrialized building systems. Layout and topologies for bridges. Drawings of a bridge project. Bridge foundations. Bridge trusses. Suspended bridges.

Learning Outcomes: On completing the course students should be able to:
1. Discuss main features of design of steel and concrete composite members
2. Use plastic methods to design steel beams and frames
3. Analyse building frames subjected to gravity, lateral or gravity and lateral loads
4. Discuss modern structural systems in buildings and the concept of industrialized building systems
5. Compare structures of buildings
6. Interpret various layouts and topologies for bridges and illustrate them with Engineering drawings
7. Apply computational software packages in the analysis and design of structures.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Eng Design (Course Outcome 2, 4, 7)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 5, 6, 7)

ECN Exit Level Outcomes Assessed:

2 APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE

Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies

The assessment will constitute the following:

At least 2 Assignments and at least 2 Tests all making 50%, Examination (1 x 3 hour paper) making 50%.

To pass this course a student should obtain a sub-minimum mark of 50% in the exam and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, mechanics, basic science and civil Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the design modern structural systems, structural analysis and design of buildings, plastic methods to design steel beams and frames as well as various layouts and topologies of bridges; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of civil Engineering science at a fundamental level and in at least one specialist area.

What constitutes satisfactory performance?
After consideration the 3 hour exam paper, the student is expected to obtain a sub- minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily. The Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "Application of Scientific and Engineering Knowlegde" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent".

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.
The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

Module Title:	**ROAD PAVEMENT AND GEOMETRIC DESIGN**
Code	TCVD3871
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week or field trip
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper
Pre-requisite(s)	TCVD3682 Soil Mechanics

Content: Design of Urban and Rural Roads: geometrical design, junctions, traffic calming, capacity, location and design; rural and urban at-grade intersection design; grade separations; interchanges; parking lots and terminals. Pavement Design: Pavement Type, Stress, strain and deflection, Traffic volume and load, Materials for road construction, soil stabilization, structural pavement design, design of surface treatment, gravel roads, and maintenance and rehabilitation. Road Construction Materials: Road construction technology. Drainage: drainage installations for roads.
Learning Outcomes: On completing the course students should be able to:
1. Describe general layouts and geometry of urban and rural roads and pavements
2. Characterize the key attributes of vehicles, operators, and highway systems that affect geometric design
3. Elaborate on the basic parameters and constraints for design of rural and urban alignment, cross section and intersections and apply them in an actual design project.
4. Correlate the behaviour and selection of construction materials to the construction of roads and highways and available methods of soil stabilization
5. Discuss the various drainage systems for roads and highways Apply computational software packages in the analysis and design of structures.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 2, 3, 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3 Eng Design (Course Outcomes 1, 3, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 4)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 5)

Module Title:	**RAILWAYS AND PUBLIC TRANSPORT SYSTEMS**
Code	TCVD3881
NQF Level	8
Contact Hours	3L + 1Tor 1PS/Week or field trip
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper
Pre-requisite(s)	TCVD3682 Soil Mechanics

Content: Overview of the railway transport system. General technical features of railway layouts; geometry of railways; infrastructure for railways. Soil properties; mechanical stabilization of soils for railway lines. Design of Railways: main railway lines; underpasses; overpasses, rail traffic control systems, passenger platforms. Public transport systems. History and role of Public Transportation in Urban Development. Urban Passenger Transport Modes. Vehicle Characteristics and Motion. Highway Transit Modes: Buses and Trolleybuses. Rail Transit Modes: Street Cars, Light Rail, Rapid Transit and Regional Rail. New Concepts and Proposed Modes. Transit System Performance: Capacity, Productivity, Efficiency and Utilization.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Discuss the main features of railway transport systems
2. Elaborate on the infrastructure, general layouts and geometry of railway lines
3. Outline properties and stabilization methods for soils suitable for railway lines
4. Develop basic designs of railway lines, passenger platforms and traffic control
5. Demonstrate basic understating the social and economic benefits of public transportation
6. Perform economic feasibility of different transport modes as a function of passenger demand
7. Apply necessary formulation to have an objective estimate of selecting and sizing the public transportation modes

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2, 3, 4, 7)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 6, 7)
3 Eng Design (Course Outcomes 2, 3, 4, 7)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5, 6, 7)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6, 7)

Module title:	**WASTE WATER AND SOLID WASTE MANAGEMENT**
Code	TCVI3881
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) making 30%, presentation (10%) and report (10%); Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TCVI3622 Infrastructure Planning and Design I
Co-requisite(s)	TCVD3782 Urban Water Systems

Content: Wastewater Management: Available technologies. Theory and basic design of processes for wastewater treatment. Sludge treatment and disposal, process train selection. Linking source water quality to process design: principles, experimental and pilot plant studies, design criteria, parameters for design of treatment processes. Legislation and codes. Rural, semi-urban, domestic and industrial sewerage. Solid Waste Management: Characterization of solid wastes, sources, quantities, characteristics. Solid waste collection and transportation systems, ultimate disposal systems. Design of landfills: site selection, environmental impact assessment of waste disposal. Treatment of solid waste for energy production. Production of biogas from semi-solid waste.

Learning Outcomes: On completing the course students should be able to:

1. Discuss methods and technologies used in wastewater treatment.
2. Identify parameters for design of wastewater treatment, sludge treatment and disposal.
3. Discuss legislation and codes of practice for wastewater treatment.
4. Elaborate the characteristics of solid wastes and techniques for solid waste management.
5. Correlate solid waste disposal systems with the design of landfills.
6. Combine life-cycle assessment and material flow analysis in solid waste management.
7. Appraise solid waste treatment including biogas production from waste.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2, 3, 4, 5, 6, 7)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7)
3 Eng Design (Course Outcomes 3, 4, 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 4, 5, 6)
7 Sustainability and Impact of Eng Activity (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:

9 INDEPENDENT LEARNING ABILITY

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

1. The assessment will constitute the following:
2. At least 2 Assignments and at least 2 Tests making 30%, Presentation (10%) and Report on selected topics in wastewater (10%), all together making 50%.
3. Examination (1 x 3 hour paper) making 50%.

To pass this course a student should obtain a sub-minimum mark of 50% in the exam and also meet the requirement of ECN exit level outcome 9 assessed in the presentation and the submitted, independent study report.

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. This will be assessed through tests, individual assignments, presentations and report writing, set in a way that allows evidence of the student's ability to engage in independent learning through well-developed learning skills showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology as well as need to access, comprehend and apply knowledge acquired outside formal instruction to be evaluated.

What constitutes satisfactory performance?

The lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "Independent Learning Ability" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent". The student is expected to obtain a sub-minimum average continuous assessment mark of 50% before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

Quality Assurance Arrangements

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

7.6.4.2 YEAR 4 SEMESTER 2

Module title:	**RESEARCH PROJECT**
Code	TCVR3892
NQF Level	8
Contact Hours	17.5 hours of Research Work per week (17.5 hours x 16 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation
NQF Credits	30
Assessment:	Continuous 100% Two Seminar Presentations (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TEGR3760 Experimental and Research Methods
Prerequisite	All third year courses

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:

1. Design an Engineering investigation (methodology)
2. Conduct appropriate experiments for an Engineering investigation (data collection including from simulation) taking into consideration ethical issues like: health, safety and the environment
3. Analyse and interpret the experimental data using appropriate tools including information technology
4. Assess, benefits and impacts of the research: ergonomics, social, legal, health, safety, and environmental
5. Communicate research findings effectively, both orally and in writing, with Engineering audiences and the community at large, clearly drawing reasonable conclusions and suggestions for future work
6. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2, 3)
2 Application of Scientific and Eng Knowledge (Course Outcomes 1, 2, 4)
3 Engineering Design (Course Outcomes 1, 2)
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2, 3)
5 Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 2, 3)
6 Professional and Technical Communication (Course Outcome 5)
7 Sustainability and Impact of Engineering Activity (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 1, 4, 6)
9 Independent Learning Ability (Course Outcome 6)
10 Engineering Professionalism (Course Outcome 4)

ECN Exit Level Outcomes Assessed:

4 INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Demonstrate competence to formulate and conduct investigations and experiments.

5 ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Demonstrate competence tom use appropriate Engineering methods, skills and tools, including those based on information technology.

6 PROFESSIONAL AND TECHNICAL COMMUNICATION

Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences the community at large.

Assessment Strategies

Continuous Assessment 100% (Progress report presentation 20%; Final Oral Presentation of Research Report 20%; Final Research Report 60%).

To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 4, 5 and 6 assessed in the final research report in the section dealing with the corresponding outcome.

The assessment for each of the outcomes 4, 5 and 6 shall be as follows:

ECN Exit Level Outcome 4 - INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with Investigations, Experiments and Data Analysis, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Investigations, Experiments and Data Analysis" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent". In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Investigations, Experiments and Data Analysis" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, skills and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent". In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 6 - PROFESSIONAL AND TECHNICAL COMMUNICATION

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final research report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of research report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitutes satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with Professional and Technical Communication, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Professional and Technical Communication" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent". In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Professional and Technical Communication" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	CIVIL ENGINEERING DESIGN PROJECT
Code	TCVD3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of Engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated Engineering drawings or computer source codes consistent with professional Engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:

Identify, analyse and define a convergent/divergent Engineering problem that can be solved using Engineering knowledge and skills

Formulate possible design approaches to the solution of the defined Engineering problem

Perform techno-economic analyses to evaluate alternative solutions and select best solution

Design (procedural and non-procedural), synthesize and optimized a system prototype based on the selected solution using necessary information and applicable Engineering knowledge, skills and tools, showing elements of creativity/innovation

Assess sustainability, benefits and impacts of the design: ergonomics, social, legal, health, safety, and environmental

Develop a design project plan and identify resources required to complete project milestones

Present technical designs accompanied with detailed analysis, calculations, manual and/or prototype/model of the possible solutions(s) or source codes and any other relevant information in an appropriate form

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4, 6)
9 Independent Learning Ability (Course Outcomes 2, 6)
10 Engineering Professionalism (Course Outcomes 4, 7)
11 Engineering Management (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:

1 PROBLEM SOLVING
Identify, formulate, analyze and solve complex engineering problems creatively and innovatively.

3 ENGINEERING DESIGN
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

7 SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY
Demonstrate critical awareness of the sustainability and impact of engineering activity on the social, industrial and physical environment.

Assessment Strategies

Continuous Assessment 100% (Two Seminar Progress report presentations of design 30%; Final Oral Presentation of Design Report 20%; Final Design Report 50%).

To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 1, 3 and 7 assessed as follows:

ECN Exit Level Outcome 1 - Problem Solving

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "not satisfactory", "satisfactory" or "excellent". In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “Problem Solving” in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
If this particular ELO only is missed, the student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.
ECN exit level outcome 3 - Engineering Design

Where and how is this exit outcome assessed?
Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognise and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimisation.

What constitutes satisfactory performance?
After consideration of the section of the final design report that deals with Engineering Design, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “ Engineering Design” in a manner that is considered: “not satisfactory”, “satisfactory” or “excellent”. In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “Engineering Design in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
If this particular ELO only is missed, the student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of Engineer Trainee and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate Engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
2. Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3. Discuss the role of engineers in the management and organization of engineering enterprises
4. Discuss in details the main technical activities undertaken during the attachment

8 CURRICULUM FOR THE DEGREE BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS) – EXTENDED

YEAR 1 OF (32BHCX) BSc IN ELECTRONICS AND COMPUTER ENGINEERING HONOURS – EXTENDED 132 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Electrical, Electronics and Computer I Engineering	13500TI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Electronics and Computer Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Mathematics support I	I3401MS	4	0	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Physics for Engineers Support I	I3421PS	4	0	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Chemistry for Engineers Support	I3441CS	4	0	None
Total credits Core Semester BSc Electronics and Computer Engineering				**44**	
MODULE	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Engineering Mathematics support II	I3402MS	4	0	None
2	Physics for Engineers II	I3582NP	5	12	I3581NP
2	Physics for Engineers Support II	I3422PS	4	0	None
Total credits 2nd Semester BSc Electronics and Computer Engineering				**24**	

YEAR 2 OF (32BHCX) BSc IN ELECTRONICS AND COMPUTER ENGINEERING HONOURS – EXTENDED 136 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Electronics and Computer Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Drawing	I3530ID	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Engineering Economics	I3661IE	6	8	None
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
Total credits 1st Semester BSc Electronics and Computer Engineering				**52**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
2	Materials Science	I3592IS	5	12	None
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM,** I3611IM
2	Fundamentals of Electrical Engineering	I3522EE	5	8	I3511IM
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	I3511IM
Total credits 2nd Semester Electronics and Computer Engineering				**60**	

8.1 CURRICULUM FOR THE DEGREE BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

8.2 DEGREE NAME: BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS) 32BHCI

8.3 AIM

The curriculum for the degree of BSc in Electronics and Computer Engineering (Honours) aims at producing multidiscipline Graduate Engineers with knowledge and skills in electronics and computer Engineering, and who can competently work in the design, production and service of electronics and computer hardware, as well as in the information and communication technology industry, thus providing the potential for further professional training towards the requirements for registration as Professional Engineers. The programme is designed with the objective of meeting the national and regional needs for education in Electronics and Computer Engineering. The programme offers students a complementary and multidisciplinary approach to studying the broad area of Electronics and Computer Engineering through modules covering Engineering Sciences, Mathematical Sciences, Basic Sciences, Computing and Information Technologies.

8.4 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Electrical Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study (semester CORE, **I** and **II)** is common to all Engineering disciplines. In Years 2 to 4 (semesters **III** must do at least two (2) Written to **VIII**), students take discipline-specific modules and a few common modules. There are no taught modules in Semester VIII since this semester is fully dedicated to Research and Design Projects.

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Session. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some assignments and Lab reports, where applicable.

YEAR 1 OF (32BHCI) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING – 164 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Electrical, Electronics	13500EC	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Electronics and Computer Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Drawing	I3530ID	5	16	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Chemistry for Engineers	I3511NC	5	16	None
Total credits 1st Semester BSc Electronics and Computer Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Physics for Engineers II	I3582NP	5	12	(I3521NP)
2	Fundamentals of Electrical Engineering	I3522EE	5	8	(I3511IM)
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	(I3511IM)
Total credits 2nd Semester BSc Electronics and Computer Engineering				**68**	

YEAR 2 OF (32BHCI) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING – 168 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	U3583AL
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Electronics and Computer Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) I3511IM
1	Engineering Economics	I3661IE	6	8	None
1	Computer Programming I	I3691CP	6	12	(I3551CC)
1	Electric Circuit Analysis I	I3681EC	6	12	(I3522EE)
1	Computer Networks	I3621CN	6	8	(I3581CC)
1	Analogue Electronics I	I3691CA	6	12	(I3522EE)
Total credits 1st Semester BSc Electronics and Computer Engineering				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics IV	I3612IM	6	16	(I3611IM) **I3512IM**
2	Computer Programming II	I3692CP	6	12	(I3691CP)
2	Electric Circuit Analysis II	I3692EC	6	12	(I3651EC)
2	Digital Electronics	I3632CD	6	16	(I3522EE)
2	Signals and Systems	I3692CS	6	12	(I3512IM)
2	Measurements and Instrumentation	I3622CI	6	8	(I3522EE)
Total credits 2nd Semester BSc Electronics and Computer Engineering				**76**	

YEAR 3 OF (32BHCI) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING – 136 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Microprocessor Systems	I3721CM	7	8	**(I3632CD)**
1	Machine Learning	I3791CM	7	12	(I3611IM)
1	Applied Electromagnetics	I3781CE	7	12	(I3582NP)
1	Analogue Electronics II	I3781CA	7	12	**(I3691CA)**
1	Electronic Product Development	I3761CD	7	8	I3781CA
1	Analogue and Digital Communication	I3711CA	7	16	(I3692CS), (I3582IS)
Total credits 1st Semester BSc Electronics and Computer Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Technical Writing	I3762VW	7	8	U3683AL
2	Microcontroller Architecture and Programming	I3742CM	7	8	(I3721CM)
2	RF and Microwave Engineering	I3782CM	7	12	(I3781CE)
2	Database Systems	(I3791CD)	7	12	**(I3692CP)**
2	Operating Systems	I3792CO	7	12	**(I3691CP)**
2	Control Engineering	I3832EC	8	16	(I3611IM)
Total credits 2nd Semester BSc Electronics and Computer Engineering				**64**	

YEAR 4 OF (19BCEE) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3742
1	Project Management	EGM3881	8	12	**TEGT3761**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Digital Signal Processing	TCEE3831	8	16	**TTCE3692**
1	Embedded Systems Design II	TETD3831	8	16	**TETD3792**
1	Wireless Communication	TCEW3891	8	12	**TTCE3741** TTCD3792
Total credits 1st Semester BSc Electronics and Computer Engineering				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Research Project	TCER3892	8	30	All 3rd Year Modules
2	Design Project	TCEE3890	8	34	All 3rd Year Modules
1 or 2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total credits 2nd Semester BSc Electronics and Computer Engineering				**64**	

TOTAL CREDITS FOR THE BSc IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS) **608**

8.5 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

8.5.1 YEAR 1 OF (32BHCI) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING

8.5.1.1 YEAR 1 SEMESTER CORE

Module Title:	**SKILLS PORTFOLIO**
Module Code	U3403FS
NQF Level	5
Notional Hours	N/A
Contact hours	N/A
Additional learning requirements	None
NQF Credits	0
Prerequisite	None
Semester Offered	Core
Module Coordinator and Contact Details	-

Module Purpose
The purpose of this module is to determine, develop and maintain individual students' academic motivation, needs and strengths for effective learning ensuring academic success.
Overarching Learning Outcome
Apply skills relevant to their academic journey at the University in terms of successful attainment of professional and personal goals.
Specific Learning Outcomes
On completing the module students should be able to:
1. Apply motivational theories to demonstrate positive attitudes in their professional and academic life.
2. Identify and manage needs and factors that may negatively impact their academic work including the design of action plans to motivate and guide them.
3. Identify and make use of the different learning styles to promote learning in a more efficient manner using various study methods and skills.
4. Manage time effectively
5. Design and make use of various test taking and examination preparation strategies.
6. Identify and use tools to improve and maintain Mental Health and wellbeing.
7. Apply the dynamics of interpersonal communication.
8. Manage their finances.
9. Identify violence as a social problem in the Namibian context to manage and prevent the occurrence thereof in their life.
10. Recognize the importance of skills training and upgrading in career planning and development to improve their classroom experiences.
11. Create a career plan, set clear, realistic and attainable career goals and engage in activities to enhance their CVs.

Module Content
UNIT 1: Academic Planning and Goal Setting
Individual Needs and Values; Steps in Reaching a Personal Vision; Proactive Approach Towards Learning; Self-Regulated Learning; Personal and Academic Goal Setting; Receptiveness to Learning; Exploring Self-Development and Self- Awareness.
UNIT 2: Attitude and Motivation
Understanding Motivation; Personal Attitudes, Behaviours and Interests; Self-Reflective Process; Approaches to Dealing with Negative Factors; Class Attendance and Participation; Procrastination; Self-Reliance; Discipline; Accountability; Healthy Habits.
UNIT 3: Learning styles
Understanding Personal Approaches to Learning; Dynamics of The Learning Process; Learning Styles and Strategies.
UNIT 4: Study Methods and Skills
Study Habits and Strategies; Learning Styles and Techniques; Effective Study Methods and Skills; Note Taking; Memory and Reading Skills; Critical Thinking.
UNIT 5: Time Management
Effective Time Management; Planning; Decision-making; Prioritization; Setting Boundaries; Time for Self – care; Procrastination.
UNIT 6: Assessment Preparation
In class exercise; Test and Examination preparation; Organizing academic workload; Setting daily study goals; Staying physically active; Study groups.
UNIT 7: Mental well-being
Understanding mental health; Signs and indicators of poor mental health; commonly experienced mental health challenges; psychosocial stressors; Seeking professional help; Coping strategies.
UNIT 8: Interpersonal Communication
Effective Communication Skills; Verbal and Non-Verbal Communication; Listening Skills; Problem Solving; Assertiveness; Negotiation Skills; Practicing Empathy in Communication; Self-Confidence; Receptiveness to Feedback; Building Trust; Teamwork; Leadership; Public Speaking Skills.
UNIT 9: Financial matters and management
Financial Literacy; Budgeting; Available Finance Options and Assistance; Managing Financial Resources.
UNIT 10: Student Violence

Types of Violence; Individual Roles in Violence; Myths, Forms; Consequences of Violence; Prevention Measures; Seeking for Help.
UNIT 11: Career Planning and Development
Defining and Selecting Career Goals; Career Exploring Different Strategies; Soft Skills Training.
Learning and Teaching Strategies/Activities
The course will be facilitated through, but not limited to, the following learning activities:
- Online teaching: Self-study on theoretical foundations and concepts of the Skills Portfolio module
- Discussion forums (peer review): reflecting on own contexts, experiences and sharing perspectives
- Inquiry: carrying out research to explore and understand scenarios and problems relating to self
- Portfolio writing: writing reflective learning journals related to the Skills Portfolio module

Student Assessment Strategies
- 100% continuous assessment
- Reflective journal on each unit (portfolio)

Learning and Teaching Enhancement Strategies
- Student – lecturer evaluations, conducted twice a year
- Moderation of assessment tools

Learning Resources
[1] Feldman, R. S. and Chick, S. (2005) Power learning: Strategies for Success in Higher Education and Life. Toronto: Mc Graw-Hill Ryerson Limited.
[2] Light, R. J. (2001). Making the most out of College: Students Speak their Minds. Cambridge, Mass: Harvard University Press.
[3] Tracy, E. (2002). The student's guide to exam success. Philadelphia: Open University Press
[4] Toft, D. (2005). Mastering Student Guide to Academic Success. Boston: Houghton Mifflin Company.

Issue Date: September 2023
Next Revision: September 2028

Module Title: ACADEMIC LITERACY I (First year students with NSSCO A, B, C and NSSAS a, b, c, d in English 1st and 2nd language).	
Module Code	U3583AL
NQF Level	5
Notional Hours	80
Contact hours	Core Semester: 2 Lectures + 1 Tutorial / Week.
Semester	1: 2 Lectures / Week.
Semester	2: 2 Lectures / Week.
Additional learning requirements	None
NQF Credits	8
(Co-requisites)/ Pre-requisite	(None)
Semester Offered	0, 1 and 2

Module Purpose
The purpose of this module is to introduce students to academic literacy practices in a university setting.
Overarching Learning Outcome
Students should be able to apply the skills learnt from this module to enable them to cope with academic reading, listening, speaking and writing demands at the university level.
Specific Learning Outcomes
1. On completing the module students should be able to:
2. Compose an academic essay.
3. Apply appropriate study skills in academic meaning systems.
4. Practice academic integrity to avoid plagiarism.
5. Apply features of academic writing and other academic conventions in own writing.
6. Use patterns of text organisation to academic writing.
7. Edit and proofread own and others' work.
8. Summarise main ideas or relevant parts of texts.
9. Read and critique academic texts.
10. Apply appropriate reading comprehension strategies.
11. Illustrate the correct use of academic register in speaking and writing.
12. Use information from listening materials to complete writing and speaking tasks.
13. Participate in oral presentations on academic subjects using technology.

Module Content
The module will cover study skills, reading, listening, speaking, writing, referencing, language usage and text organisation.
Contribution to Exit Level Outcome
Professional and technical communication (Course Outcomes 1 - 12).
Learning and Teaching Strategies/Activities
1. The module will be facilitated through the following teaching and learning activities:
2. Blended Lectures: comprising face-to-face and online.

3. Face-to-face consultations.
4. Tutorials.
5. Oral presentations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA).
Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

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MODULE TITLE:	**INTRODUCTION TO ELECTRICAL, ELECTRONICS AND COMPUTER ENGINEERING**
Module Code	I3500EC
NQF Level	5
Notional Hours	60
NQF Credits	6
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial per week
Additional learning requirements	Group work and Project
Semester Offered	0

Module Purpose
The purpose of this module is to enable the students understand the fundamentals of the engineering profession and acquire basic engineering problem solving skills.

Overarching Learning Outcome
Ensure that students are conversant with engineering roles, responsibilities and methods in different industries.
Specific Learning Outcomes
On completing the module students should be able to:
1. Describe Electrical, Electronics and Computer Engineering by definition.
2. Describe a few practical experiments available that can be performed in our laboratory.
3. Explain the steps involved in engineering problem solving.
4. Identify general steps involved in engineering design and communication.
5. Describe and explain basic important materials needed in Electrical, Electronics and Computer Engineering.
6. Describe the role of nanoelectronics in the context of nanotechnology as employed in improvement of electronic components and systems with respect to size, power consumption etc.

Module Content
Introduction to Electrical, Electronics and Computer Engineering: The definition of Electrical, Electronics and Computer Engineering. Practical Orientation of what is expected of EEandC engineering student: The module provides an integrated introduction to electrical engineering, electronics and computer science, taught using substantial laboratory experiments.
Introduction to Engineering Design and Problem Solving: Types of Problems, Problem Solving Approach and Skills, The Design process, Brainstorming, Criteria and Evaluation, Sustainability**. Engineering Communication and Teamwork Skills:** The Importance of Communication Skills in Engineering, Basic Presentation skills, Basic Technical Writing Skills. Principles of Teamwork, Characteristics of an Effective Team Member. **Basic important engineering materials:** Exciting and important basic material from electrical engineering, electronics and computer engineering, including modern software engineering, linear systems analysis, electronic circuits, and decision-making.
Contribution to Exit Level Outcome:
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5).
- 5 Eng Methods, Skills, and Tools including IT (Course Outcomes5).

Learning and Teaching Strategies/Activities
- Two lecture periods per week for 6 weeks

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities.
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
i. Assignments, Project and Presentation: 60%.
ii. Tests (at least 2 tests): 40%.

Criteria for qualifying for the Examination:
No Examination.

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
2. Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

Issue Date: September 2023
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Module Title:	**DIGITAL LITERACY**
Module Code	U3583DD
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial/ week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Prerequisite	None
Semester Offered	Core
Module coordinator and Contact Details	Mr Erkkie Haipinge, ehaipinge@unam.na, Tel: +264 612064906

Module Purpose

The purpose of this module is to equip students with competencies to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment and entrepreneurship.

Overarching Learning Outcome

Apply digital literacy skills for effective learning across the curriculum and for successful attainment of their personal and professional goals.

Specific Learning Outcomes
On completing the module students should be able to:

9. Use ICT-based devices, basic productivity software, a web browser and search engines, email and other digital communication services
10. Carry out digital productivity activities such as download and upload materials to the internet or cloud or institutional shared spaces, and use digital tools to fit learning
11. Discover, organise and manage relevant digital information using relevant search engines, indexes or tag clouds, and evaluate digital information trustworthiness and relevance
12. Access and make sense of messages in a range of digital media, and appreciate how digital messages are designed
13. Design new digital materials, make decisions and solve problems and adopt new digital tools for learning
14. Participate in a range of digital communication media, work in digital teams and projects, and participate in a range of online networks
15. Identify, choose and participate in digital learning opportunities
16. Manage and maintain digital profiles suitable for different networks that consider digital reputation

Module Content
Digital Proficiency: ICT-based devices (laptops, tablets, smartphones, desktop computers, digital instruments and equipment); a mouse, keyboard, touch screen, voice control and other forms of input; screens, audio headsets and other forms of output; digital capture devices; University digital learning systems and a range of personal digital services such as social media, cloud storage

services, sharing sites **Digital Productivity:** Basic productivity software (text editing, presentation, spreadsheets, image editing); email and other digital communication services; Internet or cloud or institutional shared spaces for organising, managing and backing up digital files; software/apps and services suitable for learning-related tasks; digital tools fit learning and managing learning time. **Information Literacy:** search engines, indexes or tag clouds; wikis, blog posts, scholarly journals, e-books and the open web; file spaces and folders, bookmarks, reference management software and tagging; copyright, and digital citizenship issues. **Data and Media Literacy:** Digital data using spreadsheets and other media; data security and privacy; digital media messages – text, graphics, video, animation, audio and multimedia. **Digital Creation and Innovation:** digital materials (video, audio, stories, presentations, infographics); new digital tools for learning in digital settings. **Digital Communication, Collaboration and Participation**: digital communication; differences between media, norms of communicating in different spaces; false or damaging digital communications; collaborative tools and online environments; online networks. **Digital Learning and Development:** digital learning opportunities; digital learning resources; digital tools/materials for organising, planning and reflecting on learning (mind-mapping, note-taking, e-portfolio/ learning journal/ blog). **Digital Identity and Wellbeing:** online profiles for different networks (personal, professional, academic); digital reputation; managing personal data and privacy; digital CV or portfolio of work; digital technologies for personal development; online etiquette; wellbeing and safety online; internet addiction; cyberbullying and other damaging online behaviour.

Contribution to Exit Level Outcome:

- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4 and 6)

Learning and Teaching Strategies/Activities

- **Lectures**: presentation on concepts and other theoretical foundations of Digital Literacy
- **Discussion forums:** reflecting on own contexts and sharing perspectives
- **Collaborative learning:** group learning and activities carried as part of projects
- **Inquiry:** carrying out of research to explore and understand scenarios and problems
- **Projects:** carry out projects on digital literacy
- **Presentations and demonstrations:** presentation of outcomes of projects (products, processes, impact)
- **Portfolio writing:** writing reflective learning journals related to digital literacy

Student Assessment Strategies

- **Collaborative assessment tasks**
  - Digital productivity: *cloud based collaborative digital media creation using cloud platforms*
  - Project: Digital communication, collaboration and participation/ Digital Wellbeing
- **Individual assessment tasks**
  - Assignment: information literacy assignment
  - Test x 2
- **Practical**
  - Digital proficiency
  - Data and Media literacy
- **No written examination**

Learning and Teaching Enhancement Strategies

- **Student feedback:** feedback from students using focused feedback instruments
- **Peer feedback:** student feedback on peer evaluation of each other's collaboration, participation and contribution
- **Self-evaluation:** quizzes and students' reflective journal/ portfolio on their own learning
- **Learning analytics:** use of learning management tools on student participation and online learning activities, and analyse assessment performance

Prescribed Learning Resources

Textbook

[1] Schwartz, M., Bali, M., Blocksidge, K., Brown, C., Caines, A., Dermody, K., and Peters, J. (2020). *Digital Citizenship Toolkit*. Retrieved from https://pressbooks.library.ryerson.ca/digcit/ (online version); https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/3/Digital-Citizenship-Toolkit-1598899274.pdf (PDF version) https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/2/Digital-Citizenship-Toolkit-1598899308.epub (eBook)

Digital Resources

[1] JISC. (2019). Jisc digital capabilities framework: The six elements defined.
Retrieved from https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf
[2] JISC. (2017). Digital capabilities framework.
Retrieved from https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF
[3] Joint Research Centre (European Commission). (2019). *The Digital Competence Framework 2.0*.
Retrieved from https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework
[4] Carretero, S., Vuorikari, R., and Punie, Y. (2017). The digital competence framework for citizens.
Publications Office of the European Union. Retrieved from http://svwo.be/sites/default/files/DigComp%202.1.pdf

Course resources (videos and SCORM package)

[1] Microsoft. (2021). *Microsoft digital literacy courses and resources (videos and SCORM packages)*.
Available at https://www.microsoft.com/en-us/digital-literacy
[2] Microsoft. (2021). *Microsoft digital literacy: Teaching guides*.
Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWBupo
[3] OER Commons. (2021). *Digital Literacy (learning objects)*. Retrieved https://www.oercommons.org/curated-collections/347

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Module Title:	NATIONAL AND GLOBAL CITIZENSHIP
Module Code	U3420CN
NQF Level	5
Notional Hours	20
Contact hours	Up to 1 contact lecture period per week for 6 Weeks
Mode of Delivery	Blended: Face to face and Online
Additional learning requirements	Each student will be required to work on a personal project which will include a site visit
NQF Credits	2
(Co-requisites) /Prerequisite	None (University Core Module)
Semester Offered	Core Semester
Scheduled Review Date	TBC
Module coordinator and Contact Details	Dr Romanus Shivoro, rshivoro@unam.na ; Ext. 3378

Module Purpose

The purpose of this Module is to equip UNAM students with knowledge to understand the interconnectedness of local and global issues. Students will become acquainted with perspectives on, global citizenship, globalization and civic engagement. The module will enable students to reflect on issues affecting their communities and the world by providing a platform where students can meet and learn from one another and from external sources of information. It will guide students to determine how they can contribute to bring positive changes in their communities in relation to the Sustainable Development Goals. Furthermore, it will provide knowledge and understanding of cultural diversity and intercultural communication to enable students to become thoughtful stewards in a globalized world.

Overarching Learning Outcome

Students demonstrate understanding of global citizenship and initiate action towards the betterment of local, national and global conditions, as informed and responsible citizens with a civic duty in their personal and professional lives.

Specific Learning Outcomes

On completing the module students should be able to:

1. Explain the importance of the National Constitution;
2. Express understanding of National and Global Citizenship;
3. Participate in community engagement activities as part of community upliftment;
4. Express understanding of globalization;
5. Apply intercultural communication skills; and
6. Interpret SDGs to initiate personal action towards contribution of their achievement.

Module Content

UNIT 1: Constitution and its Importance
What is a constitution; Functions of a constitution; What it contains; Constitution and democracy
UNIT 2: Global Citizenship
The meaning of global citizenship; Importance of global awareness; World issues of concern to global citizens.
UNIT 3: Civic Engagement
What do we mean by civic engagement; Dimensions of civic engagement; Indicators of civic engagement;
Promoting civic engagement.
UNIT 4: Globalization
Understanding globalization; Cultural construction of neoliberal globalization; Major players; Major domains;
Major Issues; Futures of Globalization
UNIT 5: Intercultural Communication
Dealing with difference; Levels of culture; Stereotypes and generalizations; Intercultural communication Processes
UNIT 6: Sustainable Development Goals and individual action
Introduction to SDGs; Contributing to achievement of SDGs through action

Learning and Teaching Strategies/Activities

Student learning in this module will be supported by provision of subject knowledge; engaging students in class discussions, and individual awareness and action portfolios. It will expose students to real life situation through formal lectures, guest lectures, experiential activities such as engaging local civic organizations; Students will engage in active and participatory learning in which they generate ideas and share their knowledge on a topic. Material will include journal articles, videos, PowerPoint presentations, as well as handouts for students' reflection.

Student Assessment Strategies

Continuous assessment of 100% - Assessment will be done by completing online pop-up quizzes; and developing their online portfolios of personal action as response to tasks assigned in class.

Learning and Teaching Enhancement Strategies

1. Strategies will include: Continuous Module Review, and Lecturer/student evaluations.
2. Student progress will be monitored by observing class participation during live lectures, and submission of feedback material. Including online portfolios.

Recommended Learning Resources

1. Adler, R.P and Goggin, J. (2005). What do we mean by Civic Engagement? A Journal of Transformative Education. 3 (3) 236 – 253
2. Bennett, M.J (1998). Intercultural Communication: A current Perspective. In Milton J. Bennett (Ed.) Basic Concepts of Intercultural Communication: Selected Readings. Yarmouth: ME Intercultural Press
3. Green, M. (2012). Global Citizenship: What are we talking about and why does it matter. NAFSA Association of International Education
4. International IDEA (2014). What is a Constitution? Principles and Concepts. Constitution-building Primers.
5. Perception Change Project. 170 Daily Actions to Transform our World. United Nations Office in Geneva
6. Ritzer, G. (Ed.)(2007). The Blackwell Companion to Globalization. Blackwell Publishing: USA
7. United Nations. Transforming our World: the 2030 Agenda for Sustainable Development. UNDP

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8.5.1.2 YEAR 1 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS I
Module Code	I3511IM
NQF Level	5
Notional Hours	120
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome
Students should be able to apply the basic principles of engineering mathematics to determine the equations of lines and planes in Cartesian and polar coordinates, analyse matrices, sequences, series and functions and to solve differential equations.

Specific Learning Outcomes
1. **On completing the module students should be able to:**
2. **Solve basic mathematics and engineering problems using vectors and matrices.**
3. **Calculate eigenvalues and eigenvectors of matrices and relate them to engineering solutions.**
4. **Transform functions (Cartesian/polar), sketch and name some polar graphs.**
5. **Use various mathematical functions and apply them to engineering.**
6. **Apply trigonometry in solving mathematical and engineering problems.**
7. **Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.**
8. **Manipulate sequence and series of numbers.**
9. **Define, interpret complex numbers and to perform elementary complex numbers algebra.**

Module Content
Lines and Planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersection of lines and planes. Matrix Algebra: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms. Sequences and series of numbers: Introduction to sequences and series. Absolutely convergent series, tests for convergence. Power series. Radius of convergence and interval of convergence. Functions: Limits and continuity of functions: limit at a point, improper limit and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions. Polar coordinates/Graphs: Definition of polar coordinates, relate Cartesian and polar coordinates, sketch and name different types of polar graphs. Differentiation: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimisation, related rates. Implicit differentiation, the chain rule, differentiation of algebraic functions. Integration: Anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, basic integration techniques, integration of trigonometric functions. Introduction to complex numbers: Definition of complex numbers and the complex plane, complex number representation on argand diagrams, complex number algebra. Demoivre's theorem.

Contribution to Exit Level Outcomes
1. Problem solving (Course Outcomes 1, 2, 3, 5, 6, 7 and 8).
2. Application of scientific and engineering knowledge (Course Outcomes 2, 3, 4, 5 and 6).
3. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities
1. The module will be facilitated through the following teaching and learning activities:
2. Lectures.
3. Tutorials.
4. Face-to-face consultations.

Student Assessment Strategies
6. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination.
7. The Continuous Assessment will be made up of the following assessment activities:
8. Tests (at least 2): 30%.
9. Assignments (tutorials, quizzes): 20%.
10. Examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
- To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

The evaluation and improvement of the quality and standards of teaching and learning will be by:

1. Internal and/or external moderation of examination scripts and marked examination scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Bird, J. (2017). Engineering Mathematics. 8th Edition, Routledge.
2. Stroud, K.A., and Booth, D.J. (2013). Engineering Mathematics. 5th Edition. Macmillan International Higher Education.
3. Stewart, J., Clegg, D.K., and Watson, S. (2020). Calculus: early transcendentals 6th Edition. Cengage Learning.
4. Stewart, J., Redlin, L., and Watson, S. (2015). Precalculus: Mathematics for calculus 7th Edition. Cengage Learning.

Issue Date: September 2023
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Module Title:	**ENGINEERING MATHEMATICS SUPPORT I**
Module Code	I3401MS
NQF level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Prerequisite	None
Semester Offered:	1

Module Purpose

The purpose of this module is to consolidate school curriculum computation skills whilst creating a wider context in which students can contextualise mathematical knowledge.

Overarching Learning Outcome

Consolidate numeracy and problem solution skills in a wide range of mathematics fundamentals.

Specific Learning Outcomes

Upon completion of this module, a student should be able to

1. Explain and conduct deductive arguments involving sets and relations.
2. Identify and correlate intervals.
3. Solve systems of linear equations methodically.
4. Handle matrix calculus.
5. Identify types of real valued functions.
6. Compute the domain and range of a real valued function.
7. Assess properties of real-valued functions.

Module Content:

Number system: Natural, integers, rational, irrational, real and complex numbers. Sets: cardinal number, operations on a set (equality, intersection, union, relative compliment, de Morgan’s law, power set, application of cardinality (inclusion-exclusion formula), Cartesian products, ordered pairs and relations), intervals and inequalities. Solving equation and inequalities: linear and quadratic equation, inequalities involving two variables. System of linear equations: Matrices and matrices operations (addition, subtraction, multiplication, associativity, distrutivity, determinant, invertible, Gaussian row and column operations, rank, solution to system of linear equations). Real-valued function: definition, relation, domain and range, injective, bijective, inverse, odd and even, piecewise defined, graphs. Coordinates system: polar, polar graph, cylindrical, cylindrical graph.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

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Module Title:	**ENGINEERING DRAWING**
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 L + 1 P and/or 1T
Additional learning requirements	None
NQF Credits	16
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1 and 2

Module Purpose
The purpose of this module is to enable students visualise, create and interpret engineering drawings in two and three dimensions to meet the industrial demands of modern technology by the application of geometrical and engineering methods and make detail drawings with full dimensions in line with ISO standards.

Overarching Learning Outcome
Students should be able to apply the basic skills of technical drawing to represent engineering objects, section technical objects and to produce assembly drawings.

Specific Learning Outcomes
On completing the module students should be able to:
1. Use standard equipment for technical drawing.
2. Sketch engineering components free hand or with the aid of drawing equipment.
3. Present engineering components as drawings in orthographic and isometric projections.
4. Use sections, interpenetration, and development to produce clear engineering drawings.
5. Produce parts and assembly drawings of various engineering components.

Module Content
Foundations of representing technical bodies: drawing equipment, drawing formats, types of lines, construction geometry, simplified representations, scales, lettering, title block, elaboration of part drawings, Principle of orthographic projection, sectioning, dimensioning. Isometric and oblique representations. Sections, Interpenetrations, and developments: cones, cylinders, pyramids. Free-hand techniques: Introduction to free-hand sketching of machine parts. Assembly drawing.

Contribution to Exit Level Outcome
1. Engineering design (Course Outcomes 4 and 5).
2. Engineering methods, skills, and tools, including information technology (Course Outcomes 1 and 3).
3. Professional and technical communication (Course Outcomes 2, 3, 4 and 5).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Tests (at least 2): 60%.
2. Assignments (at least 4): 40%.

Criteria for passing the module
- To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of test papers and scripts.
2. Peer review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Parker, M.A., and Pickup, F. (1992). Engineering drawing with worked examples. Vol. 1, 3rd Edition.
2. Simmons, C.H., Maguire, D.E., and Phelps, N. (2020). Manual of engineering drawing: British and International Standards. 5th Edition. Butterworth-Heinemann.
3. Yarwood, A. (1994). Technical Drawing with Design. Macmillan.
4. Madsen, D.A. and Madsen, D.P. (2016). Engineering drawing and design. Cengage Learning.

Issue Date: September 2023
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Module Title:	**PHYSICS A FOR ENGINEERS I**
Module Code	I3581NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	12
(Co-requisites) / Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of Physics as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to prepare students to apply fundamental Physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:
1. Do unit conversions
2. Solve problems regarding one and two dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gasses.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.
10. Demonstrate abilities to communicate ideas and facts using equations, graphs and principles.

Module content
Measurements and Units: Instruments and Uncertainty, Standards and Units. Kinematics: One Dimensional Motion, Vectors, Projectile Motion, Circular Motion, Relative Motion. Dynamics: Newton's Laws of Motion, Newton's Law of Gravitation, Free-Body Diagrams, Friction. Work, Energy and Power. Momentum: Collisions, Impulse, Centre of Mass. Rotational Dynamics: Rolling Motion, Torque, Rotational Inertia and Energy, Angular Momentum. Planetary Motion: Kepler's Laws of Planetary Motion. Elasticity: Hooke's Law. Fluids: Pressure, Buoyancy, Fluid Dynamics: Flow Rates, Equation of Continuity and Bernoulli's Equation. Heat and Thermodynamics: Thermal Expansion, Ideal Gas, Specific Heat, Heat Capacity, Latent Heat, Calorimetry, Heat Transfer: Laws of Thermodynamics, Entropy, Enthalpy, Gibbs Free Energy.
Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching methods
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment
1. Students will be assessed through continuous assessments activities and a final examination.
2. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes, lab and field reports): 20%
b. Tests (At least 2 tests): 30%
c. The final examination (1 x 3-hour paper): 50%

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources
1. Young, H. D. and Freedman, R. A. (2020) University Physics with Modern Physics in SI Units, Pearson Education Limited, Harlow, United Kingdom.
2. Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
3. Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT I**
Module Code	I3421PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	Entry requirements
Semester Offered	1

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course.

Overarching Learning Outcome
Solve problems, in single-particle mechanics, Newtonian gravity, fluids, and heat.

Specific Learning outcomes
On completing the module students should be able to:
1. Employ units, do unit conversions, express uncertainties use significant figures, use vectors in 2 dimensions.
2. Solve basic problems regarding one and two-dimensional kinematics.
3. Apply Newton's laws of motion and energy principles to a variety of basic problems in dynamics.
4. Discuss and solve simple problems in rotational kinematics and dynamics.
5. Discuss the principles of waves and sound.
6. Solve basic problems in statics, Newtonian gravitation, fluids, heat, and gasses.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Measurement and estimation; Kinematics in 1D; Kinematics in 2D; Vectors; Dynamics/Newton's Laws; Circular motion; Gravitation; Work and Energy; Linear Momentum; Rotational Motion; Static Equilibrium; Fluids; Oscillation and Waves; Sound; Temperature and Kinetic Theory; Heat; The Laws of Thermodynamics.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
    b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

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Next Revision: September 2028

Module Title:	**COMPUTING FUNDAMENTALS**
Module Code	I3581CC
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1

Module Purpose

This course aims to introduce students to general computer literacy, the basic principles of problem-solving using computers, advanced Microsoft Excel skills for data analysis, computer programme planning, basic data communication and computer networks and the basic skills on modern web development tools. It also introduces students to the basic tools and environments needed for machine learning programming.

Overarching Learning Outcome

Students should be able to discuss basic computer working environments, modern web development tools, develop a simple computer-based problem-solving plan and solve engineering problems using advanced spreadsheets and related tools.

Specific Learning Outcomes

1. On completing the module students should be able to:
2. Relate with computers under the Windows and Linux operating environment for information processing and presentation.
3. Recall basic features of common computer hardware architectures.
4. List the basic communication architecture of a computer.
5. Show algorithms for solving basic problems using flowcharts and pseudocode.
6. Recall advanced spreadsheet tools and functions.
7. Match basic web applications using modern web development tools and frameworks to simple real-life problems.
8. Define basic concepts of networking.

Module Content

Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored programme concept. Von-Neumann architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. Computer Arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types). Introduction of computer operating environment Windows and UNIX based systems. Computer Architecture: The design and structure of a computer. Information Processing and Data Analysis tools: Equations and Formulae Creation, Diagram Creation and Editing, PowerPoint Presentations Creation Advanced Spreadsheets Skills. Computer Programme Planning. Flowcharts and Pseudocode Introduction to Computer Networking: Basics of Communication Systems and Computer Networks. Web Developments: Front-End Web Development, Web Page Styling and Website logic development with scripting languages such as JavaScript. Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Introduction to Data Science Tools: Installation and basic use of Anaconda and Jupyter Notebooks.

Contribution to Exit Level Outcome
1. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 5 and 6).
2. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5 and 6).

Learning and Teaching Strategies/Activities
1. The module will be facilitated through the following teaching and learning activities:
2. Lectures.
3. Tutorials.
4. Group mini project.
5. Face-to-face consultations wherever necessary.
6. A special hands-on demonstration that may involve an expert from outside.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessment (CA) as follows:
2. Assignments (tutorials, quizzes, reports, practical assignments): 20%.
3. Tests (at least 2 tests): 50%.
4. Semester mini project (prototype oral presentation and development report): 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Prescribed Textbook(s).
2. Online links.
3. Lecture notes and videos.
4. On-site and/or online video laboratory demonstrations.

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Module Title:	**CHEMISTRY FOR ENGINEERS**
Module Code	I3511NC
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	16
(Co-requisites) / Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of chemistry as they relate to engineering.

Overarching Learning Outcome
The overarching outcome of this module is to equip students with firm grasp of fundamental chemistry principles which are applicable in engineering industries.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the fundamental techniques used for chemical analysis in industrial processes.
2. Explain the basic concept of batteries and fuel cells and their applications.
3. Describe the processing of high polymers and their applications.
4. Explain different methods for water analysis and purification.
5. Describe different ways of dealing with pollution and managing solid waste.

Module Content
Spectroscopic techniques and Applications: Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet and Visible and Raman spectroscopy. **Electrochemistry:** Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system. **Battery Technology;** Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life. Basic requirements for commercial batteries. Construction, working and applications of: Zn-Ag_2O, Ni-Cd, Zn-air and Lithium-ion battery. Fuel Cells-

Differences between battery and a fuel cell, Classification of fuel cells - based on type of fuel, electrolyte and temperature. Construction, working and applications of solid oxide fuel cell. **Water Analysis;** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method), Alkalinity -determination, Determination of dissolved oxygen, Determination of chemical oxygen demand, Boiler scales-formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis. **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methods). Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapor deposition. **Polymers;** Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (BunaS, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. **Environmental Chemistry**; Air Pollution, Water Pollution, Radioactive Pollution, Solid Waste Management, Green Chemistry.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching methods

The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
3. Assignments (tutorials, quizzes, lab and field reports): 20%
4. Tests (At least 2 tests): 30%
5. The final examination (1 x 3-hour paper) 50%

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources
1. Mukhopadhyay, Raghupati, and Sriparna Datta. Engineering chemistry. New Age International Pvt Limited, Publishers, 2008.
2. Agarwal, Shikha. Engineering chemistry: Fundamentals and applications. Cambridge University Press, 2019.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS SUPPORT**
Module Code	I3441CS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	None
Semester Offered	1

Module Purpose

To introduce the student to general chemistry, lay the foundation of basic facts necessary for further studies in Chemistry and acquaint students with safety rules and regulations in a chemical laboratory.

Overarching Learning Outcome

Apply and interpret knowledge on basic facts in Chemistry for further studies.

Specific Learning outcomes

On completing the module students should be able to:
1. Use scientific notation and significant figures when doing all calculations
2. Define and explain the mass number (A), atomic number (Z) and isotope and also state the symbol for an isotope given its mass number and atomic number
3. Define the terms molar mass, relative molecular mass (Mr) and relative atomic mass (Ar) and carry out calculations involving these

4. Define and explain the terms empirical formula and molecular formula and also to determine the empirical and molecular formulae of a given compound
5. Use balanced chemical equations to obtain information about the amounts of reactants and products
6. Prepare dilute solutions from concentrated stock solutions and solve solution stoichiometry problems
7. Describe and explain data from experiments to distinguish between strong and weak acids and bases
8. Differentiate between oxidation and reduction reactions and balance redox reactions by the half-reaction method (acid and basic medium)
9. Apply quantum theory to predict the electron configuration of elements and explain the variation of properties across the periodic table
10. Explain the structure and bonding in molecules and ions and draw their Lewis structures
11. Apply Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) to describe molecular geometry as well as physical and chemical properties of some compounds

Module Content
Introduction: Matter, Measurement and Molecules; Stoichiometry: Calculations with Chemical Formulae and Equations; Aqueous Reactions and Solutions Stoichiometry; Electronic Structure of Atoms; Periodic Properties of the Elements and Relationships Among Elements; Basic Concepts of Chemical Bonding; Intermolecular Forces; Basic Molecular Geometry and Bonding Theories; Gases.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Brown T. L., LeMay H.E, Bursten B.E., Murphy C., Woodward P., Langford S., Sagatys D. and George A. (2014). Chemistry: The Central Science. (3rd Ed.). Pearson Australia. Australia
2. Chang, R. (2010). Chemistry. (10th Ed.) McGraw Hill Higher Education. New York. ISBN:978-0-07

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8.5.1.3 YEAR 1 SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS II**
Module Code	I3582IM
NQF Level	5
Notional Hours	120
Contact hours	3Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) /	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Students should be able to solve simple engineering problems using matrices, calculus, differential equations, integral transforms, Fourier series and Fourier transforms.
Specific Learning Outcomes
On completing the module students should be able to:
1. Calculate eigenvalues and eigenvectors and relate them to engineering solutions.
2. Solve calculus problems using integration by parts and the reduction formula technique.
3. Apply calculus to trigonometric functions to solve mathematical and engineering problems.
4. Solve engineering problems using 1st order and 2nd order differential equations.
5. Define and analyse Fourier series of real-valued functions.
6. Use Laplace and Fourier transforms in solving differential equations.

Module Content
Further Matrix Algebra: eigenvalue-eigenvector problems; Hermitian and unitary matrices; Quadratic forms. Further Integration: Integration by parts technique. Integration by substitution. Integration of trigonometric functions. Integration of powers of trigonometric functions. Integration of trigonometric functions by substitution. Reduction formula. Application of integration: areas, volumes of revolution, etc. Differential Equations: Meaning and solutions of differential equations. First order ordinary differential equations (separable, homogenous, Exact and linear types) and their applications. Solutions of second order linear ordinary differential equations with constant coefficients; initial or boundary value problems using the methods of undetermined coefficients and variation of parameters. Integral Transforms: Laplace Transforms (LT), Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st and 2nd order ordinary differential equations. Fourier Series and Transforms: Fourier series. Fourier sine and cosine series. Introduction to Fourier transforms and its applications in solving boundary value problems.
Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5 and 6).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5 and 6).
3. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5 and 6).
Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
2. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes): 20%.
b. Tests (at least 2): 30%.
c. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.

3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Ross, S.L. (1991). Introduction to Ordinary Differential Equations. 4th Edition, John Wiley and Sons.
2. Kreyszig, E. (2020). Advanced Engineering Mathematics. 10th Edition, John Wiley and Sons.
3. Bird, J. (2017). Engineering Mathematics. 8th Edition, Routledge.
4. Stroud, K.A. and Booth, D.J. (2020). Engineering Mathematics. 8th Edition, Red Globe Press.
5. Stewart, J., Clegg, D.K., and Watson, S. (2020). Calculus: Early Transcendentals. 9th Edition, Cengage Learning.

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Module Title:	**ENGINEERING MATHEMATICS SUPPORT II**
Module Code	I3402MS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(**Co-requisites) /Prerequisite**	None
Semester Offered:	2

Module Purpose
The purpose of this module is to equip students with an intuitive grasp of the behaviour of a real-valued function as well as the analytical techniques to test their intuition.
Overarching Learning Outcome
Gather sufficient information about the behaviour of a real valued function to sketch its graph with accuracy.
Specific Learning Outcomes
Upon completion of this module, a student should be able to
1. Employ the exact definitions of limit and continuity.
2. Use various differentiation techniques and assess differentiability.
3. Apply those tools to study local extrema, end behaviour, and asymptotic behaviour of function graphs.
4. Use integration to compute the area below a curve.
5. Handle complex numbers.

Module Content:
Solving equation: Exponentials and logarithms. Graph of a function: polynomial, rational, exponential, logarithmic, trigonometric functions. Limit of a function: definition, continuity, differentiation, sum, product, quotient, chain rules, examples from the engineering sciences. Integration: Definition and basic properties of the Riemann integral, the Fundamental Theorem of calculus, integrals of simple function, substitution rule and integration by parts; applications to the computation of areas and (rotational) volumes.
Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. B. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS A FOR ENGINEERS II**
Module Code	I3582NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	12
(**Co-requisites) /Prerequisite**	Physics A for Engineers
Semester Offered	2

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of Physics as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to prepare students to apply fundamental Physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:
1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.
5. Demonstrate entry-level general laboratory skills including elementary data analysis.
6. Demonstrate abilities to communicate ideas and facts using equations, graphs and principles
Module content
Electrostatics: Electric charge, Current and Current Density, Electric field, Electric Potential, Resistance and Resistivity, Capacitance and Dielectrics. Magnetostatics: Biot-Savart law, Magnetic field, Magnetic materials, Motion of a Charged Particle in a Magnetic Field, Magnetic force, Ampere's Law; Torque and Magnetic Moments; Electromagnetic Induction: Electromagnetic Force (EMF), Faraday's Law of Electromagnetic Induction, Lenz's Law, Fleming's Right Hand Rule, Inductance and Mutual Inductance. Vibrations and Waves: Simple harmonic motion, Oscillations, Wave Motion, Types of Waves, Standing Waves and Resonance. Sound: intensity of Sound, interference of Sound Waves, Doppler's Effect. Light and Optics: Reflection, Refraction and Diffraction, Snell's Law, Lenses, Lens Equation. Radioactivity: types of radioactivity.
Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)
Learning and Teaching methods
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes, lab and field reports): 20%
b. Tests (At least 2 tests): 30%
3. The final examination (1 x 3-hour paper): 50%

Criteria for passing the course:
• To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources
1. Young, H. D. and Freedman, R. A. (2020) University Physics with Modern Physics in SI Units, Pearson Education Limited, Harlow, United Kingdom.
2. Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
3. Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

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Module Title:	PHYSICS FOR ENGINEERS SUPPORT II
Module Code	I3422PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Pre-requisites	Entry requirements
Semester Offered	2

Module Purpose

To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course. This course focuses on Electricity and Magnetism, Optics and Radioactivity

Overarching Learning Outcome

Solve problems in electricity and magnetism, optics, and radioactivity.

Specific Learning outcomes

On completing the module students should be able to:

1. Discuss and solve basic problems on electric field and magnetic field.
2. Find currents and resistances in simple electric circuits.
3. Analyse DC and AC circuits involving capacitors, resistors, and inductors.
4. Resolve problems involving electromagnetic induction.
5. Solve simple problems in geometrical optics and nuclear physics.
6. Explain concepts pertaining to radioactivity and the effects of radiation.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content

Electric charge and electric field; Electric Potential; Electric Currents; DC Circuits; Magnetism; Electromagnetic induction; Electromagnetic waves; Geometric optics; Light; Radioactivity; Effects and Use of Radiation.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
4. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
5. Tests (at least 2 tests): 60%

Prescribed Learning Resources

1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Module Code	I3522EE
NQF Level	5
Notional Hours	80
Contact hours	3 Lectures + 1 Tutorial or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to give all engineering students an understanding of the basic principles of electrical circuits and networks. The module further aims at introducing common technical vocabulary.

Overarching Learning Outcome

Students should be able to analyse basic electrical circuits using the established laws and theorems of electrical circuit analysis.

Specific Learning Outcomes

On completing the module students should be able to:

1. Distinguish between real and ideal voltage and current source.
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving of DC circuits.
3. Apply the principles of circuit analysis to series and parallel R, L, C circuits.
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information.
5. Describe the principles of a transformer and the basic AC generator and DC motors.
6. Conduct basic circuit analysis using appropriate CAD software (MATLAB, MultiSIM, etc.).

Module Content

Introduction: SI Unit and notations, Basic Electric Circuit (resistance, voltage and current). Resistance: Resistor coding, Series and parallel resistor networks, Y and delta resistor networks. Sources: Voltage and Current sources, dependent and independent sources, source transformations. DC Circuit Analysis Techniques: Ohm's law, Power and Energy, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, DC Circuit Theorems: Superposition Theorem, Thevenin's and Norton's Theorem, Maximum power transfer theorem. Capacitors: Capacitance, capacitors in series and parallel, Capacitor charging and time constant. Inductors: Inductance and mutual inductance. AC Voltage: AC voltage generation, AC Resistive circuit, AC capacitive circuit, AC inductive circuit. Electrical Machine Basics: Basics principles of transformers, AC generators, DC motors, three phase voltage generation and mathematical expression. Basics of circuit simulation using CAD software.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 1, 2, 3 and 4).
2. Engineering design (Course Outcome 4).
3. Investigations, experiments and data analysis (Course Outcome 4).
4. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3 and 4).
5. Engineering methods, skills and tools, including information technology (Course Outcome 5).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations wherever necessary.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) activities as follows:

1. At least 2 quizzes and at least 2 laboratory reports: 40%.
2. Tests (at least 2 tests): 60%.

Criteria for passing the module

- To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of project reports and test scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Boylestad R. (2015). Introductory Circuit Analysis. 13th Edition, Pearson Education, USA.
2. Alexander C. and Sadiku M. (2016). Fundamentals of Electric Circuits, 6th Edition, McGraw Hill.
3. Hughes E. (2016), Electrical and Electronic Technology, 12th Edition, Pearson Education.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	MATERIALS SCIENCE
Module Code	I3592IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Pre-requisite (	(None)
Semester Offered	2

Module Purpose
The purpose of this module is to enable the students to understand the relationship between the structure and properties of the materials used in engineering.

Overarching Learning Outcome
Students should be able to describe the characteristics of engineering materials and apply the knowledge from this module to make good engineering decisions in choosing the right materials for a particular job.
Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the molecular and crystal structure of materials.
2. Perform calculations on elemental diffusion in metals.
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams.
4. Describe the various phase transformations in the Fe-Fe3C phase system and associated microstructures.
5. Explain how materials properties depend on structure and crystal defects.
6. Demonstrate practical basic skills in metallography and report writing.
7. Explain the relationship between Materials Science and the Fourth Industrial Revolution.

Module Content
Materials for Engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; Solidification, Crystalline Imperfections and Diffusion in solids; Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. Properties of Materials: review of Mechanical, Electrical, Optical and Thermal properties of materials. Mechanical properties of materials: Stress and Strain, Tensile testing, True stress and True strain, Deformation modes; Yield and Fracture, Hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. Real-world applications of Engineering materials: Functional Materials and Devices; The Relationship between Materials Science and the Fourth Industrial Revolution. Basic criteria for the selection of materials for engineering applications.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 1, 2, 3 and 4).
2. Application of scientific and engineering knowledge (Course Outcomes 2, 3, 4 and 5).
3. Investigations, experiments and data analysis (Course Outcome 6).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Laboratory demonstrations.
4. Face-to-face consultations wherever necessary.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
2. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments (tutorials, quizzes, laboratory and field reports): 20%.
b. Tests (at least 2 tests): 30%.
3. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.
Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Callister, W. D., Rethwisch, D. G. (2018). Materials Science and Engineering: An Introduction, 10th Edition, Wiley and Sons.
2. Askeland, D.R. and Wright, W.J. (2018). Essentials of Materials Science and Engineering. 4th Edition. Cengage Learning.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MECHANICS I**
Module Code	I3582NM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3581NP Physics for Engineers I)
Pre-requisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to equip the students with the knowledge to analyse system of forces on engineering components and to develop an approach to solving engineering problems.

Overarching Learning Outcome

Students should be able to analyse effect of forces on systems and structural bodies.

Specific Learning Outcomes

On completing the module students should be able to:

1. Express force operations and force systems using vectors.
2. Apply the laws of static equilibrium of forces.
3. Produce a free body diagram from a specified engineering problem.
4. Analyse trusses using the method of joints and method of sections.
5. Apply the principles of static and kinetic friction in solving engineering problems.
6. Calculate and plot bending moment and shear force distributions in beams.
7. Determine the centroid and moment of inertia for plane and composite cross-sectional areas.

Module Content

Systems of forces and moment forces: coplanar forces, addition of forces, couples and moments, resultants and equivalent systems; Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions; Equilibrium in three dimensions; Forces in submerged surfaces; Distributed forces: centroids and centre of gravity; Friction: dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction; Beams: shear forces and shear force diagrams; bending stresses and bending moment diagrams; Analysis of forces in a truss: method of joints and method of sections. Laboratory demonstrations.

Contribution to Exit Level Outcome

1. Problem solving (Course Outcomes 1, 2, 3, 4, 5 and 6).
2. Investigations, experiments and data analysis (Course Outcome 7.
3. Application of scientific and engineering knowledge (Course Outcomes 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations.
4. Laboratory demonstrations.
5. Field trips.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment will be made up of the following assessment activities:
   a. Assignments (at least 4 assignments): 10%.
   b. Tests (at least 2 tests): 30%.
   c. Laboratory demonstration and report: 10%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Soutas-Little, R.W. and Inmand, D.J. (1999). Engineering Mechanics Statics. Prentice-Hall, Inc.
2. Meriam, J.L., Kraige, L.G., and Bolton, J.N (2019). Engineering Mechanics: Statics. 9th Edition, John Wiley and Sons.
3. Hibbeler, R.C. (2016). Engineering Mechanics: Statics. 14th Edition, Pearson Prentice Hall.
4. Shames, I.H. (1966). Engineering Mechanics Statics. 2nd Edition, Volume 1, Prentice-Hall.

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Next Revision: September 2028

Module Title:	**STATISTICS FOR ENGINEERS**
Module Code	I3582IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the concept of probability theory, statistical modelling and inference in engineering.

Overarching Learning Outcome
Students should be able to apply the principles of probability in sampling, data analysis and representation.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the theory of probability.
2. Analyse data using probability distribution and densities.
3. Use principles of sampling distribution and densities.
4. Apply linear regression and correlation to a set of data.
5. Apply analysis of variance to solve engineering problems.
6. Analyse data using R or python software.

Module Content
Probability: Theory (Random experiments, Random events), conditional probability and Bayes theorem, mathematical expectation and decision making. Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, uniform, Gamma, Beta and Weibull. Sampling Distributions: Mean, variance, inferences concerning mean and proportions: point and interval estimations, parametric tests, nonparametric tests. Regression and Correlation: Simple and multiple linear regressions, correlation. The Logistic regression model. Analysis of Variance: Completely randomised and randomised block designs, multiple comparisons. Introduction to Data Analysis with R: Laboratory 1: Measures of Central Tendency: mean, median, and other quantiles, mode. Saving and using graphics, etc. Laboratory 2: Measuring Variability: variance and standard deviation, median, Interquartile Range, coefficient of variation, covariance and correlation of variables. Laboratory 3: Measuring symmetry: skewness, kurtosis, etc. Frequency distributions: histograms, bar charts, pie charts, box plots, line graphs, scatterplots.

Contribution to Exit Level Outcome
1. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4 and 5).
2. Investigations, experiments and data analysis (Course Outcomes 4, 5 and 6).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.
4. Computer laboratory demonstrations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:
1. The Continuous Assessment will be made up of the following assessment activities:
2. Assignments (laboratory assessment): 20%.
3. Tests (at least 2 tests): 30%.
4. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Navidi, W. (2019). Statistics for Engineers and Scientists. 5th Edition, McGraw Hill.
2. Devore, J.L. (2020). Probability and Statistics for Engineering and the Sciences, 9th Edition, Cengage.
3. Chatterjee, S. (2012). Regression Analysis by Example, 5th Edition, John Wiley and Sons.

Issue Date: September 2023
Next Revision: September 2028

8.5.2 YEAR 2 OF (32BHCII) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING

8.5.2.1 YEAR 2 CORE SEMESTER

Module Title:	**ACADEMIC LITERACY II**
Module Code	U3683AL
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Pre-requisite	**U3583AL Academic Literacy I**
Semester Offered	0

Module Purpose

The purpose of this module is to teach students to navigate with ease the demands of academic study in their respective faculties. This module will help hone students' research, presentation writing and reading skills as demanded by different university disciplines. The module is also aimed at sharpening students' critical and analytical thinking skills. The module encourages a bridge between theory and real-life scenarios.

Overarching Learning Outcome

Students should be able to effectively communicate in academic discourse.

Specific Learning Outcomes

On completing the module students should be able to:

1. Communicate effectively in a computer-mediated environment.
2. Communicate effectively in various discursive modes and situations.
3. Read and comprehend academic texts.
4. Read and critique academic texts.
5. Produce short researched essays.
6. Synthesise information from different texts into a coherent text.
7. Correct error related to functional grammar, spelling, punctuation.
8. Proofread written work/using online systems to assist with proofreading and editing.
9. Write for specific purposes.
10. Make and substantiate arguments.
11. Distinguish different types of reasoning in academic texts.
12. Use technology to give oral academic presentations.

Module Content

The module is designed for students enrolled in a bachelor's degree course, which requires them to undertake basic research, read specific academic material, produce specific writing and give academic presentations. The module teaches academic reading, speaking, listening and writing skills.

Contribution to Exit Level Outcome

Professional and technical communication (Course Outcomes 1 - 12).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Blended Lectures: comprising face-to-face and online.
2. Face-to-face consultations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA).

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). Academic literacy. 2nd Edition. Cape Town: Juta and Company (Pty) Ltd.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	ENGINEERING ENTREPRENEURSHIP
Module Code	I3620IE
NQF Leve l	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	0

Module Purpose
The purpose of this module is to enable the students to understand the concept of entrepreneurship and innovation in the engineering field and the different aspects that make an entrepreneur.

Overarching Learning Outcome
Students should be able to conduct a feasibility study for a proposed business, prepare a business development plan and to discuss the concepts and theories of entrepreneurship and innovation.

Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the concept of entrepreneurship.
2. Describe key attributes of entrepreneur.
3. Carry out a feasibility study and draw up a business development plan.
4. Discuss the process of innovation (transformative and incremental) and product development.
5. Relate economic challenges and business creation.
6. Describe the procedures followed in starting a new business venture including some regulations guiding the process.
7. Explain the risk management process.
8. Discuss the theory of motivation and its application to entrepreneurship.
9. Discuss the roles of strategic business and marketing management in entrepreneurship.
10. Explain the importance of change management theory in entrepreneurship.

Module Content
Entrepreneurship: concept of entrepreneurship, characteristics of an entrepreneur, examples of good local and international entrepreneurial ventures, feasibility studies and business plan development and its components, government policies and regulations for starting new business ventures. Entrepreneurship opportunities in Engineering: innovative ideas and process of innovation, transformative and incremental innovations, innovation and business development, product development process and market research. Risk management: types of risk, risk management process, risk control and mitigation, risk response. Change management: Importance of change management, group dynamics and communication. Strategic business management: Management functions, strategic planning and management, resource management plan. Strategic marketing management: Marketing functions, marketing mix, innovative marketing, competitor analysis.

Contribution to Exit Level Outcome
1. Sustainability and impact of engineering activity (Course Outcome 3).
2. Engineering Management (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Assignments: 20%.
2. Tests (at least 2 tests): 50%.
3. Written reports: 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Nieuwenhuizen, C. and Nieman, G. (2018). Entrepreneurship: A South African Perspective 4th Edition, Van Schaik Publishers.
2. Sibanda, M. (2021). Nuts and Bolts, Strengthening Africa's Innovation and Entrepreneurship Ecosystems. Tracey McDonald Publishers.
3. Bota, T. (2019). Entrepreneurship and how to establish your own business. 6th Edition, Juta Legal and Academic Publishers.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**WORKSHOP PRACTICE**
Module Code	I3640IW
NQF Level	6
Notional Hours	80
Contact hours	3 Practical Sessions / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	0

Module Purpose
The purpose of this module is to enable the students understand the fundamentals of engineering profession and engineering workshop practices.

Overarching Learning Outcome
Students should be able to discuss the steps involved in engineering problem solving and to apply these steps in the fabrication engineering components and structures such as walls and electric circuits in an engineering workshop.

Specific Learning Outcomes
On completing the module students should be able to:
1. Work collaboratively in a team setting and use modern engineering tools and practices.
2. Discuss general safety procedures applicable to engineering workshops.
3. Describe specific hand tools used in engineering workshops.
4. Construct basic wall structures using brickwork, cement, and mortar.
5. Differentiate between a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Fabricate a prescribed wooden component using the principles of carpentry.
11. Perform simple plumbing and pipe fitting exercises.
12. Describe the general operation of air-conditioning and refrigeration systems.

Module Content
Safety procedures applicable to engineering workshops: Safety equipment; Protective clothing; Signage. Use of workshop hand tools. Principles and practices of: Masonry and brickwork; Machining Operations (cutting, drilling, turning, milling, shaping); Sheet metal and fitting; Welding fabrication; Auto mechanics; Electrical wiring and installation; Soldering and de-soldering of electronic components; Carpentry and woodwork; Plumbing and pipe fitting; Refrigeration and air-conditioning systems and their installation. Workshop demonstration.

Contribution to Exit Level Outcome
1. Problem solving (Course Outcomes 3, 5 and 10).
2. Engineering methods, skills and tools, including information technology (Course Outcomes 1- 12).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Seminars.
2. Tutorials.
3. Laboratory demonstrations.
4. Supervised practical use of hand tools and machine tools.
5. Fabrication of simple components using various workshops and tools.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. At least 5 laboratory reports: 40%.
2. Fabricated components: 60%.

Criteria for qualifying for the Examination
No examination.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of project reports and test scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Moaveni, S. (2007). Engineering Fundamentals: An Introduction to Engineering. Cengage Learning, 4th Edition.
2. Holtzapple, M. and Reece, W. (2002). Foundations of Engineering. 2nd Edition, McGraw Hill Education.

Issue Date: September 2023
Next Revision: September 2028

8.5.2.2 YEAR 2 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Module Code	I3611IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3512IM Engineering Mathematics II)
Prerequisite	**I3511IM Engineering Mathematics I**
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad and advanced mathematical skills to solve engineering problems**.**

Specific Learning Outcomes

On completing the module students should be able to:

1. Apply differential vector calculus to solve mathematical and engineering problems.
2. Apply functions of several variables in solving engineering problems.
3. Approximate solutions to 2nd order differential equations using power series.
4. Describe the basis for complex analysis in engineering problem solving.
5. Apply the residual theorem to engineering problems.

Module Content

Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binomial, torsion, curvature. Functions of several variables: limits, continuity, derivatives, differentials, the Jacobian, matrix and determinants, composite functions, higher order derivatives. Applications: optimization on surfaces, constrained optimization. The gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Power Series and their applications: Power series. Radius of convergence and interval of convergence. Power series representation of functions, Taylor and Maclaurin series, the Binomial theorem. Power series solutions to ODEs with variables coefficients. Analytic Functions: Complex functions, derivatives, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem and evaluation of complex integrals.

Contribution to Exit Level Outcome:

- o 1 Problem solving (Course Outcomes 1,2,3,4,5)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3)
- o 5 Engineering Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).

- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.

[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.

[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.

[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.

2. Lecture notes

Issue Date: September 2023

Next Revision: September 2028

Module Title:	**ENGINEERING ECONOMICS**
Module Code	I3661IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose

The purpose of this module is to introduce the students to key economic concepts and how they are applied in the different sectors of the economy and in engineering.

Overarching Learning Outcome

Apply key economic concepts in the different sectors of the economy and in engineering.

Specific Learning Outcomes

On completing the module students should be able to:

1. Discuss the fundamentals of microeconomics
2. Apply the concept of time value of money
3. Apply investment analysis techniques for projects (NPV, ROR, IRR, CBA, Payback Period, etc.)
4. Apply depreciation methods on assets for valuation

5. Discuss the fundamentals of macroeconomics
6. Apply financial accounting principles in engineering projects
7. Discuss the principles of marketing engineering products

Module content

Microeconomics: economic concepts, economic problems, demand and supply, consumer choice and demand theory, production functions, production costs, profit maximisation: **Time value of Money:** time value of money, investment analysis (NPV, ROR, IRR, ROI, CBA, etc.), depreciation methods (straight line, reducing balance, some of digits) **Macroeconomics:** inflation and deflation, business cycle, monetary and fiscal policies, unemployment, international trade. **Financial accounting:** product costing, cost accounting, Cost estimation, financial statements and budgeting. **Introduction to marketing:** marketing principles.

Contribution to Exit Level Outcome:

- 11 Engineering Management (Course Outcomes 3, 6 and 7).

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Consultations

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - i) Assignments: 40%
  - ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Issue Date: September 2023
Next Revision: September 2028

[1] Goodwin, N., Harris, J., Nelson, J.A., Roach, B. and Torras, M. (2020). Principles of Economics in Context 2nd ed. Routledge
[2] Mohr, P. (2015). Economics for South African Students 5th edition, Van Schaik Publishers

Module Title:	COMPUTER PROGRAMMING I
Module Code	I3691CP
NQF Level	6
Notional Hours	150
Contact hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	
Prerequisite	**I3551CC Computing Fundamentals**
Semester Offered	1

Module Purpose:

The course aims to equip students with general principles of programming, skills, theories, and techniques for computer programmes design and solutions.

Overarching Learning Outcome

Design and analyse computer programme.

Specific Learning Outcomes

On completing the module students should be able to:

- Design algorithms and data structures for solving mathematical and engineering problems using pseudo code, flowcharts, and related tools.
- Differentiate different programming paradigms (structural, functional, and object-oriented).
- Discuss the concept of compiled and interpreted languages.
- Use different data types in the design of programmes.
- Apply arithmetic, logical, and bitwise operations on different data types in programming.
- Compile computer programmes in different integrated development environments.
- Apply and test the three basic programming structures (Sequential, Decision and Looping) using specific programming languages (e.g., MATLAB, Python, C, etc.)

Module Content:

Programme design: programming problem definition, programme requirements elicitation and analysis, specification development, design methods, design tool (pseudo code, flow charts etc.).

Programming Paradigms: Structural, functional, and object-oriented programming concepts.

Introduction to programme compilation and interpretation: Definition and differences between compiled and interpreted languages, Compilation process, Execution of compiled code, Interpretation process, Examples of compiled and interpreted language, Advantages, and disadvantages of each type of languages.

Introduction to programming: variables, operators, data types, iteration, branching

Data Structures: Arrays, lists, stack and queues, structures and enumeration/hash maps.

Fundamental concepts of programming: Data types, variables, programme flow control (decisions and loops), string manipulation, functions, data structures and their operations

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 5)
5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 12 weeks
- One tutorial or one practical session per week for 12 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.
- Special soft skills lecture that may be done on-site or via video demos.

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
2. The Continuous Assessment will be made up of the following assessment activities:
   a) Assignments (tutorials, quizzes, reports, practical assignments): 20%
   b) Tests (At least 3 tests): 50%
   c) Semester Mini project (prototype, oral presentation and development report): 30%

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student's evaluation

3. Regular review of the course content
4. Face-to-face consultations
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Prescribed Learning Resources

[1] Cay Horstmann, Rance Necaise; Python for Everyone, Second Edition, Wiley, 2016.
[2] William J. Palm III; Introduction to MATLAB for Engineers, Third Edition, Mc Graw Hill, 2011.
[3] Gregg Perry and Dean Miller; C Programming Absolute Beginner's Guide, Third Edition, Pearson, 2014.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ELECTRIC CIRCUIT ANALYSIS I**
Module Code	**I3681EC**
NQF Level	Level 6
Notional Hours	120
Contact hours	3L + 1T and/or PS /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	TEGT3542 Fundamentals of Electrical Engineering
Prerequisite	**None**
Semester Offered	1

Module Purpose:
The course aims to equip students majoring in electrical and electronic engineering with main theories, techniques and theorems for analysing electric circuits and networks.

Overarching Learning Outcome
Demonstrate ability to design and analyse DC and AC electric circuits and networks using laws, techniques and theorems.

Specific Learning Outcomes
On completing the module students should be able to:
1. Apply circuit theorems to simplify and find solutions to electrical circuits or networks.
2. Design, develop and interpret electrical circuits.
3. Use computer simulation tools for electric circuit design and analysis.
4. Perform DC and AC power calculations and measurements including power factor corrections.
5. Represent the total system response as a sum of a transient and steady state response and a natural and forced response.
6. Analyse, simulate, and experimentally validate DC and AC circuits.
7. Analyse three phase systems with balanced and unbalanced loads.

Module Content:
DC Transient Analysis: Natural response of first order RL and RC circuits. Step response of first order RL and RC circuits, general solution of first transient circuits. Natural and step response of second order series and parallel circuits (RLC). **Sinusoidal Steady State Analysis**: AC voltage and current, AC behaviours in basic elements (R, L and C). Phasor analysis with complex algebra, two terminal networks - impedance, admittance, and susceptance. **AC Circuit Analysis Techniques**: Ohms Law, KVL, KCL, loop/mesh and nodal analysis. **A.C. Circuit Theorems:** Superposition theorem, Thevenin's and Norton theorems; maximum power transfer theorem. **AC Power**: instantaneous, average, or active, reactive, apparent, and complex power, power triangle, power factor and power factor correction. **Frequency Response Curves**: Resonance, series and parallel resonance, half power points, bandwidth, the concept of Q-factor, tuned circuits' frequency selective networks, mutually coupled circuits. **Three Phase Networks**: Concept of three-phase voltage generation, phase diagrams for three phase networks, Analysis of balanced three phase networks, star and delta networks (source and loads), Unbalanced three phase circuits. Power and power measurement in three phase circuits. Computer circuit analysis and simulation using appropriate CAD software.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 6, 7)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- Two tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
    i) At least 2 quizzes, and at least 2 lab reports: 40%
    ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 40% in the continuous assessments activities.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Books:
    - Boylestad Robert. (2015), Introductory Circuit Analysis, 13th Edition, Pearson Education, USA
    - Alexander K. Charles and Sadiku N.O. Mathews. (2013), Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, USA
    - Nilsson JW and Riedel SA. (2015), Electric Circuits, 10th Edition, Pearson Education, USA

2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title	COMPUTER NETWORKS
Code	I3621CN
NQF Level	6
Notional Hours	80
Contact Hours	2L + 1T or PS /Week
Additional learning requirements	NONE
NQF Credits	8
(Co-requisites) Prerequisite(s)	(I3522CC Computing Fundamentals) NONE
Semester Offered	1

Module Purpose
This course aims to provide knowledge of the operations and security of computer networks.

Overarching Learning Outcomes
Discuss the OSI model, TCP/IP model, and issues related to addressing between networks as well as different network security threats and their various solution.

Specific Learning Outcomes
1. Classify computer network layers and topologies.
2. Distinguish the OSI model and the TCP/IP model.
3. Inspect the issues related to addressing between networks.
4. List common security risks for Internet-connected computers.
5. Survey threats, unauthorized access and virus infections in relation with network and data compromise (denial-of-service/attacks operation).
6. Independently study and make a presentation on one emerging network technology.

Module Content:
Communications within computer systems: structure and components of computer networks, packet switching, layered architectures, applications: web/http, communication protocols, voice−over−IP (VOIP), peer− to−peer (p2p) file sharing and **TCP/IP (Transmission Control Protocol/Internet Protocol**), reliable transfer, flow control, and congestion control, data link control, medium access control; **introduction to local area networks**: **metropolitan area networks and wide area networks.** network layer: names and addresses, routing, local area networks: Ethernet and switches, wireless networks and network security. **Open Systems Interconnection model (OSI):** physical layer, data link layer, medium access control sublayer, network layer, transport layer, session layer, presentation layer and application layer. **Network topologies:** network protocols, routing protocols, emerging network technologies, Quality of Service, network management and troubleshooting. **Network security:** Denial of Service, Threats, secret-key crypto, public key Algorithms, intrusion detection, authentication systems, Kerberos, email security (PGP, S/MIME), firewalls.

Contribution to Exit Level Outcome:
1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
2. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5)
3. Independent Learning Ability (Course Outcomes 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks
2. One tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination.
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments (tutorials, quizzes, reports, practical assignments, labs): 40%
2. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. D. E. Comer, Computer Networks and Internets, Fifth Edition, Cisco Research Cisco, Inc. San Jose, CA 95138, 2009.
2. Computer Networks by Andrew S. Tanenbaum and David J. Fifth Edition, Wetherall Prentice Hall.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ANALOGUE ELECTRONICS I**
Module Code	I3691CA
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	
NQF Credits	12
(Co-requisites)	
Prerequisite	TEGT3542, Fundamentals of Electrical Engineering
Semester Offered	1

Module Purpose
This course aims to provide the necessary and fundamental knowledge and skills for analysis and design of analogue electronic circuits.

Overarching Learning Outcome
Analyse, design, construct and operate a variety of semiconductor devices including diodes, BJT and FETs.

Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the atomic structure of semiconductor materials.
2. Discuss the construction and operation of semiconductor diodes.
3. Analyse and design diode-based circuits.
4. Discuss the construction of BJTs.
5. Analyse and design BJT amplifier and switching circuits.
6. Discuss the construction of FETs.
7. Analyse and design FET biasing, amplifier and switching circuits.
8. Discuss the internal circuitry and operation of op-amps.
9. Analyse and design op-amp circuits.
10. Use EDA software to analyse electronic circuits.

Module Content
Review of semiconductor theory. Semiconductor materials, covalent bonding, energy levels, valence band, conduction band. **Diodes: Types:** p-n type, Zener. **Construction**, diode equivalent circuits, transition and diffusion capacitance, reverse recovery time, specification sheets, diode equation. **Diode applications:** clippers, clampers, limiters, rectification - full and half wave**. Bipolar Junction Transistors (BJTs): structure**-pnp transistor, npn transistor, transistor terminals operation characteristics curves, cut off region, saturation region,

active region, Q- point **biasing:** fixed, emitter stabilized, voltage divider, dc bias with feedback, load line **applications:** switching circuits, amplifier circuits, oscillator circuits, Darlington pair, Current mirror circuits, current source circuits, cascaded systems, logic gates. **AC modelling:** Application in the a. c. domain, BJT small signal model, voltage and current gain, fixed bias configuration, voltage divider bias, emitter follower, feedback configurations, re model, hybrid pi equivalent model. **Field Effect Transistors (FET)**: **structure**- n transistor, p channel, transistor terminals, FETs Vs BJTs. Types: JFETs, MOSFETS, D-type mosfets, E Type mosfets, MESFETS Operation: characteristics curves, operation region, pinch off region, Shockley equation. **Biasing:** Fixed – Bias, Self-Bias, Voltage-Divider Bias, Feedback Configuration, **applications:** switching circuits, amplifier circuits, oscillator circuits, current source circuits, cascaded systems, voltage variable resistors, op-amps, cascade amplifier, chopper, logic gates, current limiter, Three-Channel Audio Mixer, Silent Switching, Phase Shift Networks, Motion Detection System. **AC modelling:** transconductance, dynamic resistance, ac equivalent model, gain calculation for Fixed – Bias, Self-Bias, Voltage-Divider Bias, Feedback Configuration for JFET and MOSFETs. **OP-Amps: internal structure**, open loop and closed loop configurations, ideal and practical op-amps, characteristics of ideal op-amps, equivalent model, inverting and non-inverting amplifier, gain expressions, specifications sheets, input output offset parameters **applications:** inverting op-amp, non-inverting op-amp, unity follower, Summing amplifier, Integrator, Differentiator. Analysis of electronic circuits using Electronic Design Automation (EDA) software: Proteus, Multi-sim

Contribution to Exit Level Outcome
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 6, 8)
3 Engineering Design (Course Outcomes 3, 5, 7,9)
4 Investigations, Experiments and Data Analysis (Course Outcomes 8,10)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5,7,9)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
1. Three lecture periods per week for 14 weeks
2. Two tutorial sessions per week for 14 weeks
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations.

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
    i) Continuous 50% (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50)
    ii) Examination 50% (1 x 3 hour paper).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Prescribed Learning Resources
1. Books
    - Electronic Devices and circuit theory: Robert L Boylestad.
    - Fundamentals of Analog Circuits: Thomas L Floyd.
    - -Analog Electronics*: Ian Hickman*
2. Lecture notes
3. Video lectures

Issue Date: September 2023
Next Revision: September 2028

8.5.2.3 YEAR 2 SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS IV
Module Code	I3612IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**I3512IM Engineering Mathematics II**
Semester Offered	2

Module Purpose

The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Equip students with broad and advanced mathematical skills that will help them solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Solve systems of first order linear differential equations using the LT and the matrix approach.
2. Define, classify and solve partial differential equations analytically and
3. Apply integral calculus to functions of several variables and describe Green's theorem
4. Describe the principal of numerical methods and computational linear algebra

Module Content

Systems of Linear Differential Equations: Homogeneous and nonhomogeneous systems and their methods of solutions: The Laplace Transform method and the matrix methods (eigenvalue-eigenvector approach). **Partial Differential Equations:** Partial differential equations classification; elliptic, parabolic and hyperbolic. Neumann, Dirichrit boundary conditions of PDEs. Method of separation of variables to the heat and wave equations; vibrations of a stretched elastic string fixed at both ends. **Integral Calculus of Functions of Several Variables**: Double and triple integrals, Double, triple and iterated integrals, Line integrals in the plane, Green's Theorem, Independence of path, Surface integral, Divergence theorem, Stoke's theorem, Irrotational and solenoidal fields, Physical and engineering applications. **Numerical Methods:** Zeros of functions, Polynomial interpolation and least squares approximation, numerical differentiation and integration. Numerical solution of first order ordinary differential equations and boundary value problems.

Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,3,4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3,4)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
   [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
   [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
   [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
   [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title	**COMPUTER PROGRAMMING II**
Code	I3692CP
NQF Level	6
Notional Hours	150
Contact Hours	4L + 1T or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	None
Prerequisite(s)	**I3631CP Computer Programming I**
Semester Offered	2

Module Purpose

The module aims at introducing advanced programming design knowledge and skill with emphasis on object-oriented programming.

Overarching Learning Outcomes

Design and implement efficient programmes to solve engineering and mathematical problems using the top-down stepwise object-**oriented** programming approach.

Specific Learning Outcomes

- Discuss various recognized programming standards, guidelines and models.
- Apply advanced problem-solving techniques on numerical computations and engineering problems.
- Discuss Object-Oriented Programming Techniques.
- Design, Implement and Test object-oriented programmes using various object-oriented programming language such as C++/C#/Java and Python.
- Employ encapsulation, inheritance, polymorphism, abstraction and abstract data types in Programming Solutions.
- Use programming to solve numerical differentiation and integration problems.
- Write programme to read from and write content to files.

Module Content:

Recognized standards, guidelines and models used in programming. Flowchart ANSI symbols and usage. Extensive examples, and programming exercises using pseudo-code/flowchart to solve practical problems in engineering.

Advanced Problem Solving: Top-down stepwise refinement approach, Code Tracing and Debugging techniques and the Try-Catch Clause.

Advanced Structured Programming: Standard Libraries, arithmetic and logical operators, Bitwise operators and bit masking; Precedence and Associativity of Arithmetic Operations; Unary Operators; application of Structs hash maps and Enums. Symbols, keywords, identifiers, data types

Selection and Repetition Structures: If Statement, Conditional Operator, Switch-Case Structure, For Loops, While Loops and other Loops;

Arrays, Strings, and Pointers: Arrays; Storing and accessing Values in Arrays; Pointers; Advanced string manipulation;

File Handling: Concept of a file, files and streams, standard file handling functions, binary files, random access files.

Advanced Functions: Functions definition; Functions declaration/prototyping; Functions calling; Functions arguments; Recursion. Object Oriented Programming: Classes and Objects; Inheritance; Encapsulating; Abstraction; Polymorphism; Operators and Functions Overloading and Overriding and Design Patterns

Numerical differentiation and integration using programming.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 5)

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)

3 Engineering Design (Course Outcomes 1)

5 Engineering Methods, Skills and Tools, Including Information **Technology (Course Outcomes 2, 3, 4, 5)**

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 12 weeks
- One tutorial session or one practical session per week for 12 weeks
- Weekly consultation sessions
- A mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.
- Special soft skills lecture that may be done **on-site or via video demos.**

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
- The Continuous Assessment will be made up of the following assessment activities:

o Assignments (tutorials, quizzes, reports, practical assignments): 20%

o Tests (At least 3 tests): 50%

o Semester Mini project (prototype oral presentation and development report): 30%

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- Invite students for one-one consultation to find the root cause of the problem
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

- Hejlsberg, M. Torgersen, S. Wiltamuth, and P. Golde: The C# Programming Language (Microsoft.NET Development Series), Fourth Edition, Addison Wesley, 2002.
- S. Nakov and V. Kolev; Fundamentals of Computer Programming with C#, Svetlin Nakov and Co. 2013.

Issue Date: **September 2023**

Next Revision: **September 2028**

Module Title	**ELECTRICAL CIRCUIT ANALYSIS II**
Code	I3692EC
NQF Level	Level 7
Notional Hours	120
Contact Hours	3L + 1T or 1PS /Week
Additional learning requirements	
NQF Credits	12
(Co-requisites)	(TECE3691 Electric Circuit Analysis I)
Prerequisite(s)	NONE
Semester Offered	1

Module Purpose
The purpose of this module is to provide students with an understanding of the basic methods that are used for the time and frequency domain analysis of linear electric circuits.

Overarching Learning Outcomes
Analyse and model electrical ac circuits and their frequency response characteristics using Fourier and Laplace transformation

Specific Learning Outcomes
On completing the module students should be able to

1. Apply linear algebra and differential equations techniques in electric circuit analysis.
2. Apply Fourier series and Fourier transforms for circuit analysis.
3. Utilize Laplace transforms for circuit analysis.
4. Derive, draw Bode plot frequency domain transfer functions for circuits and interpret them.
5. Determine the frequency response of a given circuit.
6. Design simple electrical filters that satisfy specific functional requirements.
7. Characterize linear networks with two-port parameters.
8. Simulate linear electric circuits and measure their properties.
9. Synthesize network circuits to meet specifications.

Module Content:
Introduction: Review of Fourier series and Fourier transform, physical significance of the Fourier Transform and its application to electrical circuits. **Laplace transform:** Review Laplace transformations and its properties, Waveform synthesis. Initial and Final value theorems. Laplace Transform of network and time domain solution for RL, RC and RLC networks for ac and dc excitations. **Network functions:** Concept of complex frequency; terminal pairs/ports; driving point functions; analysis of ladder networks; analysis of non-ladder networks; poles and zeros of network functions; bode plot; **Two port network parameters:** Impedance; admittance; transmission; inverse transmission; hybrid; inverse hybrid; inter-relationships between the parameters; interconnection of two port networks; T and Pi networks; **Network Synthesis:** Hurwitz polynomials; positive real functions; realizations of LC and RC functions – Foster and Cauer Forms; Solving electric circuits using relevant **Computer aided tools** such as MATLAB, Pspice e.t.c.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2,3,4)

3 Engineering Design (Course Outcomes 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2,3,4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination.
- The Continuous Assessment will be made up of the following assessment activities:
  - i) Assignments (at least 2), 20%
  - ii) Tests (at least 2 tests): 50%
  - iii) Labs (at least 3): 30%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the CA.

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students' evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Prescribed Learning Resources

- Books
  - C. Alexander and M. Sadiku, “Fundamentals of Electric Circuits,” 5th ed., McGraw Hill, 2013.
  - Introduction to circuit analysis and design by Tildon Glisson. Jr, Springer Publications.
  - Network synthesis: Van Valkenburg; Prentice-Hall
  - Network Theory Analysis and Synthesis by Smarajit Ghosh, PHI publications
  - Networks and Systems by D. Roy Choudhury, New Age International publishers
  - J. Tront, “PSpice for Basic Microelectronics,” McGraw Hill, 2008.
- Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**DIGITAL ELECTRONICS**
Module Code	I3632CD
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 2 Tutorial and/or Practical Session / Week
Additional learning requirements	
NQF Credits	16
(Co-requisites) Prerequisite	TETE3691 Analogue Electronics I
Semester Offered	2

Module Purpose

This course aims to provide the necessary and fundamental knowledge and skills for analysis and design of digital electronic circuits.

Overarching Learning Outcome

Design and analyze combination and sequential logic circuits; design and analyze internal circuitry of different logic families and interfaces.

Specific Learning Outcomes

On completing the module students should be able to:

1. Discuss fundamental digital terminology.
2. Perform different number systems and coding conversions.
3. Describe the operation of different logic gates.
4. Analyse and simplify logic equations.
5. Analyse and design different combinational and sequential logic circuits.
6. Discuss the operation of Programmable Logic Devices (PLDs)
7. Implement and validate combinational and sequential digital circuits using VHDL and FPGAs.
8. Compare the performance of different logic family devices.
9. Discuss and analyse the internal circuitry of different logic family technologies.
10. Design interfaces between circuits of different logic families.

Module Content

Review of fundamental Digital concepts: Logic levels, number systems and digital codes. **Combinational Logic:** logic gates, Boolean algebra, logic simplification, combinational logic functions (including arithmetic circuits, encoders and decoders, multiplexers and demultiplexers, comparators, parity checkers and generators). **Programmable Logic Devices:** SPLDs, CPLDs, FPGAs, Schematic Entry, VHDL implementation and validation. **Sequential Logic:** latches flip-flops, counters, shift registers. **Design of Digital Systems**. **Logic gate circuits:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 8, 9, 10)
3 Engineering Design (Course Outcomes 5, 6, 10)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4,7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Four lecture periods per week for 14 weeks
- Two tutorial sessions per week for 14 weeks
- Face to face consultations
- Laboratory demonstrations, experiment documentation

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (At least 2 assignments): 20%
   ii) Practical reports (At least 4 Labs: 30%
   iii) Tests (At least 2 tests): 50%

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Prescribed Learning Resources

1. Books:
   - Digital Fundamentals: *Thomas L Floyd*
   - Digital Electronics and Logic Design: *B. Somanathan Nair*
   - Digital Electronics, Principles, Devices and Applications: *Anil K Maini*
2. Lecture notes
3. Video lectures

Issue Date: September 2023
Next Revision: September 2028

Module Title:	SIGNALS AND SYSTEMS
Module Code	I3692CS
NQF Level	6
Notional Hours	120
Contact hours	3L + 2T or 1PS /Week
Additional learning requirements	
NQF Credits	12
(Co-requisites)	None
Prerequisite	**TEGM3592 Engineering Mathematics II**
Semester Offered	*2*

Module Purpose:
The purpose of this module is to provide the fundamental knowledge and skills for analysis of continuous and discrete-time signals and Linear Time Invariant (LTI) systems using the time and frequency domain analysis techniques.

Overarching Learning Outcome
Apply transform techniques and various analysis approaches to signals and linear time invariant systems in the time and frequency domain as well as continuous and discrete time filters.

Specific Learning Outcomes
On completing the module students should be able to:

1. Discuss the classification and properties of signals and systems as well as their representations.
2. Discuss the parameters of a continuous and discrete-time signal as well as LTI system.
3. Use time domain and frequency domain analysis techniques to determine the response of an LTI system for a given input signal.
4. Design continuous and discrete time LTI filters.
5. Use MATLAB or any other simulation and visualisation tool to carry out computer-based simulations related to generating a system model, verifying system's properties as well as perform signal operations.

Module Content:
Representation of Continuous-time Signals: Introduction to typical signals; Time-domain operations; Continuous-time signal characteristics (periodicity, frequency, symmetry, energy, and power); Analogy between vectors and signals. **Signal representation and analysis:** Review of Representation of continuous-time periodic signals by trigonometric functions (Trigonometric Fourier Series) and Exponential Fourier series; Dirichlet's conditions; Properties of Fourier series. **Fourier Transform:** Definition of Fourier transform, test signals, Properties of Fourier transforms, Parseval's theorem. **Laplace transforms:** Importance and definition of Laplace transform, Properties, Laplace transform of elementary signals, Inverse Laplace transform, Region of convergence (ROC), Constraints on ROC to various classes of signals, Relationship between LT and FT of a signal. **Time domain analysis of LTI Systems:** Classification of systems, system description and parameters, Signal transmission through linear systems, Convolution and correlation of signals, Energy and Power spectral density (PSD), Relation of PSD to Autocorrelation. Applications of LT to LTI System analysis. **Analog Filter design:** Continuous-time and Discrete-time ideal and real filters (Low-pass, high-pass, band-pass, and notch filters) in the time and frequency domain (frequency, impulse, and step response); Practical RC filter circuits: Butterworth, Chebyshev, and Bessel approximations. Finite impulse response (FIR), Infinite Impulse Response (IIR) filter, **Statistical signal processing**: Random signal, White noise and its Power spectrum, Linear system with white noise input, Signal to noise ratio, Detection: Likelihood ratio test, Estimation: Maximum Likelihood estimation, MMSE.
Computer simulation software (e.g., MATLAB/PYTHON or equivalent).

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3 Engineering Design (Course Outcomes 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
- The Continuous Assessment will be made up of the following assessment activities:
    i) Assignments (at least 2 Assignments): 20%,
    ii) Labs (at least 2 labs): 30%
    iii) Tests (At least 2 tests): 50%

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Effective and efficient supervision and monitoring of assignments, tests and examinations.
- Weekly consultation hours

Prescribed Learning Resources

1. Signals and Systems, Models and Behaviours. M. L. Meade and C. R. Dillon. Kluwer Academic Publishers. Latest Edition.
2. Signals and Systems, Tarun Kumar Rawat. Oxford University Press
3. Lecture Notes

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Module Title:	**MEASUREMENTS AND INSTRUMENTATION**
Module Code	I3622CI
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS /Week
Additional learning Requirements	Include any compulsory field trips / excursions (outside the normal practicals); attachments / group work /project etc.
NQF Credits	8
(Co-requisites)	(I3502EE Fundamentals of Electrical Engineering)
Prerequisite	**None**
Semester Offered	1

Module Purpose

This module aims to provide the necessary and fundamental, theoretical and practical knowledge on measuring techniques.

Overarching Learning Outcome

Discuss the characteristics of measuring instruments and operate them in a lab environment as well as analyse and interpret measurement results.

Specific Learning Outcomes

On completing the module students should be able to:

1. Distinguish different types and methods of measurements.
2. Discuss static and dynamic characteristics of an instrument.
3. Explain the importance of signal generators and signal analysers in measurements.
4. Calculate errors and reduce them in measurements.
5. Discuss the concept of instrument calibration.
6. Explain the use of sensors and transducers.
7. Measure different quantities, analyse and interpret the measurement results.

Module Content

Systems of Units and Standards of Measurement: Absolute, derived and fundamental units. Advantages of electronic and electrical measurements. **Standards and types of standards**. International Standards, Primary Standards, Secondary Standards, Working Standards**. Errors**: sources of error. Types of errors, statistical analysis of error. **Performance characteristics of Instruments: Static characteristics** (Accuracy, Precision, Sensitivity, Reproducibility, and Tolerance etc.) **Dynamic characteristics** (Speed of response, Fidelity, Lag, dynamic error etc.). **Calibration:** Principles of calibration, calibration chain, calibration records. **Elements of generalized measurement system**, Functional elements of an instrument: Primary sensing element, variable conversion element (analogue to digital conversion), variable manipulation / conditioning element- (data amplification, attenuation) - data processing element (filtering), data transmission element, data storage element (chart recorders, computers, memory storage devices etc.), data presentation element/ termination stage**. Instrument classification:** active or passive instruments, null and deflection type instruments, analogue and digital instruments, indicating instruments and instruments with a sound output, smart and non-smart instruments. **Bridge measurement** (Wheatstone, Kelvin, Maxwell Anderson, Wien etc.) **Electrical indicating and test instruments:** Construction and operation of Digital meters (Voltage-to-time conversion digital voltmeter, Dual-slope integration digital voltmeter), Analogue meters **-** Construction and operation of Analogue meters: Moving-coil meters, moving iron meter, clamp on meter, techniques for measurement of high frequency signals. **Noise in Measurement Instruments**: Causes/ sources of Noise (Capacitive/ electrostatic, Inductive, multiple earth, thermoelectric potentials, shot noise,). Noise reduction techniques. **Measurements of electrical and non-electrical quantities: Sensors and transducers**: Transducer Characteristics, Mechanical vs electrical transducers. **Transducer classification**: active and passive transducers, on the basis of transduction principle used, analogue and digital transducers, primary and secondary transducers, **Transducer types:** potentiometric transducers, LVDT, thermocouple, capacitive, inductive, piezoelectric. **Transducer circuits:** temperature sensors, fire detector etc. **Oscilloscopes:** Internal architecture and operation, principle of signal display, voltage, current, period and frequency measurement. **Signal generators:** Requirements of a signal generator, sine wave generator, basic theory of oscillators (Wien bridge, RC phase shift, Hartley and Colpitts), RF signal generation, Lab type signal generator, function generator (specification and principle of operation), Spectrum **analysers:** characteristics and principle of operation**.**

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 7)
- 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes): 5%
    - Lab practical (At least 4 labs): 35%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% continuous assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
   [1] Measurement and Instrumentation. Theory and Application, 2nd Edition: Alan S. Morris, Reza Langari.
   [2] Introduction to Instrumentation and Measurements, 2nd Edition: Robert B. Northrop
2. Lecture notes

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8.5.3 YEAR 3 OF (32BHCI) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING

8.5.3 1 YEAR 3 SEMESTER 1

Module Title	MICROPROCESSOR SYSTEMS
Code	I3721CM
NQF Level	7
Notional Hours	80
Contact Hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	8
(Co-requisites)	
Prerequisite(s)	I3632CD DIGITAL ELECTRONICS
Semester Offered	1

Module Purpose
This course aims to provide knowledge for the architecture of microprocessors and skills for developing assembly language applications for microprocessors.

Overarching Learning Outcomes
Discuss the architecture of microprocessors as well as design, implement and analyse microprocessor-based systems and assembly language applications.

Specific Learning Outcomes
1. Discuss microprocessor architecture.
2. Write assembly language programmes for microprocessors for different applications.
3. Design memory interfacing circuits for microprocessors.
4. Design input/output peripherals interfacing circuits for microprocessors.
5. Analyse given assembly language programme to determine functionality and/or correct syntax and semantic errors.
6. Develop assembly applications capable of switching external devices ON/OFF and monitoring binary signals on microprocessor I/O ports.
7. Design interrupt generating circuit for microprocessor.
8. Develop a microprocessor-based application (incorporating digital electronics, analogue electronics, and assembly language).

Module Content:
Computer Systems: History of microprocessors-based systems, elements, and organisation of computer systems, instruction cycle. **Memory Devices**: RAM (SRAM, DRAM, DRAM cell arrays), ROM (EPROM, EEPROM), flash memory, memory addressing, address multiplexing, bus contention. **Microprocessors and architecture**: types of microprocessors, registers (general purpose register, special function registers) arithmetic and logic unit, execution unit, control unit, internal bus, external buses (address bus, data bus, control bus, bus timing), pipelining, segmentation, memory banks, pin diagram, maximum/minimum mode configuration. **Timing Diagrams**: T-cycle, machine cycle, instruction cycle, bus cycle, execution cycle and execution time of instructions. Addressing Modes: data **addressing modes**, programme memory addressing modes, I/O ports addressing, stack addressing modes. **Instruction set**: data transfer, arithmetic, logical, string manipulation, process control, control transfer instructions etc. **Microprocessor Programming**: Assembly language programming and programme structure, assembler directives compilers, debuggers, linkers, loaders etc., macros, procedures, code optimisation. **Memory interfacing**: Memory organisation, memory capacity, memory address decoder circuit, memory map design, memory interfacing. **Input/output interfacing**: Interfacing IC (e.g. 8255 PPI) architecture, pin diagram and configuration, I/O memory mapping, port address decoder circuit, command/control words, modes of operation, I/O interface programming clock generator circuits. **Interrupt mechanism**: sources, types, interrupt procedure, vector table, interrupt priority, non-maskable interrupt, maskable interrupt, priority modes, interrupt control/command words, interrupt service routines.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6)
3 Engineering Design (Course Outcomes 3 - 5)
1. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks
2. One tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions

Students Assessment Strategies
1. Students will be assessed through continuous assessments activities.
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments (at least 2), 10%
2. Practical work (at least 4), 30%
3. Tests (At least 3 tests), 40%
4. End of semester project, 20%

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.

2. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Textbooks
   i. K. M. Bhurchandi and A. K. Ray, Advanced Microprocessors and Peripherals. 3rd ed. Tata McGraw Hill Education Pvt Ltd, 2013.
   ii. Y. Liu and G. A. Gibson, Microcomputer systems: the 8086/8088 family: architecture, programming, and design. Prentice-Hall, 1986.
3. Lecture presentation slides.
4. Microprocessor datasheets.
5. Microprocessors development boards.

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Module Title:	**MACHINE LEARNING**
Module Code	I3791CM
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	(I3512IM ENGINEERING MATHEMATICS II)
Pre-requisite	**I3691CP COMPUTER PROGRAMMING I**
Semester Offered	1

Module Purpose:

This module will introduce the field of Machine Learning (ML). ML techniques enable us to automatically extract features from data so as to solve numerous predictive tasks, such as speech/object recognition, machine translation, anomaly detection, medical diagnosis and prognosis, automatic algorithm configuration, and robot control, etc., In this course, we intend to introduce some of the basic concepts of mathematics and optimization required for machine learning. We cover different learning paradigms (supervised, unsupervised learning, reinforced, and deep learning) and some of the more popular algorithms and architectures used in each of these paradigms. Students will learn the algorithms, which underpin many popular ML techniques, as well as applying mathematical/Engineering Knowledge in developing and understanding of the theoretical relationships between these algorithms. The practical labs will concern the application of ML to a range of real-world problems using computer aided software tools.

Overarching Learning Outcome

Demonstrate ability to develop algorithm and apply ML to real life problem.

Specific Learning Outcomes

On completing the module students should be able to:

1. Discuss necessary numerical computation and optimization techniques.
2. Discuss the fundamental issues and challenges of machine learning
3. Discuss important paradigms of supervised, un-supervised, reinforced learning.
4. Apply mathematical and Engineering Knowledge in developing machine learning models.
5. Evaluate models generated from data.
6. Explain Biological motivations for neural networks.
7. Estimate the parameters effecting neural networks and deep learning.
8. Design and implement various ML algorithms to solve real world problems using Computer aided software tools.

Module Content:
Introduction: Importance of Machine Learning techniques, Review of Basic Mathematics required for ML (Analytic Geometry, Matrix decomposition, Dimensionality reduction, Bayes theorem), Numerical computation and optimization, Machine Learning packages; **Learning approaches**: Supervised, Unsupervised, Reinforced learning techniques with examples. **Linear and Logistic Regression:** Bias/Variance Trade-off, Regularization, Variants of Gradient Descent, MLE, MAP; **Classical ML Techniques**: Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, k-Means clustering, kNN, Expectation Maximization. **Neural Networks**: Introduction, Early models, Biological neural network, Artificial neuron, Artificial neural network (ANN) architecture, Multilayer Perceptron learning, Backpropagation, Initialization, training and Validation, Parameter estimation. **Convolutional Neural Networks**: CNN Operations, CNN architectures, Training, Transfer Learning. **Deep Learning**: Introduction, parameters affecting DL, Deep convolutional neural networks, Recurrent neural networks, feature extraction, Autoencoders, Training of deep neural networks. **Applications**: Speech/Image (1D/2D) processing data sets
LAB: Computer aided software (MATLAB/Python/TensorFlow/Keras)

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks
2. one tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
    1. At least 2 assignments, and at least 2 lab reports: 50%
    2. Mini-project and presentation (at least 2 presentations): 50%

Criteria for qualifying for the Examination:
1. A student must obtain a minimum of 50% in the assessment activities.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources
1. Books
2. Lecture Notes

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Next Revision: September 2028

Module Title:	**APPLIED ELECTROMAGNETICS**
Module Code	I3781CE
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials Session / Week
Additional learning requirements	NONE
NQF Credits	12
(**Co-requisites)**	(S3582GP PHYSICS FOR ENGINEERS II)
Pre-requisite	
Semester Offered	1

Module Purpose:
The purpose of this module is to provide an understanding of electromagnetic field (EM) and wave theory in the context of applications in electrical engineering.

Overarching Learning Outcome
Analyse, with the help of laws of electromagnetics, electromagnetic wave propagation through different RF devices and circuits.

Specific Learning Outcomes
On completing the module students should be able to:
1. Interpret visualizations of electric fields, electric scalar potentials, and magnetic fields in terms of the forces that charged particles or currents would experience.

2. Apply electromagnetic laws, Columbus, Gauss, Biot - Savart, Amperes laws to compute electric forces and fields, magnetic forces and fields due to charge or current distributions with appropriate symmetry.
3. Distinguish the behaviour of magnetic and electric fields in the presence of dielectric and magnetic materials.
4. Analyse electromagnetic wave propagation in generic transmission line geometries.
5. Compute the reflection coefficient, VSWR, reflected and transmitted power in a transmission line with various loads. Determine these values mathematically and using a Smith chart.
6. Formulate and analyse problems involving lossy media with planar boundaries using uniform plane waves.
7. Characterize the radiation of an antenna in terms of radiation pattern, directivity, beam width, and radiation resistance.

Module Content:
Review of Vector Algebra: Classification of vector fields. **Electrostatics:** Coulomb Law and Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equations for static EM fields. Electric potential; **Electric Field in Material Space:** Polarization in Dielectric; dielectric constant and strength; Continuity Equation and Relaxation Time; Boundary Conditions; **Magnetostatics**: Biot-Savart's Law; ampere Circuital Law; Maxwell Equation for time varying fields; Application of Ampere's Law Magnetic Flux Density; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices; Magnetic Boundary Conditions. Maxwell's equations in time-varying fields; Waves and phasors. Transmission lines; infinite transmission line; terminated transmission line; input impedance; standing and travelling waves; VSWR; power flow.
Basics Concept of Mode: TEM, TE and TM Modes and their characteristics Smith Chart: Development; use; matching-single and double stub. **Plane waves**: Plane wave propagation; Wave reflection and transmission**; Radiation and antennas**: Basic radiation fundamentals; launching and receiving radiating waves.

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2,3,5,6,7)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. one tutorial session per week for 12 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments (tutorials, quizzes): 20%
2. Tests (At least 3 tests): 60%
3. Labs (lab reports): 20%

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 40% in the CA.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students' lecturer evaluation
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources
- Books
  1. Fawwaz T. Ulaby and Umberto Ravaioli, Fundamentals of Applied Electromagnetics, 7th Edition, Pearson Education International, 2015.
  2. M. N. O. Sadiku, Elements of Electromagnetics, 5th Ed., Oxford University Press, 2010.
  3. J. Edminster, Schaum's Outline of Electromagnetics, 3rd Ed., McGraw Hill Professional, 2010.
  4. Karl E. Lonngren, etc., Fundamentals of Electromagnetics with MATLAB, 2nd Edition, Scitech Publishing, Inc., 2007.
  5. NannapaneniNaraynan Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson Education International, 2006.
  6. W.H. Hayt and J.A. Buck, Engineering Electromagnetics, 8th Edition, Boston: McGraw Hill, 2012.
- Lecture Notes

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Module Title	ANALOGUE ELECTRONICS II
Code	I3781CA
NQF Level	7
Notional Hours	120
Contact Hours	3L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	
Prerequisite(s)	**I3691CA ANALOGUE ELECTRONICS I**
Semester Offered	1

Module Purpose
This course aims to provide advanced knowledge and skills for analysis and design of analogue electronic circuits.

Overarching Learning Outcomes
Analyse and design different analogue electronic circuits for different engineering applications.

Specific Learning Outcomes
1. Determine the frequency response of transistor-based circuits.
2. Analyse and design different op-amp based circuits.
3. Analyse and design power amplifiers.
4. Analyse and design filter circuits.
5. Analyse and design oscillator circuits.
6. Analyse ADC and DAC circuits.
7. Analyse and design power supply circuits.
8. Analyse and design switching circuits employing power electronics components.
9. Develop printed circuit boards.

Module Content:
Frequency response of BJTs and FETs transistor circuits. logarithmic scale, decibel concept, frequency bode plot, cut off frequency, midrange frequency, low frequency response, high frequency response, Miller capacitance, Multistage frequency effects. Square wave testing. **Op-Amps**: Differential amplifier circuit. BiFET, BiMOS and CMOS differential amplifier circuits. Practical Op-Amp circuits. Op-Amp specifications**. Applications**: including summing amplifiers, controlled sources, differential amplifiers, active filters, oscillators., comparators, Schmitt trigger, timer circuits, analogue to digital conversion, digital to analogue conversion, Controlled sources. Instrumentation circuits. etc**. Power Amplifiers**: Class A, B, C and D: series fed circuits, including transformer coupled circuits; **construction**: Transistor configuration, Q- operating point location. **operation**- biasing methods of Class A, B, C and D, push pull operation, cross -over distortion, calculation of efficiency of class A, B, C and D. **Linear Digital ICs**: ADC and DAC circuits, comparator unit operation, Timer IC unit operation, voltage-controlled oscillator, phase locked loop circuits. **Oscillator Circuits**: relaxation and sinusoidal oscillators. **Oscillator operation**. conditions for oscillation, start-up conditions, Barkhausen criterion**. Oscillator Types** Phase shift oscillator. Wien bridge oscillator. Tuned oscillator and crystal oscillator. Feedback transistor-based oscillator circuits, Uni-junction oscillator **Power Supplies**: Block diagram, rectification, filtering circuits, ripple factor, regulation (series and shunt circuits), IC voltage regulators. **Power electronics devices**: Construction Principle of operation, and applications of (SCR, SCS, GTO, Triacs, DIACs, UJT, LASCR, IGBTs): construction, operation, Other two terminal devices: Construction, operation and applications of Schottky diode, Varactor diode, Power diodes, Tunnel diode, Photodiode, Photoconductive cells, IR emitters, Solar cells, Thermistors, Liquid crystal displays.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcome 1 - 8)
3 Engineering Design (Course Outcomes 2 - 8)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1 - 9)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorials or one practical session per week for 12 weeks
3. Weekly consultation sessions
4. Face to face consultations

Students Assessment Strategies
- Students will be assessed through continuous assessments activities.
- The Continuous Assessment will be made up of the following assessment activities:
  i. Assignments (at least 2), 10%
  ii. Practical work (at least 4), 30%
  iii. Tests (At least 3 tests), 40%
  iv. End of semester project, 20%

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and project.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. Books
   i. Electronic Devices and circuit theory: Robert L. Boylestad.
   ii. Fundamentals of Analog Circuits: Thomas L. Floyd.
   iii. Analog Electronics: Ian Hickman.
2. Lecture Notes
3. Videos and online lectures

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Module Title	**ELECTRONIC PRODUCT DEVELOPMENT**
Code	I3761CD
NQF Level	7
Notional Hours	80
Contact Hours	2L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	8
(Co-requisites)	
Prerequisite(s)	**I3691CA ANALOGUE ELECTRONICS I**
Semester Offered	1

Module Purpose
This course aims to provide knowledge, and practical skills, required to identify, analyse opportunities and requirements for Electronic Product Development.

Overarching Learning Outcomes
Develop an electronic and/or computer engineering product prototype to solve an identified problem/opportunity and requirements.

Specific Learning Outcomes
1. Identify and document problems/opportunities that can be solved using electronics and computer engineering knowledge and skills.
2. Identify and analyse system requirements, and corresponding testing methods, necessary to safely solve an identified problem/opportunity.
3. Develop and systematically select different concepts/methods/technologies capable of safely meeting system requirements based on clearly outlined valid criteria.
4. Develop design specifications for electronics products to requirements as well as industrial standards and regulations.
5. Develop a product/prototype, incorporating a printed circuit board, following a to satisfy design specification.
6. Test and troubleshoot the electronic circuit product based on identified requirements.
7. Produce a technical document of the product.

Module Content:
Electronic product development cycle; Problem Statement: problem/opportunity identification, problem/opportunity analysis, problem statement; System Requirements: identification and analysis, functional block diagrams; Product Design: Concepts identification and selection, design specifications, detailed design; Prototyping and testing: PCB development, schematic capture, layout design, heat sinks, Product packaging; Product design documentation. Project.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcome 1 - 7)
3 Engineering Design (Course Outcomes 1 - 7)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 6 first weeks
2. One tutorial session per week for first 6 weeks
3. Supervised individual/group project for final 6 weeks.
4. Consultation sessions.

Students Assessment Strategies
1. Students will be assessed through continuous assessments activities.
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignment reports and presentations (at least 3), 25%.
2. End of semester demonstration, 25%.
3. End of semester project report, 50%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies
1. The course will be facilitated on a project-based learning method.
2. Internal and external moderation of student project reports.
3. Peer-review of course outlines and teaching.
4. Student's evaluation.
5. Regular review of course content.
6. Effective and efficient supervision and monitoring of assignments and project.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:
1. Invite students for one-one supervision to find the root cause of the problem.
2. Offer extra reading materials where applicable.
3. Implement a semester course evaluation.

Prescribed Learning Resources
1. Books
   i. Product Design and Development by Ulrich and Karl
   ii. Electronic Instrument Design by Kim R. Fowler.
2. Lecture Notes and videos.

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Module Title		**ANALOGUE AND DIGITAL COMMUNICATIONS**
Code		I3711CA
NQF Level	7	
Notional Hours		160
Contact Hours		4L + 1T or 1PS /Week
Additional learning requirements	NONE	
NQF Credits		16
(Co-requisites)		I3692CS Signals and Systems
Prerequisite(s)		**I3582IS Statistics for Engineers**
Semester Offered		1

Module Purpose
This course aims to provide the necessary and underlying principles applied in analogue and digital techniques for the transmission and reception of information.

Overarching Learning Outcomes
Analyse and design elements of an analogue and digital communication systems used for transmission and reception of audio/radio signals.

Specific Learning Outcomes
1. Apply principles involved in the transmission and reception of information in a communication system.
2. Explain the architecture of a generic analogue and digital communication systems.
3. Analyse the effect of different types of noise in communication systems.
4. Analyse the performance of analogue/digital modulated signals under white noise.
5. Discuss the process of converting analogue signal to digital format and its application to waveform coding.
6. Estimate the channel capacity of a bandlimited communication channel.
7. Apply different source, error correction, channel coding and decoding techniques for error free communications.
8. Evaluate the performance of various communication systems using simulation packages (e.g., MATLAB or equivalent).
9. Design baseband receiver, matched filter for optimal digital signal reception.

Module Content:

Fundamentals of Electronic communication: Review of Signal models and analysis. Elements of communication system, Communication channels, Bandwidth, Classification of Electronic communication systems, limitations of communication systems, comparison of analogue and digital communication systems. **NOISE**: Noise sources, Classification of noise, noise bandwidth, noise figure and noise temperature; noise models **Analog modulation techniques**: Modulation Types – Need for Modulation. **Amplitude modulation**: Theory of AM, DSBSC and SSB Techniques. Generation and Detection of AM, DSB SC and SSB waves. Vestigial sideband transmission, **AM Receiver**: Receiver characteristics, Tuned radio frequency (TRF) receiver, Super-heterodyne receiver, Automatic Gain control, Noise in AM, **Angle Modulation**: Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band and Wide band FM, Generation and Detection of FM Waves, Comparison of FM and AM, PM and FM. FM receiver, Noise in angle modulation, Pre-emphasis, and De-emphasis. **Pulse modulation techniques**: Analog to digital conversion, Generation, and detection of PAM, PWM and PPM, Performance comparison. **Waveform coding:** Pulse code modulation (PCM), Quantization noise, Companding, standards for Companding, DPCM, Delta and Adaptive delta modulation, Voice codecs and codec standards. **Multiplexing Techniques**: Frequency division, time division, and code division multiplexing, Comparison of frequency division and time division multiplexing, T1-Carrier system. **Baseband transmission**: Basic lines codes, comparison and spectral estimation of line codes, coding standards for LAN and telecommunications networks. Bit error rate, Inter-symbol interference and equalization. Eye diagrams. Repeaters and regenerators. **Digital modulation techniques**: Digital carrier systems, Passband transmission model and performance parameters, working principle of ASK, FSK and PSK transmitter and receiver, M-ary PSK, QAM, Signal space representation, Band width, Applications of Digital modulation techniques, OFDM. **Information theory and Source coding**: Definition of Information, Symbol source encoding, representation and analysis of codes, entropy coding methods, conditional entropy and redundancy, entropy rate, channel capacity. **Channel coding:** Error control coding, Linear block codes: generator and parity check matrices, syndrome testing, typical linear block codes and their applications. Cyclic codes, polynomial representation of codes, convolutional codes, Turbo codes. **Optimal receiver design**: Baseband Signal Receiver and its probability of error, Optimum Receiver, Matched Filter, Probability of error for ASK, PSK, FSK.

LAB Practicals: Use Computer simulation software (e.g., MATLAB/PYTHON or equivalent) and Analog and Digital communication trainer kits

Contribution to Exit Level Outcome:
2. Application of Scientific and Engineering Knowledge (Course Outcome 1 - 10)
3. Engineering Design (Course Outcome 11)
4. Investigations, Experiments and Data Analysis (Course Outcome 10)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcome 4, 7 -10)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions

Students Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments (at least 2 Assignments): 20%,
2. Labs (at least 5 labs): 30%
3. Tests (At least 3 tests): 50%

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment (CA).

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Prescribed Learning Resources
1. B.P. Lathi, “Modern Digital and Analog Communication Systems, 3rd Edition, Oxford University Press, 1998
2. S. Haykin and M. Moher, “Introduction to Analog and Digital Communications”, Wiley, 2nd Edition, 2007.
3. Sanjay Sharma, “Analog and Digital communication System”, S.K. Katariaand sons, 6th Edition, 2013

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8.5.3.2 YEAR 3 SEMESTER 2

Module Title:	TECHNICAL WRITING
Module Code	I3762VW
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(U3683AL Academic Literacy II)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with skills based in theory relating to professional and technical writing.
Overarching Learning Outcome
Students should be able to communicate effectively and professionally - orally and through audio-visual means - and to write good technical documents individually and in teams.
Specific Learning Outcomes
On completing the module students should be able to:
1. Produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. Communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates and complying with constraints on document format.
3. Adapt content and rhetorical strategies according to audience and purpose for each document.
4. Select appropriate, credible sources to support the claims, findings or recommendations made in technical documents.
5. Incorporate ideas from source material, including images and figures.
6. Create and deliver technical briefings tailored to specific audiences, purposes and media.
7. Explain ethical considerations applicable to technical communication in engineering and computer sciences.

Module Content
Introduction: academic vs technical communication; introduction to a various technical and business writing theories and practices designed to be applicable to the production of business communication in the real world. Technical writing: fundamentals of good business/technical writing, including protocols for business letters, memoranda, electronic mail, good and bad messages; persuasive messages and formal reports and proposals. Technical reports: planning, structure, style and language for purpose and audience; effective graphical support. Professional Oral communication: structure, style and language; academic and professional discourse; group presentations to industry professionals. Posters and e-portfolios.
Contribution to Exit Level Outcome
Professional and technical communication (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).
Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Face-to-face consultations wherever necessary.
3. Case studies.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Assignments: 20%.
2. Group oral presentations: 10%.
3. Individual reports: 40%.
4. Tests (at least 2): 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of project reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
English, J. (2013). Professional Communication: Deliver effective written, spoken and visual messages. 3rd Edition, Juta Academic.

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Module Title	MICRONTROLLER ARCHITECTURE AND PROGRAMMING
Code	I3742CM
NQF Level	7
Notional Hours	80
Contact Hours	2L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	8
(Co-requisites)	
Prerequisite(s)	**I3721CM MICROPROCESSOR SYSTEMS**
Semester Offered	1

Module Purpose
This course aims to provide knowledge for the architecture of microcontrollers and skills for developing assembly language applications for microcontrollers.
Overarching Learning Outcomes
Discuss the architecture of microcontrollers as well as design, implement and analyse assembly language applications for 8-bit microcontrollers.
Specific Learning Outcomes
1. Analyse given assembly language programme to determine functionality and/or correct syntax and semantic errors.
2. Develop assembly applications capable of switching external devices ON/OFF and monitoring binary signals on microcontroller's I/O ports.
3. Develop interrupt based assembly applications.
4. Develop assembly application that incorporate microcontroller built-in EEPROM memory.
5. Develop assembly applications capable of converting analogue voltage to digital form.
6. Develop assembly application that incorporate microcontroller USART module.
7. Develop assembly application that capable of interacting with liquid crystal displays (LCD) and keypads.
8. Develop a microcontroller application (incorporating digital electronics, analogue electronics, and assembly language) as an end of semester project.

Module Content:
Microcontroller Architecture (for one selected 8-bit microcontroller family i.e., PIC or Atmel – with internal ADC): Pinout, port structure, Microcontroller Memory Organisation and Memory Mapping: SRAM organisation, general purpose registers, pointer registers, I/O registers, stack memory; programme memory organisation, programme memory counter; EEPROM organisation, additional microcontroller internal peripherals**. Microcontroller Applications Development Tools**: Development board (datasheet), development environments, assemblers, programme uploading and verification. **Assembly Language** (for one selected 8-bit Microcontroller family): Assembly vs Machine language, assembly file structure, assembler directives, include files, sub-procedures and macros. **Instruction Set** (for selected 8-bit Microcontroller family): Instruction set, arithmetic logic instructions, branch instructions, data transfer instructions, bitwise instructions, CPU control instructions, stack pointer initialisation. **Application Design Principles and tools**: Pseudocode, flowcharts, design to code translation. **I/O register access,** on/off control of external components e.g LEDS, dc motors etc., monitoring of digital input voltage e.g., from push buttons, or other external digital circuits**; Analysis and design of delays** (without built-in timers): Machine cycles, long delay implementation. **Interrupts**: Interrupt vectors, external interrupt setup, interrupt service routines. Internal EEPROM: EEPROM registers, writing to **internal EEPROM**, reading from internal EEPROM. **Internal Analogue to Digital Conversion** (single ended only): ADC features, Internal ADC operation, ADC registers, ADC sampling frequency selection, single conversion ADC operation, free running ADC operation, interrupt-based ADC operation. USART**: USART** registers, configuration, reading and writing to USART devices.
Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6)
3 Engineering Design (Course Outcomes 3 - 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 5)
Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions

Students Assessment Strategies
1. Students will be assessed through continuous assessments activities.
2. The Continuous Assessment will be made up of the following assessment activities:
3. Assignments (at least 2), 10%
4. Practical work (at least 4), 30%
5. Tests (At least 3 tests), 40%
6. End of semester project, 20%

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. Invite students for one-one consultation to find the root cause of the problem.
2. Offer extra reading materials where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Textbook
    - Programming And Customizing The AVR Microcontroller by Dhananjay V. Garde, McGraw Hill Education TAB; 1st edition (October 9, 2000), ISBN-13 : 978-0071346665.
2. Lecture presentation slides.
3. Microcontroller datasheets.
4. Microcontroller development boards.

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Module Title	**RADIO FREQUENCY AND MICROWAVE ENGINEERING**
Code	I3782CM
NQF Level	7
Notional Hours	120
Contact Hours	3L + 1T /Week
Additional learning requirements	Mini group Design Project
NQF Credits	12
(Co-requisites)	(I3781CE Applied Electromagnetics)
Prerequisite(s)	
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to radio frequency (RF) /microwave analysis methods and design techniques.
Overarching Learning Outcomes
Analyse and design microwave circuits and components.
Specific Learning Outcomes

1. Model different RF components, RF Front end architecture used in microwave communication.
2. Analyse wave propagating properties of guided wave structures (TE, TM, TEM waves): coaxial line, parallel plate, microstrip, stripline, rectangular and circular waveguides, and coupled lines.
3. Apply N-port representations for analysing microwave circuits.
4. Analyse transmission line and dimensions needed for the specific system requirements.
5. Design a matching network to maximize systems performance.
6. Examine passive and active microwave semiconductor devices.
7. Analyse and design basic microwave circuits using microwave network parameters.
8. Design simple passive microwave circuits using Computer Aided Design (CAD) tools.
9. Examine Network and Spectrum Analyzers, demonstrate Calibration Techniques for Vector Network Analyzers
10. Evaluate characteristics of antennas needed for microwave radar, communications and remote sensing systems.

Module Content:
Introduction to RF and Microwave Engineering; RF components (Coaxial Line, Rectangular Waveguide, Antennas, Microstrip Line), RF Front end design, Operation, Frequency
Principles of Microwave Semiconductor Devices: Gunn Diodes; IMPATT diodes; Schottky Barrier diodes, PIN diodes, etc. Microwave tubes: working principles of Klystron; TWT; Magnetron; **High Gain and Low Noise RF Amplifier Design**.
Three and Four Port Networks: Design and Applications of Power Dividers and Combiners; Directional Couplers and other hybrids
Microwave Filters: Periodic Structures, Filter design Concepts, Transmission Line Filters, **Microwave Filter Technologies;** Non **Ideal Effects in RF and Microwave Engineering**: Noise in Microwave Circuits, Noise Figure, Noise Measurement, Linearity, Dynamic Range;

Microwave Network Analysis: ABCD; Scattering Parameters for microwave Circuits; Lumped and Distributed Matching Circuits; Multi Section Broadband Transformers; Microwave Measurements: Spectrum and Network Analyser measurement of scattering parameters.
System design concepts: Systems Aspects of Antennas; Receiver Architectures; Operation, Frequency
RF and Microwave Computer aided tools such as AWR and CST, Sonnet, HFSS.
Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1,)
3. Engineering Design (Course Outcomes 1, 3 and 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 5, 6)
Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks
2. One tutorial session per week for 12 weeks
3. Mini group design project
4. Weekly consultation sessions
Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination.
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments (tutorials, quizzes): 20%
2. Tests (At least 2 tests): 40%
3. Labs (lab reports): 20%
4. Mini group design project 20%
Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 40% in the CA.
Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper)
Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students' evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. Davis, W. A., and Agarwal, K. (2003). Radio frequency circuit design (Vol. 162). John Wiley and Sons.
2. Pozar, David M. Microwave engineering. John wileyand sons, 2011.

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Module Title	**DATABASE SYSTEMS**
Code	I3791CD
NQF Level	7
Notional Hours	120
Contact Hours	3L + 1T or 1PS/Week
Additional learning requirements	Mini project
NQF Credits	12
(Co-requisites)	None
Pre-requisite(s)	**I3692CP COMPUTER PROGRAMMING II**
Semester Offered	2

Module Purpose
This course aims to provide knowledge and skills for the development of database systems.
Overarching Learning Outcomes
Plan and implement database systems.

Specific Learning Outcomes
1. Compare the types of database technologies.
2. Construct different types of database system prototypes.
3. Examine structured query languages.
4. Inspect technologies of conventional and file-processing systems.
5. Evaluate prototyping methodology and enterprise data models.
6. Make effective use of Structured Query Language.
7. Explain Database Security and Protection.

Module Content:
Overview of Database systems: model, schema, instance. Database system vs. File systems. Data abstraction levels, database languages, system architecture. Classification of Database Management System. Data modelling: Entity-Relationship (ER) Model, Entities and Entity types, Relationship and Relationship type, Constraints, Weak Entity Types, ER, Diagrams. Semantic object model. Process of database design: requirement analysis, conceptual database design, database schema design. Database design using entity-relationship and semantic object models, database application design. Terminology in Relational Data model, Integrity Constraints, Primitive Operations on Relations, Relational Algebra (RA), Relational Algebra Operations, Relational Completeness, Additional Operations on Relations. Foundations of relational implementation. Structured Query Language (SQL): DML Features in SQL, DDL in SQL, updates in SQL, Views in SQL, Embedded SQL, Query-by-Example (QBE). Concurrency, recovery, and security issues. Armstrong's inference rules and minimum covers, normal forms. Current trends in database systems: Client-Server database systems, Open Database connectivity (ODBC) standard, knowledge-Based Systems, Object-Based Systems, data warehousing and data mining concepts, Web databases. Concept in database systems, inverted file structure; query formulation and language; data structure to minimize access time; construction of database management systems. Commercial Programming languages and e manipulations programme preparation. Coding forms file maintenance, backup and protection. Types of databases; Evolution of Database technologies; Database technology versus conventional file-processing systems; Functional Dependencies; Normalization and denormalization.

Contribution to Exit Level Outcome:
3 Engineering Design (Course Outcomes 2, 3,5,6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 4, 7)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
8. Four lecture periods per week for 12 weeks
9. One tutorial or one practical session per week for 12 weeks
10. Weekly consultation sessions

Students Assessment Strategies
1. Students will be assessed through continuous assessments
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments and labs (at least 2 Assignments), 10%,
2. Labs (at least 3 labs): 20%
3. Tests (At least 2 tests), 50%
4. Mini project 20%

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. W. Sheilds. SQL QuickStart Guide: The Simplified Beginner's Guide to Managing, Analyzing, and Manipulating Data With SQL, ClydeBank Media LLC. 2019.
2. U. Malik., M. Goldwasser, B. Johnston: SQL for Data Analytics: Perform fast and efficient data analysis with the power of SQL, Packt Publishing, 2019.

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Module Title	OPERATING SYSTEMS
Code	I3792CO
NQF Level	8
Notional Hours	120
Contact Hours	3L + 1T or 1PS/Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	(I3691CP Computer Programming I)
Prerequisite(s)	**None**
Semester Offered	1

Module Purpose
This course aims to provide the underlying knowledge of different operating systems.
Overarching Learning Outcomes
Discuss the components and functions of operating systems including multitasking, synchronisation, deadlocks, scheduling, and inter-process communication.
Specific Learning Outcomes
1. Discuss the core functionality of modern operating systems such as Windows and Unix based
2. systems.
3. Distinguish key concepts in computer memory management.
4. Discuss the File System interface, files, processes, and inter-process communication for modern
5. Operating systems.
6. Write programmes that interface to the operating system at the system-call level.

Module Content:
Introduction and General overview of operating systems and basic concepts. OS organization: processes and interprocess communication, kernels, multithreaded programming, memory allocation, resource allocation and scheduling, file systems and persistent storage, protection and security. OS services, System calls, User interface, Shell command interpreter, Operating System Design and Implementation, Virtual machines. Processes: Process concept, Process state, Process management. Threads concept, Threads versus processes, P-Threads, Multi-threaded applications. Scheduling: Short-term CPU scheduling, Longer-term scheduling, Priority scheduling, Size-based scheduling. Concurrency and Synchronization: Concurrent processes, Contention, Synchronization issues, Critical sections. Deadlocks: Deadlock detection and prevention. Memory Systems: Memory layout, Memory management, Hardware and software support for addressing, Segmentation versus paging. Virtual Memory: Virtual memory systems, Memory hierarchy, Hardware and software support, Page tables, Page faults and TLBs. File System Interface: File system concepts, File operations, Basic storage, File management issues. File System Implementation: File system design issues, Original Unix file system, Unix fast file system, Caching, File system optimization. Storage and I/O Systems: Storage systems, Speed. Capacity, Reliability, RAID systems, Input/output. Memory-mapping, Peripheral devices, Networked I/O, Storage Area Networks.

Contribution to Exit Level Outcome
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3,4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
7. Two lecture periods per week for 12 weeks
8. One tutorials or one practical session per week for 12 weeks
9. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination.
2. The Continuous Assessment will be made up of the following assessment activities:
2. Assignments (tutorials, quizzes, reports, practical assignments): 20%
3. Tests (At least 2 tests): 60%
4. Labs (at least 3 labs reports): 20%

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 40% in the CA.
Criteria for passing the course:
2 To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper)

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.

2. Peer-review of course outlines and teaching.
3. Students' evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts Ninth Edition, Wiley, 2012
2. G. Tomosho, Guide to Operating Systems Fifth Edition, Cengage Learning, 2007

Issue Date:	September 2023
Next Revision:	September 2028

Module Title	**CONTROL ENGINEERING**
Code	I3832EC
NQF Level	8
Notional Hours	160
Contact Hours	4L + 1T or 1PS/Week
Additional learning requirements	NONE
NQF Credits	16
(Co-requisites)	(I3611IM ENGINEERING MATHEMATICS III)
Prerequisite(s)	
Semester Offered	2

Module Purpose

Aim of this Module is to introduce students to modelling, analysis, and design of linear feedback control systems from both classical and modern viewpoints, with a strong emphasis on the design of performance-oriented controllers under typical practical implementation constraints

Overarching Learning Outcomes

Analyse the performance of feedback control systems and design controllers to meet the required system specifications...

Specific Learning Outcomes
1. Model basic electrical systems as control systems or part of control systems.
2. Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
3. Design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
4. Explain the industrial applications of Controllers and compensators (PD, PI and PID)
5. Apply engineering software for modelling, analysis and design of control systems

Module Content:

Control Systems Basics: Fundamentals of control Theory, Components of a control system, applications of control systems, open and closed loops, Examples of Modern control systems

Modelling of dynamic Systems: Laplace transform review, Models of dynamic systems in differential equation form; electrical, mechanical, electro-mechanical systems, hydraulic systems, gear-trains and rotational systems. Modelling of the system using block diagrams. Transfer functions; transfer function representation of a model

Time Domain Analysis: Laplace transform review, system response to typical input signals, Step response performance Steady state errors in unity and non- unity feedback systems. Static error constants and system type,

Feedback control system concept and stability: Essential principles of feedback. Sensitivity of control systems to parameter variation. Disturbance signals in feedback signals. Stability analysis; concept of stability, Routh_ Hurwitz stability criterion, other stability criterion, relative stability of feedback systems, stability of closed loop systems.

Root Locus method: Root loci, plotting of root loci, System poles and zeros. Rules for root locus construction,

Frequency Response Concept: asymptotic approximation (Bode Plots), Nyquist stability criterion, gain and phase margins. Stability using Nyquist diagram and bode plots.

State space analysis: State variable system description, state vector differential equation, state equation form block diagram, and transfer function, Solution of state equation; characteristic equation of a state model, Control of multivariable systems; controllability and observability

Control Systems Design and compensation techniques: improving transient response and steady- state response using cascade compensation. Feedback compensation. System compensation using phase- lead, phase – lag and phase lead – lag networks on the Bode diagram and root locus, Dynamic compensation using; proportional (P), derivative (D), integral (I) proportional and derivative (PD), proportional and integral (PI), proportional derivative and integral (PID) controllers, Design of Feedback Controllers using PI, PD and PID Controllers

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1,2, 3, 4, 5,6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4,5)
3. Eng Design (Course Outcomes 4)
4. Investigations, Experiments and Data Analysis (Course Outcomes 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorials and/or one practical session per week for 12 weeks
3. Weekly consultation sessions
4. A group design project at the end of the modules

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
1. Assignments (tutorials, quizzes, lab and field reports): 5%
2. Tests (At least 2 tests): 15%
3. Design project (oral presentation and design report): 30%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in total CA marks

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour)

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. Norman S. Nise, "Control System Engineering"- 6th Ed, John Wiley and Sons, USA, 2011
2. Richard C. Dorf and Robert H. Bishop, "Modern Control system" 12th Ed, Pearson, UK, 2010

Issue Date: September 2023
Next Revision: September 2028

8.5.4.YEAR 4 OF (19BCEE) BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING

8.5.4.1 YEAR 4 SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 100% (at least 2 Assignments 20%, at least 3 Tests (covering the aspects: Law, Professionalism, Health and Safety) 80%).
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: Engineering societies and registration procedure for different Engineering disciplines. **General principles of Engineering ethics:** statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace.
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 7 (health and safety), 8)

10 Engineering Professionalism (Course Outcomes 1, 2, 3)

ECN Exit Level Outcomes Assessed:

10 ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).***Where and how is this exit outcome assessed?***

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitutes satisfactory performance?

After consideration of the 3 tests and 2 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Module Title:	PROJECT MANAGEMENT
Code	TEGM3891
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (at least 2 Assignments 20%, at least 2 Tests 30%, group project presentation 20% and group project report 30%). The group must consist of students from a minimum of two different disciplines.
Pre-requisite(s)	**TEGT3761 Fundamentals of Economics**

Content: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing Engineering projects**: medium to large scale and community based projects, inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation;
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team.

CONTRIBUTION to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

8 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**

Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitutes satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project

management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitutes satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Tittle	**CONTROL ENGINEERING**
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50% (At least 1 Assignment, At least 2 Tests and a mini-project), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGT3671 Engineering Mathematics III**

Contents: Control Systems Basics: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems:** Laplace transform review**,** transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of electrical systems. **Control System Analysis:** system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques:** Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators.

Learning Outcomes: On completing the course students should be able to:

1. Discuss different control theory terminologies.
2. Model basic electrical systems as a control systems or part of parts of control systems.
3. Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control Engineering.
4. Analyse and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Use Engineering software for modelling, analysis and design of control systems

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
3 Engineering Design (Course Outcomes 4, 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5)

Module Title:	**DIGITAL SIGNAL PROCESSING**
Code	TCEE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (2 Assignments and 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite	**TTCE3692, Signals and Systems;**

Contents: Introduction: Review of signal classes and the sampling theorem, overview of analog-to- digital and digital-to-analog conversion. **Discrete-Time Signals and Systems**: Analysis of discrete-time linear time-invariant (LTI) systems, difference equations, implementation. **The z-Transform**: definition, properties, rational z-transforms, inverse of z-transform, analysis of LTI systems in the z-domain. **Frequency-Domain Analysis**: Discrete-time Fourier transform (DTFT), frequency response of LTI systems, frequency selective filters, inverse systems and deconvolution **Sampling and Reconstruction**: Discrete-time processing of continuous-time signals, quantization errors, sampling of bandpass signals. **DFT and FFT**: Discrete Fourier Transform, complexity of filtering, radix-2 fast Fourier transform. **Implementation of Discrete-Time Systems**: Structures for the realization of discrete-time systems, FIR systems, IIR systems, representation of numbers. **Digital Filter Design**: General considerations, symmetric and antisymmetric FIR filters, FIR filter design using windows, IIR filter design by using bilinear approximation. **Applications to audio, image and video processing**.

Learning Outcomes: Upon completing the course students should be able to:

1. Discuss the fundamental concepts of DSP

2. Apply mathematical and basic science tools in analysis of discrete signals and systems
3. Apply mathematical and basic science tools for signal processing
4. Design, implement and test digital filters.
5. Develop audio and video systems incorporating DSP algorithms

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
3 Engineering Design (Course Outcomes 4, 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5, 1)

ECN Exit Level Outcomes Assessed:

2. **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**
Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve Complex Engineering problems.

Assessment Strategies

The assessment will constitute the following:
Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, basic science and Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the use of mathematical, numerical analysis and statistical knowledge and methods to bear on Engineering problems; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of Engineering science at a fundamental level and in at least one specialist area.

What constitutes satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be allowed to take the supplementary exam, after which if the minimum competence is still not obtained, then the student is considered to have failed the course.

Module Title	**EMBEDDED SYSTEMS DESIGN II**
Code	TETD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 100% (at least 4 labs 20%, at least 2 tests 40%, Mini Project 40%)
Pre-requisite(s)	**TETD3792 Embedded Systems Design I**

Contents: Embedded systems design methodology; Embedded C programming (using AVR compiler or equivalent**):** C versus Assembly, header files, variables, constants, data types, type casting, operators (including bitwise operators), expressions, control statements. Built-in and user defined functions, (including prototyping and declaration. Pointers and arrays, structures and unions. Accessing different memory types. Timers and interrupts**; Advanced Applications:** e.g. ADC, PWM stepper motor control, USB applications, Serial Peripheral Interface (SPI) (e.g. SD card) applications, UART applications (including communication with PCs and AT based modems and devices), EEPROM usage, state machines; **Advanced embedded systems programming concepts:** processes, tasks, device drivers; **Embedded Systems Performance:** optimisation and algorithmic efficiency (memory and speed), levels of optimisation, embedded systems performance analysis, power consumption optimisation. Optimisation trade-offs. Mini group projects.

Learning Outcomes: On completing the course students should be able to:

1. Discuss merits and demerits of high level and assembly languages as used in embedded systems.
2. Explain the embedded systems design cycle.
3. Discuss advanced embedded systems programming concepts
4. Design and write efficient C programmes for embedded systems.
5. Optimise C code for embedded systems.
6. Discuss and use different embedded systems optimisation methods and algorithms
7. Execute micro-controller based individual and/or group projects effectively.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 7)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3)
3 Engineering Design (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5, 6)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 7)

Module Title:	WIRELESS COMMUNICATION

Code	TCEW3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics in wireless communication (**10%**), Examination (1 x 3 hour paper) making **50%**
Co-requisites	TTCD3792 Digital Communication
Pre-requisites	**TTCE3741 Telecommunication Principles**

Contents: Radio transmission: Propagation models, ground wave, space wave, ionospheric propagation, interference, noise analysis, Doppler effect. **Multiuser Communication**: Multiuser communication techniques, access techniques, interference mitigation techniques. **Mobile Telephony**: Telephone systems, frequency reuse technique, cellular architecture, handover techniques, mobility management. **Satellite Communication**: Geometry, transmission and access technique, radio sub systems, link design, network, application. **Mobile Communications Systems**: GSM, UMTS and LTE Network. Wireless Local Area Network: IEEE802.11, Bluetooth and IEEE802.15.4 based sensor networks. Individual students project on selected topics in wireless communication.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the Architecture and operation of wireless communications networks
2. Identify and discuss the fundamental operational and design problems of wireless communication systems
3. Apply basic techniques to design point to point wireless links and basic communication systems
4. Discuss network planning in wireless communication
5. Discuss basic technical standards related to 2G/3G/4G wireless systems
6. Make a presentation on independently studied selected topic in wireless communication.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3)

3 Engineering Design (Course Outcomes 2, 4, 5)

9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

9 **INDEPENDENT LEARNING ABILITY**

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will constitute the following:

At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics in wireless communication (**10%**), Examination (1 x 3 hour paper) making **50%**

To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 9 which will be assessed as follows:

Where and how is this exit outcome assessed?

Students will be given topics to study independently and make a presentation and submit a report.

This exit level outcome is assessed in the **presentation** and submitted **report** where the students are expected to demonstrate ability to

- Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative
- accurately self-evaluate and take responsibility for learning requirements;
- Consider social and ethical implications of applying knowledge in particular contexts.

What constitutes satisfactory performance?

After consideration of the **presentation** and submitted independently studied **report**, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the presentation and report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised independently studied report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will not obtain the sub minimum and hence will not be allowed to proceed to the exam and therefore will have to repeat the course. If a student meets the requirement but failed to obtain a minimum final mark of 50%, then he or she will have to repeat the course.

8.5.4.2 YEAR 4 SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TCER3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	Continuous 100%: Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s)	All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:

1. Design an Engineering investigation (methodology);
2. Conduct appropriate experiments for an Engineering investigation (data collection including from simulation) taking into consideration ethical issues like: health, safety and the environment;
3. Analyse and interpret the experimental data using appropriate tools including information technology;
4. Assess, benefits and impacts of the research: ergonomics, social, legal, health, safety, and environmental;
5. Communicate research findings effectively, both orally and in writing, with Engineering audiences and the community at large, clearly drawing reasonable conclusions and suggestions for future work.
6. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.

Contribution to Exit Level Outcome:

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5 Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6 Professional and Technical Communication (Course Outcomes 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**
   Demonstrate competence to formulate and conduct investigations and experiments.
5. **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**
   Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.
6. **PROFESSIONAL AND TECHNICAL COMMUNICATION**
   Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following:

Progress report presentation (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcomes 4, 5 and 6 assessed in the final research report in the section dealing with the corresponding outcome.

The assessment for each of the outcomes 4, 5 and 6 shall be as follows:

ECN Exit Level Outcome 4 - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN exit level outcome 6</u> - **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final research report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of research report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitutes satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title	DESIGN PROJECT
Code	TCEE3890
NQF Level	8
Contact Hours	Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
NQF Credits	34
Assessment	Continuous 100% [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Content: An essential element of Engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated Engineering drawings or computer source codes consistent with professional Engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:

1. Identify, analyse and define a convergent/divergent Engineering problem that can be solved using Engineering knowledge and skills;
2. Formulate possible design approaches to the solution of the defined Engineering problem;
3. Perform techno-economic analyses to evaluate alternative solutions and select best solution;
4. Design (procedural and non-procedural), synthesize and optimized a system prototype based on the selected solution using necessary information and applicable Engineering knowledge, skills and tools, showing elements of creativity/innovation;
5. Assess sustainability, benefits and impacts of the design: ergonomics, social, legal, health, safety, and environmental;
6. Develop a design project plan and identify resources required to complete project milestones;
7. Present technical designs accompanied with detailed analysis, calculations, manual and/or prototype/model of the possible solutions(s) or source codes and any other relevant information in an appropriate form.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4, 6)
9 Independent Learning Ability (Course Outcomes 2, 6)
10 Engineering Professionalism (Course Outcomes 4, 7)
11 Engineering Management (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**
Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively.

3 **ENGINEERING DESIGN**
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

7 **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY**
Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and Physical environment.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following:
Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 1, 3 and 7 assessed as follows:

ECN Exit Level Outcome 1 - **Problem Solving.**

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 - **Engineering Design**

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognise and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimisation.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with Engineering ***Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering ***Design***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "Engineering ***Design*** in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 7 - **Sustainability and Impact of Engineering activity.**

Where and how is this exit outcome assessed?

Students are expected to show critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. The final design report should show evidence of the student's ability to consider the impact and benefits of the design on social, legal, health, safety and environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with **Sustainability and Impact of Engineering activity** and with reference to how this knowledge are considered in the Engineering analysis and design considerations, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Sustainability and Impact of Engineering activity**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Sustainability and Impact of Engineering activity**" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	Continuous assessment 100% (Logbook record 20%, Lecturer/Employer Evaluation 20%, Final report 60%)
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of Technician Trainee and will undertake at least four weeks of attachment to an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Describe the organizational structure and the operational processes of the company or organization
2. Describe in details his/her contribution to the company during the internship

9 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS) - EXTENDED

YEAR 1 OF (32BHEX) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING HONOURS – EXTENDED 132 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Electrical, Electronics and Computer I Engineering	13500TI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Electrical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Mathematics support I	I3401MS	4	0	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Physics for Engineers Support I	I3421PS	4	0	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Chemistry for Engineers Support	I3441CS	4	0	None
Total credits 1st Semester BSc Electrical Engineering				**44**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Engineering Mathematics support II	I3402MS	4	0	None
2	Physics for Engineers II	I3582NP	5	12	I3581NP
2	Physics for Engineers Support II	I3422PS	4	0	None
Total credits 2nd Semester BSc Electrical Engineering				**24**	

YEAR 2 OF (32BHEX) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING HONOURS – EXTENDED 136 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Electrical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Drawing	I3530ID	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Engineering Economics	I3661IE	6	8	None
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
Total credits 1st Semester BSc Electrical Engineering				**52**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Statistics for Engineers	I3582IS	5	12	I3511IM
2	Fundamentals of Electrical Engineering	I3522EE	5	8	I3511IM
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM,** I3611IM
Total credits 2nd Semester BSc Electrical Engineering				**60**	

9.1 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

9.2 DEGREE NAME: BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS) 32BHEI

9.3 AIM

The curriculum for the degree of Bachelor of Science in Electrical Engineering (Honours) aims at producing Graduate Engineers with knowledge, skills and abilities in electrical Engineering, and who can competently work in the design, planning and operation of electric power systems and devices, power generation, transmission, distribution, control of electrical energy systems/components and related service industries.

9.4 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Electrical Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study (semester **I** and **II)** is common to all Engineering disciplines. In Years 2 to 4 (semesters **III** to **VIII**), students take discipline-specific modules and a few common modules. There are no taught modules in Semester VIII since this semester is fully dedicated to Research and Design Projects.

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Session. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some assignments and Lab reports, where applicable.

YEAR 1 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS) – 164 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Electrical, Electronics	13500EC	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Electrical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Drawing	I3530ID	5	16	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
Total credits 1st Semester BSc Electrical Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Physics for Engineers II	I3582NP	5	12	(I3521NP)
2	Fundamentals of Electrical Engineering	I3522EE	5	8	(I3511IM)
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	(I3511IM)
Total credits 2nd Semester BSc Electrical Engineering				**68**	

YEAR 2 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING – 160 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	U3583AL
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Electrical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) I3511IM
1	Engineering Economics	I3661IE	6	8	None
1	Computer Programming I	I3691CP	6	12	(I3551CC)
1	Electric Circuit Analysis I	I3681EC	6	12	(I3522EE)
1	Analogue Electronics I	I3691CA	6	12	(I3522EE)
Total credits 1st Semester BSc Electrical Engineering				**60**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics IV	I3612IM	6	16	(I3611IM) **I3512IM**
2	Measurements and Instrumentation	I3622CI	6	8	(I3522EE)
2	Electric Circuit Analysis II	I3692EC	6	12	(I3651EC)
2	Digital Electronics	I3632CD	6	16	(I3522EE)
2	Signals and Systems	I3692CS	6	12	(I3512IM)
2	Electrical Machines I	I3682EM	6	12	(I3522EE)
Total credits 2nd Semester BSc Electrical Engineering				**76**	

YEAR 3 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING – 128 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Microprocessor Systems	I3721CM	7	8	**(I3632CD)**
1	Machine Learning	I3791CM	7	12	(I3611IM)
1	Applied Electromagnetics	I3781CE	7	12	(I3582NP)
1	Power Electronics	I3731EP	7	16	(I3691CA)
1	Power Systems I	I3751EP	7	16	(I3681EC), (I3692EC)
Total credits 1st Semester BSc Electrical Engineering				**64**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Technical Writing	I3762VW	7	8	U3683AL
2	Microcontroller Architecture and Programming	I3742CM	7	8	(I3721CM)
2	Renewable Energy Technologies	I3772ER	7	16	(I3522EE)
2	Electrical Machines II	I3752EM	7	16	(I3682EM)
2	Control Engineering	I3832EC	8	16	(I3611IM)
Total credits 2nd Semester BSc Electrical Engineering				**64**	

YEAR 4 OF (19BCEE) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING - 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	**Society and the Engineer**	TEGT3821	8	8	TEGT3742
1	**Project Management**	EGM3881	8	12	**TEGT3761**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Computation Methods in Power Engineering	TECE3891	8	12	TECP3831 **TECE3731**
1	Power Systems Protection	TECP3831	8	16	**TECE3791**
1	Microprocessor and Programmable Logic Controllers	TECP3851	8	16	**TETD3692**
Total credits 1st Semester BSc Electrical Engineering				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	**Research Project**	TECR3892	8	30	All 3rd Year Modules
2	**Design Project**	TECD3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total credits 2nd Semester BSc Electrical Engineering				**64**	

Total credits for BSc in Electrical Engineering (Honours) **592**

9.5. DETAILED COURSE CONTENT FOR (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

9.5.1 YEAR 1 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

9.5.1.1 YEAR 1 SEMESTER CORE

Module Title:	SKILLS PORTFOLIO
Module Code	U3403FS
NQF Level	5
Notional Hours	N/A
Contact hours	N/A
Additional learning requirements	None
NQF Credits	0
Prerequisite	None
Semester Offered	Core
Module Coordinator and Contact Details	-

Module Purpose
The purpose of this module is to determine, develop and maintain individual students' academic motivation, needs and strengths for effective learning ensuring academic success.
Overarching Learning Outcome
Apply skills relevant to their academic journey at the University in terms of successful attainment of professional and personal goals.
Specific Learning Outcomes
On completing the module students should be able to:
1. Apply motivational theories to demonstrate positive attitudes in their professional and academic life.
2. Identify and manage needs and factors that may negatively impact their academic work including the design of action plans to motivate and guide them.
3. Identify and make use of the different learning styles to promote learning in a more efficient manner using various study methods and skills.
4. Manage time effectively
5. Design and make use of various test taking and examination preparation strategies.
6. Identify and use tools to improve and maintain Mental Health and wellbeing.
7. Apply the dynamics of interpersonal communication.
8. Manage their finances.
9. Identify violence as a social problem in the Namibian context to manage and prevent the occurrence thereof in their life.
10. Recognize the importance of skills training and upgrading in career planning and development to improve their classroom experiences.
11. Create a career plan, set clear, realistic and attainable career goals and engage in activities to enhance their CVs.

Module Content
UNIT 1: Academic Planning and Goal Setting
Individual Needs and Values; Steps in Reaching a Personal Vision; Proactive Approach Towards Learning; Self-Regulated Learning; Personal and Academic Goal Setting; Receptiveness to Learning; Exploring Self-Development and Self- Awareness.
UNIT 2: Attitude and Motivation
Understanding Motivation; Personal Attitudes, Behaviours and Interests; Self-Reflective Process; Approaches to Dealing with Negative Factors; Class Attendance and Participation; Procrastination; Self-Reliance; Discipline; Accountability; Healthy Habits.
UNIT 3: Learning styles
Understanding Personal Approaches to Learning; Dynamics of the Learning Process; Learning Styles and Strategies.
UNIT 4: Study Methods and Skills
Study Habits and Strategies; Learning Styles and Techniques; Effective Study Methods and Skills; Note Taking; Memory and Reading Skills; Critical Thinking.
UNIT 5: Time Management
Effective Time Management; Planning; Decision-making; Prioritization; Setting Boundaries; Time for Self – care; Procrastination.
UNIT 6: Assessment Preparation
In class exercise; Test and Examination preparation; Organizing academic workload; Setting daily study goals; Staying physically active; Study groups.
UNIT 7: Mental well-being
Understanding mental health; Signs and indicators of poor mental health; commonly experienced mental health challenges; psychosocial stressors; Seeking professional help; Coping strategies.
UNIT 8: Interpersonal Communication
Effective Communication Skills; Verbal and Non-Verbal Communication; Listening Skills; Problem Solving; Assertiveness; Negotiation Skills; Practicing Empathy in Communication; Self-Confidence; Receptiveness to Feedback; Building Trust; Teamwork; Leadership; Public Speaking Skills.
UNIT 9: Financial matters and management
Financial Literacy; Budgeting; Available Finance Options and Assistance; Managing Financial Resources.
UNIT 10: Student Violence
Types of Violence; Individual Roles in Violence; Myths, Forms; Consequences of Violence; Prevention Measures; Seeking for Help.
UNIT 11: Career Planning and Development
Defining and Selecting Career Goals; Career Exploring Different Strategies; Soft Skills Training.
Learning and Teaching Strategies/Activities
The course will be facilitated through, but not limited to, the following learning activities:
- **Online teaching**: Self-study on theoretical foundations and concepts of the Skills Portfolio module
- **Discussion forums (peer review):** reflecting on own contexts, experiences and sharing perspectives
- **Inquiry:** carrying out research to explore and understand scenarios and problems relating to self
- **Portfolio writing:** writing reflective learning journals related to the Skills Portfolio module

Student Assessment Strategies
- 100% continuous assessment
- Reflective journal on each unit (portfolio)

Learning and Teaching Enhancement Strategies

- Student – lecturer evaluations, conducted twice a year
- Moderation of assessment tools

Learning Resources

[1] Feldman, R. S. and Chick, S. (2005) *Power learning: Strategies for Success in Higher Education and Life*. Toronto: Mc Graw-Hill Ryerson Limited.
[2] Light, R. J. (2001). *Making the most out of College: Students Speak their Minds*. Cambridge, Mass: Harvard University Press.
[3] Tracy, E. (2002). *The student's guide to exam success.* Philadelphia: Open University Press
[4] Toft, D. (2005*). Mastering Student Guide to Academic Success*. Boston: Houghton Mifflin Company.

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Module Title:	**ACADEMIC LITERACY I**
Module Code	U3583AL
NQF Level	5
Notional Hours	80
NQF Credits	8
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial/ week
Semester Offered	Core

Module Purpose
The purpose of Academic Literacy I is to introduce students to sources of information required to contribute to academic discourse to enhance their receptive and productive language skills through exposure to different academic genres.
Overarching Learning Outcome
Apply information searching techniques with academic skills necessary to fulfil tasks and cope with academic reading, listening, speaking and writing demands at university level.
Specific Learning Outcomes
On completing the Module students should be able to:

1. Identify potential sources of information
2. Articulate the need of information and behavioural approaches.
3. Identify required skillset to solve academic tasks or work.
4. Develop concept mapping and task-based learning themes.
5. Integrate summaries, paraphrases and quotations to avoid plagiarism.
6. Apply features of academic writing and other academic conventions in own writing.
7. Apply patterns of text organization to academic writing.
8. Summarise main ideas or relevant parts of texts.
9. Apply appropriate reading comprehension strategies.
10. Illustrate the correct use of vocabulary and grammar in speaking and writing.

Module Content
The module will cover study skills, reading (including extensive reading), listening, speaking, writing, referencing, and language usage and text organisation.

Contribution to Exit Level Outcome:

- 6 Professional and Technical Communication (Course Outcomes 3, 4, 6, 7 and 9)
- 9 Independent Learning Ability (Course Outcomes 5, 8 and 10)

Learning and teaching strategies
The course will be facilitated through, but not limited to, the following learning activities:

- Blended instruction: Face-to-face and online
- Tests and assignments
- Tutorials/ Academic support
- Presentations

Student assessment strategies
Assessment will be based on Continuous Assessment.

Learning and teaching enhancement strategies

- Students shall be exposed to library user-based services and training.
- Students that might experience performance difficulty in the module will be identified and the necessary support and guidance as an intervention strategy will be provided by the teaching staff.
- Statistics of the module pass and failure rate will be continuously monitored.
- Student-lecturer evaluation
- Lecturer-peer evaluation
- Curriculum review
- Moderation of assessment tools

Recommended Learning Resources

1. Bailey, S. (2015). *Academic writing: A handbook for international students* (4th ed.). NY: Routledge.
2. Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). *Academic literacy* (2nd ed.). Cape Town: Juta and Company (Pty) Ltd.
3. Gaetz, S and Phadke, S. (2018). *Academic English: Reading and writing across the disciplines* (3rd ed.). London.UK: Pearson.
4. Machet, M. (2013). Mastering Information Skills for the 21st Century. 2nd Edition, UNISA Press, South Africa.
5. Piscitelli, S. (2009). Study skills: do I really need this stuff? (2nd ed). N.J. Pearson Prentice Hall,

UNAM Library Subject Specific Guides https://unam-na.libguides.com/?b=gandd=a

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**INTRODUCTION TO ELECTRICAL, ELECTRONICS AND COMPUTER ENGINEERING**
Module Code	I3500EC
NQF Level	5
Notional Hours	60
NQF Credits	6
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial per week
Additional learning requirements	Group work and Project
Semester Offered	0

Module Purpose
The purpose of this module is to enable the students understand the fundamentals of engineering profession and acquire basic engineering problem solving skills.

Overarching Learning Outcome
Ensure that students conversant with engineering roles, responsibilities and methods in different industries.

Specific Learning Outcomes
On completing the Module students should be able to:

1. Describe Electrical, Electronics and Computer Engineering by definition
2. Describe a few practical experiments available that can be performed in our laboratory
3. Explain the steps involved in engineering problem solving.
4. Identify general steps involved in engineering design and communication.
5. Describe and explain basic important materials needed by in Electrical, Electronics and Computer Engineering.
6. Describe the role of nanoelectronics in the context of nanotechnology as employed in improvement of electronics components and systems with respect to size, power consumption etc.

Module Content
Introduction to Electrical, Electronics and Computer Engineering: The definition of electrical, electronics and computer engineering. **Practical Orientation of what is expected of EEandC engineering student:** The module provides an integrated introduction to electrical engineering, electronics and computer science, taught using substantial laboratory experiments.
Introduction to Engineering Design and Problem Solving: Types of Problems, Problem Solving Approach and Skills, The Design process, Brainstorming, Criteria and Evaluation, Sustainability. **Engineering Communication and Teamwork Skills**: The Importance of Communication Skills in Engineering, Basic Presentation skills, Basic Technical Writing Skills. Principles of Teamwork, Characteristics of an Effective Team Member. **Basic important engineering materials:** Exciting and important basic material from electrical engineering, electronics and computer engineering, including modern software engineering, linear systems analysis, electronic circuits, and decision-making

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5).
- 5 Eng Methods, Skills, and Tools including IT (Course Outcomes5).

,**Learning and Teaching Strategies/Activities**

- Two lecture periods per week for 6weeks

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments, Project and Presentation:60%
   ii. Tests (at least 2 tests):40%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

Topassthiscourseastudentshouldobtainaminimumfinalmarkof50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implementabi-semestercourseevaluationtobeadministeredthroughagooglesurvey

Prescribed Learning Resources

1. Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
2. Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**DIGITAL LITERACY**
Module Code	U3583DD
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial/ week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Prerequisite	None
Semester Offered	Core
Module coordinator and Contact Details	Mr Erkkie Haipinge, ehaipinge@unam.na, Tel: +264 612064906

Module Purpose

The purpose of this module is to equip students with competencies to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment and entrepreneurship.

Overarching Learning Outcome

Apply digital literacy skills for effective learning across the curriculum and for successful attainment of their personal and professional goals.

Specific Learning Outcomes

On completing the module students should be able to:

8 Use ICT-based devices, basic productivity software, a web browser and search engines, email and other digital communication services

9 Carry out digital productivity activities such as download and upload materials to the internet or cloud or institutional shared spaces, and use digital tools to fit learning

10 Discover, organise and manage relevant digital information using relevant search engines, indexes or tag clouds, and evaluate digital information trustworthiness and relevance
11 Access and make sense of messages in a range of digital media, and appreciate how digital messages are designed
12 Design new digital materials, make decisions and solve problems and adopt new digital tools for learning
13 Participate in a range of digital communication media, work in digital teams and projects, and participate in a range of online networks
14 Identify, choose and participate in digital learning opportunities
15 Manage and maintain digital profiles suitable for different networks that consider digital reputation

Module Content
Digital Proficiency: ICT-based devices (laptops, tablets, smartphones, desktop computers, digital instruments and equipment); a mouse, keyboard, touch screen, voice control and other forms of input; screens, audio headsets and other forms of output; digital capture devices; University digital learning systems and a range of personal digital services such as social media, cloud storage services, sharing sites **Digital Productivity:** Basic productivity software (text editing, presentation, spreadsheets, image editing); email and other digital communication services; Internet or cloud or institutional shared spaces for organising, managing and backing up digital files; software/apps and services suitable for learning-related tasks; digital tools fit learning and managing learning time. **Information Literacy:** search engines, indexes or tag clouds; wikis, blog posts, scholarly journals, e-books and the open web; file spaces and folders, bookmarks, reference management software and tagging; copyright, and digital citizenship issues. **Data and Media Literacy:** Digital data using spreadsheets and other media; data security and privacy; digital media messages – text, graphics, video, animation, audio and multimedia. **Digital Creation and Innovation:** digital materials (video, audio, stories, presentations, infographics); new digital tools for learning in digital settings. **Digital Communication, Collaboration and Participation**: digital communication; differences between media, norms of communicating in different spaces; false or damaging digital communications; collaborative tools and online environments; online networks. **Digital Learning and Development:** digital learning opportunities; digital learning resources; digital tools/materials for organising, planning and reflecting on learning (mind-mapping, note-taking, e-portfolio/ learning journal/ blog). **Digital Identity and Wellbeing:** online profiles for different networks (personal, professional, academic); digital reputation; managing personal data and privacy; digital CV or portfolio of work; digital technologies for personal development; online etiquette; wellbeing and safety online; internet addiction; cyberbullying and other damaging online behaviour.

Contribution to Exit Level Outcome:
- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4 and 6)

Learning and Teaching Strategies/Activities
- **Lectures**: presentation on concepts and other theoretical foundations of Digital Literacy
- **Discussion forums:** reflecting on own contexts and sharing perspectives
- **Collaborative learning:** group learning and activities carried as part of projects
- **Inquiry:** carrying out of research to explore and understand scenarios and problems
- **Projects:** carry out projects on digital literacy
- **Presentations and demonstrations:** presentation of outcomes of projects (products, processes, impact)
- **Portfolio writing:** writing reflective learning journals related to digital literacy

Student Assessment Strategies
- **Collaborative assessment tasks**
  - Digital productivity: *cloud based collaborative digital media creation using cloud platforms*
  - Project: Digital communication, collaboration and participation/ Digital Wellbeing
- **Individual assessment tasks**
  - Assignment: information literacy assignment
  - Test x 2
- **Practical**
  - Digital proficiency
  - Data and Media literacy
- **No written examination**

Learning and Teaching Enhancement Strategies
- **Student feedback:** feedback from students using focused feedback instruments
- **Peer feedback:** student feedback on peer evaluation of each other's collaboration, participation and contribution
- **Self-evaluation:** quizzes and students' reflective journal/ portfolio on their own learning
- **Learning analytics:** use of learning management tools on student participation and online learning activities, and analyse assessment performance

Prescribed Learning Resources
Textbook
[1] Schwartz, M., Bali, M., Blocksidge, K., Brown, C., Caines, A., Dermody, K., and Peters, J. (2020). *Digital Citizenship Toolkit*.

Retrieved from https://pressbooks.library.ryerson.ca/digcit/ (online version); https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/3/Digital-Citizenship-Toolkit-1598899274.pdf (PDF version) https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/2/Digital-Citizenship-Toolkit-1598899308.epub (eBook)

Digital Resources

[1] JISC. (2019). Jisc digital capabilities framework: The six elements defined.
Retrieved from https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf

[2] JISC. (2017). Digital capabilities framework.
Retrieved from https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF

[3] Joint Research Centre (European Commission). (2019). *The Digital Competence Framework 2.0*.
Retrieved from https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

[4] Carretero, S., Vuorikari, R., and Punie, Y. (2017). The digital competence framework for citizens.
Publications Office of the European Union. Retrieved from http://svwo.be/sites/default/files/DigComp%202.1.pdf

Course resources (videos and SCORM package)

[1] Microsoft. (2021). *Microsoft digital literacy courses and resources (videos and SCORM packages)*.
Available at https://www.microsoft.com/en-us/digital-literacy

[2] Microsoft. (2021). *Microsoft digital literacy: Teaching guides*.
Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWBupo

[3] OER Commons. (2021). *Digital Literacy (learning objects).* Retrieved https://www.oercommons.org/curated-collections/347

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**NATIONAL AND GLOBAL CITIZENSHIP**
Module Code	U3420CN
NQF Level	4
Notional Hours	20
Contact hours	Up to 1 contact lecture period per week for 6 Weeks
Mode of Delivery	Blended: Face to face and online
Additional learning requirements	Each student will be required to work on a personal project which will include a site visit
NQF Credits	2
Semester Offered	Core
Module coordinator and Contact Details	Dr Romanus Shivoro, rshivoro@unam.na ; Ext. 3378

Module Purpose

The purpose of this Module is to equip UNAM students with knowledge to understand the interconnectedness of local and global issues. Students will become acquainted with perspectives on, global citizenship, globalization and civic engagement. The module will enable students to reflect on issues affecting their communities and the world by providing a platform where students can meet and learn from one another and from external sources of information. It will guide students to determine how they can contribute to bring positive changes in their communities in relation to the Sustainable Development Goals. Furthermore, it will provide knowledge and understanding of cultural diversity and intercultural communication to enable students to become thoughtful stewards in a globalized world.

Overarching Learning Outcome

Demonstrate understanding of global citizenship and initiate action towards the betterment of local, national and global conditions, as informed and responsible citizens with a civic duty in their personal and professional lives.

Specific Learning Outcomes

On completing the module students should be able to:

1. Explain the importance of the National Constitution;
2. Express understanding of National and Global Citizenship;
3. Participate in community engagement activities as part of community upliftment;
4. Express understanding of globalization;
5. Apply intercultural communication skills; and
6. Interpret SDGs to initiate personal action towards contribution of their achievement.

Module content

UNIT 1: Constitution and its Importance

What is a constitution; Functions of a constitution; What it contains; Constitution and democracy

UNIT 2: Global Citizenship

The meaning of global citizenship; Importance of global awareness; World issues of concern to global citizens.

UNIT 3: Civic Engagement
What do we mean by civic engagement; Dimensions of civic engagement; Indicators of civic engagement; Promoting civic engagement.
UNIT 4: Globalization
Understanding globalization; Cultural construction of neoliberal globalization; Major players; Major domains; Major Issues; Futures of Globalization
UNIT 5: Intercultural Communication
Dealing with difference; Levels of culture; Stereotypes and generalizations; Intercultural communication Processes
UNIT 6: Sustainable Development Goals and individual action
Introduction to SDGs; Contributing to achievement of SDGs through action

Learning and Teaching Strategies/Activities
Student learning in this module will be supported by provision of subject knowledge; engaging students in class discussions, and individual awareness and action portfolios. It will expose students to real life situation through formal lectures, guest lectures, experiential activities such as engaging local civic organizations; Students will engage in active and participatory learning in which they generate ideas and share their knowledge on a topic. Material will include journal articles, videos, PowerPoint presentations, as well as handouts for students' reflection.

Student Assessment Strategies
Continuous assessment of 100% - Assessment will be done by completing online pop-up quizzes; and developing their online portfolios of personal action as response to tasks assigned in class.

Learning and Teaching Enhancement Strategies:
Strategies will include: Continuous Module Review, and Lecturer/student evaluations.
Student progress will be monitored by observing class participation during live lectures, and submission of feedback material. Including online portfolios.

Recommended Learning Resources

- Adler, R.P and Goggin, J. (2005). What do we mean by Civic Engagement? A Journal of Transformative Education. 3 (3) 236 – 253
- Bennett, M.J (1998). Intercultural Communication: A current Perspective. In Milton J. Bennett (Ed.) Basic Concepts of Intercultural Communication: Selected Readings. Yarmouth: ME Intercultural Press
- Green, M. (2012). Global Citizenship: What are we talking about and why does it matter. NAFSA Association of International Education
- International IDEA (2014). What is a Constitution? Principles and Concepts. Constitution-building Primers.
- Perception Change Project. 170 Daily Actions to Transform our World. United Nations Office in Geneva
- Ritzer, G. (Ed.) (2007). The Blackwell Companion to Globalization. Blackwell Publishing: USA
- United Nations. Transforming our World: the 2030 Agenda for Sustainable Development. UNDP

Issue Date: September 2023
Next Revision: September 2028

9.5.1.2 YEAR 1 SEMESTER 1 OF (32BHEI) BACHELOR OF SCIENCE ELECTRICAL ENGINEERING (HONOURS)

Module Title:	**ENGINEERING MATHEMATICS I**
Module Code	I3511IM
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad basic mathematical skills to solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices.
2. Calculate eigenvalues and eigenvectors and relate them to engineering solutions
3. Perform functions transformations (Cartesian/polar), sketch and name some polar graphs.
4. Use various mathematical functions and apply them to engineering.
5. Apply trigonometry in solving mathematical and engineering problems.
6. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
7. Manipulate sequence and series of numbers
8. Define, interpret complex numbers and to perform elementary complex numbers algebra.

Module Content

Lines and Planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersection of lines and planes. **Matrix Algebra:** Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Sequences and series of numbers:** Introduction to sequences and series. Absolutely convergent series, tests for convergence. Power series. Radius of convergence and interval of convergence. **Functions:** Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions. **Polar coordinates/Graphs:** Definition of polar coordinates, relate Cartesian and polar coordinates, sketch and name different types of polar graphs. **Differentiation:** Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, the chain rule, differentiation of algebraic functions. **Integration:** Anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, basic integration techniques, integration of trigonometric functions. **Introduction to complex numbers:** Definition of complex numbers and the complex plane, complex number representation on argand diagrams, complex number algebra. Demoivre's theorem.

Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,3,5,6,7)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5,6,7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
   [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
   [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
   [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT I**
Module Code	I3401MS
NQF level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Prerequisite	None
Semester Offered:	1

Module Purpose
The purpose of this module is to consolidate school curriculum computation skills whilst creating a wider context in which students can contextualise mathematical knowledge.

Overarching Learning Outcome
Consolidate numeracy and problem solution skills in a wide range of mathematics fundamentals.

Specific Learning Outcomes
Upon completion of this module, a student should be able to
1. Explain and conduct deductive arguments involving sets and relations.
2. Identify and correlate intervals.
3. Solve systems of linear equations methodically.
4. Handle matrix calculus.
5. Identify types of real valued functions.
6. Compute the domain and range of a real valued function.
7. Assess properties of real-valued functions.

Module Content:
Number system: Natural, integers, rational, irrational, real and complex numbers. Sets: cardinal number, operations on a set (equality, intersection, union, relative compliment, de Morgan's law, power set, application of cardinality (inclusion-exclusion formula), Cartesian products, ordered pairs and relations), intervals and inequalities. Solving equation and inequalities: linear and quadratic equation, inequalities involving two variables. System of linear equations: Matrices and matrices operations (addition, subtraction, multiplication, associativity, distrutivity, determinant, invertible, Gaussian row and column operations, rank, solution to system of linear equations). Real-valued function: definition, relation, domain and range, injective, bijective, inverse, odd and even, piecewise defined, graphs. Coordinates system: polar, polar graph, cylindrical, cylindrical graph.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING DRAWING**
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to teach students how to visualize, create and interpret engineering drawing principles in two and three dimensions by applying of geometrical and engineering methods, and introduce students to computer aided drawing, with a focus on AutoCAD software,

Overarching Learning Outcome
Create and interpret basic drawings and communicate technically, as well as to use AutoCAD software to create two - and three - dimensional technical engineering drawings

Specific Learning Outcomes
On completing the module students should be able to:
- Use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts and assembly drawings of various engineering components

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD
- Create three - dimensional objects

Module Content

Foundations of Representing Technical Bodies: drawing equipment, drawing formats, types of lines, construction geometry, simplified representations, scales, lettering, tittle block, elaboration of part drawings, Principle of orthographic projection, sectioning, dimensioning. **Isometric and oblique representations**. **Sections, Interpenetrations and developments**: cones, cylinders, pyramids. **Free hand techniques**: Introduction to free-hand sketching of machine parts. **Assembly Drawing**. **Introduction to AutoCAD:** Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; **Working in two - dimensional space:** Creating objects; Drawing with precision; Controlling the drawing display; Editing methods; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; Managing content with AutoCAD design Centre; Creating a layout to plot; Plotting (model and paper spaces). **Working in three - dimensional space**: Creating three-dimensional objects using solid primitives, and from 2D profiles; editing of 3D objects. **Practical Exercises.**

Contribution to Exit Level Outcome:
- 3 Engineering Design (Course Outcomes 4 and 5)
- 5 Engineering methods, skills, Tools and including technology (course outcome 1 and 3)
- 6 Professional and Technical Communication (Course Outcomes 2, 3, 4 and 5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:
- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical exercises
- Face to face consultations

Student Assessment Strategies
- Students will be assessed through Continuous Assessments activities
- The final mark will be made of 100% Continuous Assessment.
- The Continuous Assessment will be made up of the following assessment activities:
  8 Assignments (At least 4 assignments): 40%
  9 Mini project: 20%
  10 Tests (At least 3 tests): 40%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the module

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books
   [1] Parker M. A., and Pickup F., 1992. Engineering drawing with worked examples, vol1, 3rd Edition
   [2] David A. Madsen, Engineering drawing and design, 5th Edition
   [3] Colin H. Simmons, Neil Phelps, Manual of Engineering Drawing 3rd Edition
   [4] Terry Wohlers., Applying AutoCAD, 2010.
2. Design Software: AutoCAD
3. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	PHYSICS FOR ENGINEERS I
Module Code	I3581NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of physics as they relate to engineering.
Overarching Learning Outcome
Prepare students to apply fundamental physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:

1. Do unit conversions
2. Solve problems regarding one- and two-dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gasses.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.
10. Demonstrate abilities to communicate ideas and facts using equations, graphs and principles.

Module Content
Measurements and Units: Instruments and Uncertainty, Standards and Units. **Kinematics:** One Dimensional Motion, Vectors, Projectile Motion, Circular Motion, Relative Motion. **Dynamics:** Newton's Laws of Motion, Newton's Law of Gravitation, Free-Body Diagrams, Friction. Work, Energy and Power. **Momentum:** Collisions, Impulse, Centre of Mass. **Rotational Dynamics:** Rolling Motion, Torque, Rotational Inertia and Energy, Angular Momentum. **Planetary Motion:** Kepler's Laws of Planetary Motion. Elasticity: Hooke's Law. **Fluids:** Pressure, Buoyancy, Fluid Dynamics: Flow Rates, Equation of Continuity and Bernoulli's Equation. **Heat and Thermodynamics:** Thermal Expansion, Ideal Gas, Specific Heat, Heat Capacity, Latent Heat, Calorimetry, Heat Transfer: Laws of Thermodynamics, Entropy, Enthalpy, Gibbs Free Energy.

Contribution to Exit Level Outcome:
- o 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- o 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical exercises
- Face to face consultations

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   - o Assignments (tutorials, quizzes): 40%
   - o Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies
- Peer-review of course outlines and teaching.
- Student evaluations.

- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
   [1] Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson - ISBN-13: 978-1-292-31473-0, e-Textbook ISBN-13: 978-1-292-31481-5
   [2] Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
   [3] Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT I**
Module Code	I3421PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	Entry requirements
Semester Offered	1

Module Purpose

To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course.

Overarching Learning Outcome

Solve problems, in single-particle mechanics, Newtonian gravity, fluids, and heat.

Specific Learning outcomes

On completing the module students should be able to:

1. Employ units, do unit conversions, express uncertainties use significant figures, use vectors in 2 dimensions.
2. Solve basic problems regarding one and two-dimensional kinematics.
3. Apply Newton's laws of motion and energy principles to a variety of basic problems in dynamics.
4. Discuss and solve simple problems in rotational kinematics and dynamics.
5. Discuss the principles of waves and sound.
6. Solve basic problems in statics, Newtonian gravitation, fluids, heat, and gasses.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content

Measurement and estimation; Kinematics in 1D; Kinematics in 2D; Vectors; Dynamics/Newton's Laws; Circular motion; Gravitation; Work and Energy; Linear Momentum; Rotational Motion; Static Equilibrium; Fluids; Oscillation and Waves; Sound; Temperature and Kinetic Theory; Heat; The Laws of Thermodynamics.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS**
Module Code	I3511NC
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1T or 1PS /Week
Additional learning requirements	
NQF Credits	16
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose

The purpose of this module is to enable students to understand the basic concepts of chemistry as they relate to engineering.

Overarching Learning Outcome

Equip students with firm grasp of fundamental chemistry principles which are applicable in engineering industries.

Specific Learning Outcomes

On completing the module students should be able to:

- Describe the fundamental techniques used for chemical analysis in industrial processes.
- Explain the basic concept of batteries and fuel cells and their applications.
- Describe the processing of high polymers and their applications.
- Explain different methods for water analysis and purification.
- Describe different ways of dealing with pollution and managing solid waste**.**

Module Content

Spectroscopic techniques and Applications: Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet and Visible and Raman spectroscopy. **Electrochemistry:** Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system. **Battery Technology;** Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life. Basic requirements for commercial batteries. Construction, working and applications of: $Zn\text{-}Ag_2O$, Ni-Cd, Zn-air and Lithium-ion battery. Fuel Cells- Differences between battery and a fuel cell, Classification of fuel cells - based on type of fuel, electrolyte and temperature. Construction, working and applications of solid oxide fuel cell. **Water Analysis;** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method), Alkalinity - determination, Determination of dissolved oxygen, Determination of chemical oxygen demand, Boiler scales-formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis. **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methods). Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapor deposition. **Polymers;** Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (BunaS, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. **Environmental Chemistry**; Air Pollution, Water Pollution, Radioactive Pollution, Solid Waste Management, Green Chemistry.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning and teaching activities:

- Four lecture periods per week for 14 weeks (face to face or blended)
- One practical session per week for 14 weeks relating the theory to practice
- One tutorial period per week for 14 weeks
- Face-to-face and/or online consultation

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
    i) Assignments (tutorials, quizzes, lab and field reports): 40%
    ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
Books:

[1] Mukhopadhyay, Raghupati, and Sriparna Datta. Engineering chemistry. New Age International Pvt. Limited, Publishers, 2008.
[2] Garwal, Shikha. Engineering chemistry: Fundamentals and applications. Cambridge University Press, 2019.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	CHEMISTRY FOR ENGINEERS SUPPORT
Module Code	I3441CS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	None
Semester Offered	1

Module Purpose

To introduce the student to general chemistry, lay the foundation of basic facts necessary for further studies in Chemistry and acquaint students with safety rules and regulations in a chemical laboratory.

Overarching Learning Outcome

Apply and interpret knowledge on basic facts in Chemistry for further studies.

Specific Learning outcomes

On completing the module students should be able to:

1. Use scientific notation and significant figures when doing all calculations
2. Define and explain the mass number (A), atomic number (Z) and isotope and also state the symbol for an isotope given its mass number and atomic number
3. Define the terms molar mass, relative molecular mass (Mr) and relative atomic mass (Ar) and carry out calculations involving these
4. Define and explain the terms empirical formula and molecular formula and also to determine the empirical and molecular formulae of a given compound
5. Use balanced chemical equations to obtain information about the amounts of reactants and products
6. Prepare dilute solutions from concentrated stock solutions and solve solution stoichiometry problems
7. Describe and explain data from experiments to distinguish between strong and weak acids and bases
8. Differentiate between oxidation and reduction reactions and balance redox reactions by the half-reaction method (acid and basic medium)
9. Apply quantum theory to predict the electron configuration of elements and explain the variation of properties across the periodic table
10. Explain the structure and bonding in molecules and ions and draw their Lewis structures
11. Apply Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) to describe molecular geometry as well as physical and chemical properties of some compounds

Module Content

Introduction: Matter, Measurement and Molecules; Stoichiometry: Calculations with Chemical Formulae and Equations; Aqueous Reactions and Solutions Stoichiometry; Electronic Structure of Atoms; Periodic Properties of the Elements and Relationships Among Elements; Basic Concepts of Chemical Bonding; Intermolecular Forces; Basic Molecular Geometry and Bonding Theories; Gases.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%

b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Brown T. L., LeMay H.E, Bursten B.E., Murphy C., Woodward P., Langford S., Sagatys D. and George A. (2014). Chemistry: The Central Science. (3rd Ed.). Pearson Australia. Australia
2. Chang, R. (2010). Chemistry. (10th Ed.) McGraw Hill Higher Education. New York. ISBN:978-0-07

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**COMPUTING FUNDAMENTALS**
Module Code	I3581CC
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures +1 Tutorial and/or 1Practical /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose:
The purpose of this module is to introduce students to general computer literacy, the basic principles of problem-solving using computers, advanced Microsoft Excel skills for data analysis, computer programme planning, basic data communication and computer networks and the basic skills on modern web development tools. It also introduces students to the basic tools and environments needed for machine learning programming.

Overarching Learning Outcome
Demonstrate understanding of the windows and Unix based computer working environment; skills on how to develop a computer-based problem-solving plan; basic knowledge of modern web development tools; and application of advanced spreadsheets and related tools to engineering related problems.

Specific Learning Outcomes

On completing the module students should be able to:

- Relate with computers under the Windows and Linux operating environment for information processing and presentation.
- Recall basic features of common computer hardware architectures.
- List the basic communication architecture of a computer.
- Show algorithms for solving basic problems using flowcharts and pseudocode.
- Recall advanced spreadsheet tools and functions.
- Match basic web applications using modern web development tools and frameworks to simple real-life problems.
- Define basic concepts of networking.

Module Content:
Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored programme concept. Von-Neumann architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. **Computer Arithmetic**: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). **Introduction to CISC and RISC architecture**: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types). **Introduction of computer operating environment** Windows and UNIX based systems. **Computer Architecture:** The design and structure of a computer. **Information Processing and Data Analysis tools**: Equations and Formulas Creation, Diagram Creation and Editing, PowerPoint Presentations Creation Advanced Spreadsheets Skills. **Computer Programme Planning**. Flowcharts and Pseudocode **Introduction to Computer Networking**: Basics of Communication Systems and Computer Networks. **Web Developments:** Front-End Web Development, Web Page Styling and Website logic development with scripting languages such as JavaScript. **Overview of memory system**, memory chip organization and error correction, cache memory, memory storage devices. **Introduction to Data Science Tools:** Installation and basic use of Anaconda and Jupyter Notebooks.

Contribution to Exit Level Outcome:

- 1 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2, 3,5,6)
- 2 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1,2, 3, 4, 5,6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes, reports, practical assignments): 20%
   ii) Tests (At least 2 tests): 50%
   iii) Semester Mini project (prototype oral presentation and development report): 30%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student's evaluation
3. Regular review of the course content
4. Face-to-face consultations
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

[1] F. Wempen: Computing Fundamentals: Introduction to Computers First Edition Wiley, 2015
[2] W. Palm: MATLAB for Engineering Applications 4th Edition, Mc-GrawHill, 2019
[3] J. L. Hennessy; Computer Architecture, Fifth Edition, Morgan Kaufmann, 2012.

Issue Date: September 2023
Next Revision: September 2028

9.5.1.3 YEAR 1 SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS II**
Module Code	I3582IM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose

The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad mathematical skills to solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique.
- Apply calculus to trigonometric functions to solve mathematical and engineering problems.
- Solve engineering problems using 1st order and 2nd order differential equations
- Define and analyze Fourier series of real-valued functions.
- Use Laplace and Fourier transforms in solving differential equations.

Module Content

Further Matrix Algebra: eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Further Integration:** Integration by parts technique. Integration by substitution. Integration of trigonometric functions. Integration of powers of trigonometric functions. Integration of trigonometric functions by substitution. Reduction formula. **Applications of integration:** areas, volumes of revolution, etc. **Differential Equations:** Meaning and solutions of differential equations. First order ordinary differential equations (separable, homogenous, Exact and linear types) and their applications. Solutions of second order linear ordinary differential equations with constant coefficients; initial or boundary value problems using the methods of undetermined coefficients and variation of parameters. **Integral Transforms:** Laplace Transforms (LT), Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st and 2nd ordinary differential equations. **Fourier Series and Transforms:** Fourier series. Fourier sine and cosine series. Introduction to Fourier transforms and its applications in solving boundary value problems.

Contribution to Exit Level Outcome:

- o 1 Problem solving (Course Outcomes 1,2,4,5)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
- o 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT II**
Module Code	I3402MS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(**Co-requisites) /Prerequisite**	None
Semester Offered:	2

Module Purpose
The purpose of this module is to equip students with an intuitive grasp of the behaviour of a real-valued function as well as the analytical techniques to test their intuition.

Overarching Learning Outcome
Gather sufficient information about the behaviour of a real valued function to sketch its graph with accuracy.
Specific Learning Outcomes
Upon completion of this module, a student should be able to
1. Employ the exact definitions of limit and continuity.
2. Use various differentiation techniques and assess differentiability.
3. Apply those tools to study local extrema, end behaviour, and asymptotic behaviour of function graphs.
4. Use integration to compute the area below a curve.
5. Handle complex numbers.

Module Content:
Solving equation: Exponentials and logarithms. Graph of a function: polynomial, rational, exponential, logarithmic, trigonometric functions. Limit of a function: definition, continuity, differentiation, sum, product, quotient, chain rules, examples from the engineering sciences. Integration: Definition and basic properties of the Riemann integral, the Fundamental Theorem of calculus, integrals of simple function, substitution rule and integration by parts; applications to the computation of areas and (rotational) volumes.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. B. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS II**
Module Code	I3582NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3521NP Physics for Engineers II)
Prerequisite	**None**
Semester Offered	2

Module Purpose

The purpose of this module is to enable students to understand the basic concepts of physics as they relate to engineering.

Overarching Learning Outcome

Prepare students to apply fundamental physics principles in engineering industries.

Specific Learning Outcomes

On completing the module students should be able to:

- Solve problems on electric and magnetic fields
- Sketch electric circuits and solve problems on capacitors and resistors
- Discuss and solve problems in geometrical optics, radioactivity and sound.
- Prepare and perform experiments related to the contents of the module.
- Demonstrate entry-level general laboratory skills including elementary data analysis.
- Demonstrate abilities to communicate ideas and facts using equations, graphs and principles

Module Content

Electrostatics: Electric charge, Current and Current Density, Electric field, Electric Potential, Resistance and Resistivity, Capacitance and Dielectrics**. Magnetostatics:** Biot-Savart law, Magnetic field, Magnetic materials, Motion of a Charged Particle in a Magnetic Field, Magnetic force, Ampere's Law; Torque and Magnetic Moments; **Electromagnetic Induction:** Electromagnetic Force (EMF), Faraday's Law of Electromagnetic Induction, Lenz's Law, Fleming's Right-Hand Rule, Inductance and Mutual Inductance. **Vibrations and Waves:** Simple harmonic motion, Oscillations, Wave Motion, Types of Waves, Standing Waves and Resonance. **Sound:** intensity of Sound, interference of Sound Waves, Doppler's Effect. **Light and Optics:** Reflection, Refraction and Diffraction, Snell's Law, Lenses, Lens Equation. **Radioactivity:** types of radioactivity.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes): 40%
   ii. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books

[1] Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson, ISBN-13: 978-1-292-31473-0, eTextbook ISBN-13: 978-1-292-31481-5
[2] Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
[3] Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT II**
Module Code	I3422PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Pre-requisites	Entry requirements
Semester Offered	2

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course. This course focuses on Electricity and Magnetism, Optics and Radioactivity.

Overarching Learning Outcome
Solve problems in electricity and magnetism, optics, and radioactivity.
Specific Learning outcomes
On completing the module students should be able to:
1. Discuss and solve basic problems on electric field and magnetic field.
2. Find currents and resistances in simple electric circuits.
3. Analyse DC and AC circuits involving capacitors, resistors, and inductors.
4. Resolve problems involving electromagnetic induction.
5. Solve simple problems in geometrical optics and nuclear physics.
6. Explain concepts pertaining to radioactivity and the effects of radiation.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Electric charge and electric field; Electric Potential; Electric Currents; DC Circuits; Magnetism; Electromagnetic induction; Electromagnetic waves; Geometric optics; Light; Radioactivity; Effects and Use of Radiation.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
4. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
5. Tests (at least 2 tests): 60%

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1) One-on-one consultation with students
2) Offer extra reading materials where applicable
3) Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

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Next Revision: September 2028

Module Title:	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Module Code	I3522EE
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose:
The module aims to equip students majoring in all branches of engineering, with the understanding of basic principles of electric circuits and networks. A further purpose is to introduce common technical vocabulary. Modern technology demands a teamwork approach whereby electrical engineers and nonelectrical engineers have to work together; therefore, they require a common technical vocabulary.

Overarching Learning Outcome
Demonstrate ability to analyse basic electric circuits using laws and theorems.

Specific Learning Outcomes
On completing the module students should be able to:
- Distinguish between real and ideal voltage and current sources
- State and apply the laws and rules of electric circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving of DC circuits
- Apply the principles of circuit analysis to series and parallel R, L, C circuits
- Perform a range of measurements in an electrical laboratory environment and be able to interpret the measured data to derive supplementary information
- Describe the principles of operation of a transformer and the basic AC generator and DC motors
- Conduct basic circuit analysis using appropriate CAD software (MATLAB, MultiSIM, etc.)

Module Content:
Introduction: SI Units and notations, Basic Electric Circuit (resistance, voltage and current). **Resistance:** Resistor coding, Series and parallel resistor networks, Y and delta resistor networks. **Sources:** Voltage and Current sources, dependent and independent sources, source transformations. **DC Circuit Analysis Techniques:** Ohm's law, Power and Energy, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, **DC Circuit Theorems:** Superposition Theorem, Thevenin's and Norton's Theorem, Maximum power transfer theorem. **Capacitors:** Capacitance, capacitors in series and parallel, Capacitor charging and time constant. **Inductors:** Inductance and mutual inductance. **AC Voltage:** AC voltage generation, AC Resistive circuit, AC capacitive circuit, AC inductive circuit.

Electrical Machine Basics: Basics principles of transformers, AC generators, DC motors, three phase voltage generation and mathematical expression. Basics of circuit simulation using CAD software).

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
- 3 Engineering Design (Course Outcomes 4)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 4)
- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment.
- The Continuous Assessment will be made up of the following assessment activities:
  - At least 2 quizzes, and at least 2 lab reports: 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of assessment activities.
- Peer-review of course outlines and teaching.
- Students' lecturer evaluation
- Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

4) One-on-one consultation with students
5) Offer extra reading materials where applicable
6) Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Book
   [1] Boylestad Robert. (2015), Introductory Circuit Analysis, 13th Edition, Pearson Education, USA.
   [2] Alexander K. Charles and Sadiku N.O. Mathews. (2013), Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, USA.
   [3] Hughes Edward. (2016), Electrical and Electronic Technology, 12th Edition, Pearson Education, USA.
2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title	**MATERIALS SCIENCE**
Module Code	I3592IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None.
NQF Credits	12
(Co-requisites)/ Prerequisite	(None)
Semester Offered	2

Module Purpose
The purpose of this module is to enable the students to understand the relationship between the structure and properties of engineering materials and practical skills in metallography and materials testing.
Overarching Learning Outcome
Identify the right engineering material for a particular application based on materials' structure and properties.
Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the molecular and crystal structure of materials.
2. Perform calculations on elemental diffusion in metals.
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams.
4. Outline the various phase transformations in the Fe-Fe3C phase system and associated microstructures.
5. Explain how materials properties depend on structure and crystal defects.
6. Demonstrate practical basic skills in metallography and report writing.
7. Explain the relationship between Materials Science and the Fourth Industrial Revolution.

Module Content
Materials for engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. **Structure of materials**: Atomic structure, electronic configuration, atomic bonding. **Crystallographic planes and directions:** Miller indices; Bragg's law; defects in crystals; **Solidification, Crystalline imperfections and diffusion in solids:** Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; **Equilibrium phase diagrams:** unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **Properties of materials:** Review of mechanical, electrical, optical and thermal properties of materials. **Mechanical properties of materials**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. **Effects of environment on materials:** corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. **Real-world applications of engineering materials:** Functional materials and devices; the relationship between Materials Science and the Fourth Industrial Revolution. Basic criteria for the selection of materials for engineering applications.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical sessions.
- Face-to-face consultations wherever necessary.

Student Assessment Strategies
1) Students will be assessed through continuous assessments activities and a final examination
2) The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3) The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes, lab and field reports): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.
Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.
Learning and Teaching Enhancement Strategies
1) Internal and external moderation of examination papers and scripts.
2) Peer-review of course outlines and teaching.

3) Student's evaluation.
4) Regular review of course content.
5) Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

7) One-on-one consultation with students
8) Offer extra reading materials where applicable
9) Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

   [1] Callister, W. D., Rethwisch, D. G., Materials Science and Engineering, An Introduction, 10th Edition, Wiley and Sons, 2018

   [2] Donald R. Askeland, Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2nd Edition, 2008

2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MECHANICS I**
Module Code	I3582NM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3581NP Physics for Engineers I)
Prerequisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to equip students with the knowledge to analyse system of forces on engineering components and to develop an approach to solving engineering problems**.**

Overarching Learning Outcome

Analyse the effect of static forces and equilibrium on systems and structural bodies.

Specific Learning Outcomes

On completing the module students should be able to:

1) Express force operations and force systems using vectors.
2) Apply the laws of static equilibrium of forces.
3) Produce a free body diagram from a specified engineering problem.
4) Analyse trusses using method of joints and method of sections.
5) Apply principles of static and kinetic friction in solving engineering problems.
6) Calculate and plot bending moment and shear force distributions in beams.
7) Determine the centroid and moment of inertia for plane and composite cross-sectional areas.

Module Content

System of forces and moment forces: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions.

Equilibrium in three dimensions. **Forces in submerged surfaces**. **Distributed Forces: Centroid and Centre of Gravity, Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams. **Analysis of forces in a truss:** Method of joints, method of sections.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1-6)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 3-7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Three lecture periods per week for 14 weeks

- One tutorial or practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

1) Students will be assessed through continuous assessments activities and a final examination
2) The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3) The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (At least 4 assignments): 20%
    b. Tests (At least 2 tests): 60%
    c. Practical and Report: 20%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books

[1] Robert W. Soutas-Little and Daniel J. Inmand, Engineering Mechanics Statics, copyright 1999 by Prentice-Hall, Inc.
[2] R. C. Hibbeler, Engineering Mechanics Statics, Ninth Edition, copyright 2001, 1998, 1995, 1992, 1989, 1986, 1983, 1978, and 1974 by R. C. Hibbeler.
[3] Irving H. Shames, Engineering Mechanics Statics, Second, Volume 1, copyright 1958, 1959, 1966.
[4] J. L. Meriam and L. G Kraige, Engineering Mechanics Statics, Fifth Edition, copyright 2003, John Wiley and sons.

2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**STATISTICS FOR ENGINEERS**
Module Code	I3582IS
NQF Level	5
Notional Hours	120
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Pre-requisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the concept of probability theory, statistical modelling and inference in engineering.
Overarching Learning Outcome
Students should be able to apply the principles of probability in sampling, data analysis and representation.
Specific Learning Outcomes
On completing the module students should be able to:

1. Describe the theory of probability.
2. Analyse data using probability distribution and densities.
3. Use principles of sampling distribution and densities.

4. Apply linear regression and correlation to a set of data.
5. Apply analysis of variance to solve engineering problems.
6. Analyse data using R or python software.

Module Content

Introduction: Variability, experimental design, random sampling, randomization, replication**. Summarizing Data**: Simple graphical techniques, numerical summaries and Box Plots, graphical tools for design of experiments. **Models for Experiment Outcomes**: models for single factor and two-factor experiments with and without interactions. Models for bivariate and multivariate data, fitting lines and curves, assessing the fit of a model, coefficient of determination, residual plots, correlation coefficient. Models for the random error: random variables, important discrete distributions, important continuous distributions, assessing the fit of a distribution. **Inference for a Single Population**: Central Limit theorem, confidence intervals, prediction and tolerance intervals, hypothesis tests, inferences for binominal population. **Comparing Two Populations**: paired samples, independent samples, comparing two binomial populations. **One-Factor Multi-Sample Experiments**: Analysis of Mean for unequal sample size and for proportions, ANOVA for equal and unequal sample size. **Experiments with Two Factors**: Interaction, more than one observation per cell, only one observation per cell, blocking to reduce variability. **Introduction to Multi-facto**r experiments: ANOVA for multi-factor experiments and factorial designs.

NB: the software R will be used throughout the course for different analytical purposes in each chapter.

Contribution to Exit Level Outcome

1. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4 and 5).
2. Investigations, experiments and data analysis (Course Outcomes 4, 5 and 6).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations.
4. Computer laboratory demonstrations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment will be made up of the following assessment activities:
   a. Assignments (laboratory assessment): 20%.
   b. Tests (at least 2 tests): 30%.
2. End-of-semester examination (1 x 3-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 40% in the end-of-semester examination and an average of at least 50% from both the Continuous Assessment and the end-of-semester examination.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Peter, R.N. (2003). Introductory Statistics for Engineering Experimentation. 1st edition, ELSEVIER Academic Press.

Recommended Text Books:

1. Navidi, W. (2019). *Statistics for Engineers and Scientists*. 5th Edition, McGraw Hill.
2. Devore, J.L. (2020). *Probability and Statistics for Engineering and the Sciences*, 9th Edition, Cengage.
3. Chatterjee, S. (2012). *Regression Analysis by Example*, 5th Edition, John Wiley and Sons.

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Next Revision: September 2028

9.5.2 YEAR 2 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

9.5.2.1 SEMESTER CORE

Module Title:	**ACADEMIC LITERACY II**
Module Code	U3683AL
NQF Level	6
Notional Hours	80
NQF Credits	8
Prerequisite	**U3583AL**
Contact Hours	2 Lectures + 1 Tutorial per week
Semester Offered	0

Module Purpose
The purpose of Academic Literacy IB is to introduce students to sources of information and to academic literacy practices in a university setting.
Overarching Learning Outcome
Students should be able to apply information searching techniques with academic skills necessary to fulfil tasks and cope with academic reading, listening, speaking and writing demands at university level.

Specific Learning Outcomes
On completing the Module students should be able to:
1. Articulate the need of information and behavioral approaches.
2. Identify required skillset to solve academic tasks or work.
3. Develop concept mapping and task-based learning themes.
4. Practice academic integrity to avoid plagiarism.
5. Apply features of academic writing and other academic conventions in own writing.
6. Use patterns of text organization to academic writing.
7. Summarise main ideas or relevant parts of texts.
8. Read and critique academic texts.
9. Apply appropriate reading comprehension strategies.
10. Use information from listening materials to complete writing and speaking tasks.

Module Content
The module will cover study skills, reading, listening, speaking and writing, referencing, language usage and text organisation.

Contribution to Exit Level Outcome:
1. Professional and Technical Communication (Course Outcomes 3, 4, 6, 7 and 9)
2. Independent Learning Ability (Course Outcomes 5, 8 and 10)

Learning and teaching strategies
The course will be facilitated through, but not limited to, the following learning activities:
- Blended instruction: Face-to-face and online
- Tests and assignments
- Tutorials/ Academic support
- Oral presentations

Student assessment strategies
Assessment will be based on Continuous Assessment.

Learning and teaching enhancement strategies
1. Students shall be exposed to library user-based services and training.
2. Students that might experience performance difficulty in the module will be identified and the necessary support and guidance as an intervention strategy will be provided by the teaching staff.
3. Statistics of the module pass and failure rate will be continuously kept.
4. Student-lecturer evaluation.
5. Lecturer-peer evaluation.
6. Curriculum review.
7. Moderation of assessment tools.

Prescribed Learning Resources
Academic Literacy IB Study Guide.
Recommended Learning Resources
1. Bailey, S. (2015). *Academic writing: A handbook for international students* (4th ed.). NY: Routledge.

2. Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). *Academic literacy* (2nd ed.). Cape Town: Juta and Company (Pty) Ltd.
3. Gaetz, S and Phadke, S. (2018). *Academic English: Reading and writing across the disciplines* (3rd ed.). London.UK: Pearson.
4. Machet, M. (2013). Mastering Information Skills for the 21st Century. 2nd Edition, UNISA Press, South Africa.
5. Piscitelli, S. (2009). Study skills: do I really need this stuff? (2nd ed). N.J. Pearson Prentice Hall,
6. UNAM Library Subject Specific Guides https://unam-na.libguides.com/?b=gandd=a

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING ENTREPRENEURSHIP**
Module Code	I3620IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	Core

Module Purpose
The purpose of this module is to enable the students to understand the concept entrepreneurship and innovation in the engineering field and the different aspects that makes an entrepreneur.

Overarching Learning Outcome
Apply entrepreneurship skills to innovate and manage entrepreneurial ventures.

Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the concept of entrepreneurship
2. Describe key attributes of entrepreneur
3. Carry out a feasibility study and draw up a business development plan
4. Discuss the process of innovation (transformative and incremental) and product development
5. Relate economic challenges and business creation
6. Describe the procedures followed in starting a new business venture including some regulations guiding the process
7. Explain the risk management process
8. Discuss the theory of motivation
9. Discuss the roles of strategic business and marketing management
10. Explain the importance of change management theory in entrepreneurship.

Module content
Entrepreneurship: - concept of entrepreneurship, characteristics of an entrepreneur, examples of good local and international entrepreneurial ventures, feasibility studies and business plan development and its components, government policies and regulations for starting new business ventures. **Entrepreneurship opportunities in Engineering:** innovative ideas and process of innovation, transformative and incremental innovations, innovation and business development, product development process and market research. **Risk management:** types of risk, risk management process, risk control and mitigation, risk response. **Change management:** Importance of change management, group dynamics and communication. **Strategic business management:** Management functions, strategic planning and management, resource management plan. **Strategic marketing management:** Marketing functions, marketing mix, innovative marketing, competitor analysis

Contribution to Exit Level Outcome:
- 7 Sustainability and Impact of Engineering Activity (Course Outcomes 3)
- 11 Engineering Management (Course Outcomes 4 and 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
1. Two lecture periods per week for 6 weeks
2. One tutorial or practical session per week for 6 weeks
3. Face to face consultations

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments: 20%
    b. Tests (At least 3 tests): 50%
    c. Written reports: 30%

Criteria for qualifying for the Examination:
No Examination
Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student's evaluation.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books:

[1] Nieuwenhuizen, C. and Nieman, G. (2018). Entrepreneurship: A South African Perspective 4th ed. Van Schaik Publishers
[2] Sibanda, M. (2021). Nuts and Bolts, Strengthening Africa's Innovation and Entrepreneurship Ecosystems. Tracey McDonald Publishers
[3] Botha, T. (2019). Entrepreneurship and how to establish your own business. 6th ed. Juta Legal and Academic Publisher

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**WORKSHOP PRACTICE**
Module Code	I3640IW
NQF Level	6
Notional Hours	80
Contact hours	3 PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	Core

Module Purpose
The purpose of this module is to enable the students to understand engineering workshop practices.
Overarching Learning Outcome
Carryout basic fabrications in an engineering workshop in a professional manner.
Specific Learning Outcomes
On completing the module students should be able to:

1. Work collaboratively in a team setting and use modern engineering tools and practices.
2. Discuss general safety procedures applicable to engineering workshops.
3. Describe specific hand tools used in engineering workshops.
4. Construct basic wall structures using brickwork, cement and mortar.
5. Differentiate between a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Fabricate a prescribed wooden component using the principles of carpentry.
11. Perform simple plumbing and pipe fitting exercises.
12. Describe the general operation of air-conditioning and refrigeration systems.

Module Content
Safety procedures applicable to engineering workshops: Safety equipment; Protective clothing; Signage. **Use of workshop hand tools. Principles and practices of**: Masonry and brickwork; Machining Operations (cutting, drilling, turning, milling, shaping); Sheet metal and fitting; Welding fabrication; Auto mechanics; Electrical wiring and installation; Soldering and de-soldering of electronic components; Carpentry and woodwork; Plumbing and pipe fitting; Refrigeration and air-conditioning systems and their installation.

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 5 and 10)
- 5 Engineering Methods, Skills, and Tools including Technology (Course Outcomes 2, 4, 6, 9)

Learning and Teaching Strategies/Activities

- Three practical session per week for 6 weeks
- Practical demonstrations
- Supervised practical, use of hand tools and machine tools
- Fabrication of simple components using various workshops and tools

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
   a. At least 5 practical reports: 40%
   b. Fabricated Components: 60%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student's evaluation.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books:

[1] Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
[2] Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

Issue Date: September 2023
Next Revision: September 2028

9.5.2.2 YEAR 2 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Module Code	I3611IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3512IM Engineering Mathematics II)
Prerequisite	**I3511IM Engineering Mathematics I**
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad and advanced mathematical skills to solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Apply differential vector calculus to solve mathematical and engineering problems.
2. Apply functions of several variables in solving engineering problems.
3. Approximate solutions to 2nd order differential equations using power series.
4. Describe the basis for complex analysis in engineering problem solving.
5. Apply the residual theorem to engineering problems.

Module Content

Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binomial, torsion, curvature. Functions of several variables: limits, continuity, derivatives, differentials, the Jacobian, matrix and determinants, composite functions, higher order derivatives. Applications: optimization on surfaces, constrained optimization. The gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Power Series and their applications: Power series. Radius of convergence and interval of convergence. Power series representation of functions, Taylor and Maclaurin series, the Binomial theorem. Power series solutions to ODEs with variables coefficients. Analytic Functions: Complex functions, derivatives, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem and evaluation of complex integrals.

Contribution to Exit Level Outcome:

- o 1 Problem solving (Course Outcomes 1,2,3,4,5)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3)
- o 5 Engineering Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - o Assignments (tutorials, quizzes): 40%
  - o Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.

[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.

[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.

[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.

2. Lecture notes

Issue Date: September 2023

Next Revision: September 2028

Module Title:	ENGINEERING ECONOMICS
Module Code	I3661IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the students to key economic concepts and how they are applied in the different sectors of the economy and in engineering in particular.
Overarching Learning Outcome

Apply key economic concepts in the different sectors of the economy and in engineering in particular.

Specific Learning Outcomes
On completing the module students should be able to:

1. Discuss the fundamentals of microeconomics
2. Apply the concept of time value of money
3. Apply investment analysis techniques for projects (NPV, ROR, IRR, CBA, Payback Period, etc.)
4. Apply depreciation methods on assets for valuation
5. Discuss the fundamentals of macroeconomics
6. Apply financial accounting principles in engineering projects
7. Discuss the principles of marketing engineering products

Module content
Microeconomics: economic concepts, economic problems, demand and supply, consumer choice and demand theory, production functions, production costs, profit maximisation: **Time value of Money:** time value of money, investment analysis (NPV, ROR, IRR, ROI, CBA, etc.), depreciation methods (straight line, reducing balance, some of digits) **Macroeconomics:** inflation and deflation, business cycle, monetary and fiscal policies, unemployment, international trade. **Financial accounting:** product costing, cost accounting, Cost estimation, financial statements and budgeting. **Introduction to marketing:** marketing principles.
Contribution to Exit Level Outcome:

- 11 Engineering Management (Course Outcomes 3, 6 and 7).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Consultations

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   a. Assignments: 40%
   b. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:

[1] Goodwin, N., Harris, J., Nelson, J.A., Roach, B. and Torras, M. (2020). Principles of Economics in Context 2nd ed. Routledge
[2] Mohr, P. (2015). Economics for South African Students 5th edition, Van Schaik Publishers

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Module Title:	**COMPUTER PROGRAMMING I**
Module Code	I3691CP
NQF Level	6
Notional Hours	150
Contact hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	NONE
Prerequisite	**I3551CC Computing Fundamentals**
Semester Offered	1

Module Purpose
The course aims to equip students with general principles of programming, skills, theories, and techniques for computer programmes design and solutions.

Overarching Learning Outcome
Design and analyse a computer program.

Specific Learning Outcomes
On completing the module students should be able to:
1. Design algorithms and data structures for solving mathematical and engineering problems using pseudo code, flowcharts, and related tools.
2. Differentiate different programming paradigms (structural, functional and object-oriented).
3. Discuss the concept of compiled and interpreted languages.
4. Use different data types in the design of programmes.
5. Apply arithmetic, logical and bitwise operations on different data types in programming.
6. Compile computer programmes in different integrated development environments.
7. Apply and test the three basic programming structures (Sequential, Decision and Looping) using specific programming languages (e.g., MATLAB, Python, C, etc.).

Module Content
Programme design: programming problem definition, programme requirements elicitation and analysis, specification development, design methods, design tool (pseudo code, flow charts etc.).
Programming Paradigms: Structural, functional and object-oriented programming concepts.
Introduction to programme compilation and interpretation: Definition and differences between compiled and interpreted languages, Compilation process, Execution of compiled code, Interpretation process, Examples of compiled and interpreted language, Advantages and disadvantages of each type of language.
Introduction to programming: variables, operators, data types, iteration, branching.
Data Structures: Arrays, lists, stack and queues, structures and enumeration/hash maps.
Fundamental concepts of programming: Data types, variables, program flow control (decisions and loops), string manipulation, functions, data structures and their operations.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 3, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 5)
5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions
4. A group mini project at the end of the module.
5. A special hands-on demonstration that may involve an invitation of an expert from outside.
6. Special soft skills lecture that may be done on-site or via video demos.

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
2. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (tutorials, quizzes, reports, practical assignments): 20%
    b. Tests (At least 3 tests): 50%
    c. Semester Mini project (prototype, oral presentation and development report): 30%

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student's evaluation
3. Regular review of the course content
4. Face-to-face consultations
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Prescribed Learning Resources

[1] Cay Horstmann, Rance Necaise; Python for Everyone, Second Edition, Wiley, 2016.
[2] William J. Palm III; Introduction to MATLAB for Engineers, Third Edition, Mc Graw Hill, 2011.
[3] Gregg Perry and Dean Miller; C Programming Absolute Beginner's Guide, Third Edition, Pearson, 2014.

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Next Revision: September 2028

Module Title:	**ELECTRIC CIRCUIT ANALYSIS I**
Module Code	I3681EC
NQF Level	*Level 6*
Notional Hours	*120*
Contact hours	3L + 1T and/or PS /Week
Additional learning requirements	NONE
NQF Credits	*12*
(Co-requisites)	TEGT3542 Fundamentals of Electrical Engineering
Prerequisite	**None**
Semester Offered	*1*

Module Purpose:

The course aims to equip students majoring in electrical and electronic engineering with main theories, techniques and theorems for analysing electric circuits and networks.

Overarching Learning Outcome

Demonstrate ability to design and analyse DC and AC electric circuits and networks using laws, techniques and theorems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Apply circuit theorems to simplify and find solutions to electrical circuits or networks.
2. Design, develop and interpret electrical circuits.
3. Use computer simulation tools for electric circuit design and analysis.
4. Perform DC and AC power calculations and measurements including power factor corrections.
5. Represent the total system response as a sum of a transient and steady state response and a natural and forced response.
6. Analyse, simulate, and experimentally validate DC and AC circuits.
7. Analyse three phase systems with balanced and unbalanced loads.

Module Content:

DC Transient Analysis: Natural response of first order RL and RC circuits. Step response of first order RL and RC circuits, general solution of first transient circuits. Natural and step response of second order series and parallel circuits (RLC). **Sinusoidal Steady State Analysis**: AC voltage and current, AC behaviours in basic elements (R, L and C). Phasor analysis with complex algebra, two terminal networks - impedance, admittance, and susceptance. **AC Circuit Analysis Techniques**: Ohms Law, KVL, KCL, loop/mesh and nodal analysis. **A.C. Circuit Theorems:** Superposition theorem, Thevenin's and Norton theorems; maximum power transfer theorem. **AC Power**: instantaneous, average or active, reactive, apparent, and complex power, power triangle, power factor and power factor correction. **Frequency Response Curves**: Resonance, series and parallel resonance, half power points, bandwidth, the concept of Q-factor, tuned circuits' frequency selective networks, mutually-coupled circuits. **Three Phase Networks**: Concept of three-phase voltage generation, phase diagrams for three phase networks, Analysis of balanced three phase networks, star and delta networks (source and loads), Unbalanced three phase circuits. Power and power measurement in three phase circuits. Computer circuit analysis and simulation using appropriate CAD software.

Contribution to Exit Level Outcome:

1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 5)
2. Investigations, Experiments and Data Analysis (Course Outcomes 3, 6, 7)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 3)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

1. Three lecture periods per week for 14 weeks
2. Two tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
    a. At least 2 quizzes, and at least 2 lab reports: 40%
    b. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 40% in the continuous assessments activities.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Books:
    - Boylestad Robert. (2015), Introductory Circuit Analysis, 13th Edition, Pearson Education, USA
    - Alexander K. Charles and Sadiku N.O. Mathews. (2013), Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, USA
    - Nilsson JW and Riedel SA. (2015), Electric Circuits, 10th Edition, Pearson Education, USA

2. Lecture Notes

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Next Revision: September 2028

Module Title:	**ANALOGUE ELECTRONICS I**
Module Code	I3691CA
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	
NQF Credits	12
(Co-requisites)	
Prerequisite	**TEGT3542, Fundamentals of Electrical Engineering**
Semester Offered	1

Module Purpose
This course aims to provide the necessary and fundamental knowledge and skills for analysis and design of analogue electronic circuits. .
Overarching Learning Outcome
Analyse, design, construct and operate a variety of semiconductor devices including diodes, BJT and FETs.
Specific Learning Outcomes
On completing the module students should be able to:

1. Discuss the atomic structure of semiconductor materials.
2. Discuss the construction and operation of semiconductor diodes.
3. Analyse and design diode-based circuits.
4. Discuss the construction of BJTs.
5. Analyse and design BJT amplifier and switching circuits.
6. Discuss the construction of FETs.
7. Analyse and design FET biasing, amplifier and switching circuits.
8. Discuss the internal circuitry and operation of op-amps.
9. Analyse and design op-amp circuits.
10. Use EDA software to analyse electronic circuits.

Module Content

Review of semiconductor theory. Semiconductor materials, covalent bonding, energy levels, valence band, conduction band. **Diodes: Types:** p-n type, Zener. **constructio**n, diode equivalent circuits, transition and diffusion capacitance, reverse recovery time, specification sheets, diode equation. **Diode applications:** clippers, clampers, limiters, rectification - full and half wave**. Bipolar Junction Transistors (BJTs): structure**-pnp transistor, npn transistor, transistor terminals operation characteristics curves, cut off region, saturation region, active region, Q- point **biasing:** fixed, emitter stabilized, voltage divider, dc bias with feedback, load line **applications:** switching circuits, amplifier circuits, oscillator circuits, Darlington pair, Current mirror circuits, current source circuits, cascaded systems, logic gates. **AC modelling:** Application in the a. c. domain, BJT small signal model, voltage and current gain, fixed bias configuration, voltage divider bias, emitter follower, feedback configurations, re model, hybrid pi equivalent model. **Field Effect Transistors (FET)**: **structure**- n transistor, p channel, transistor terminals, FETs Vs BJTs. Types: JFETs, MOSFETS, D-type mosfets, E Type mosfets, MESFETS Operation: characteristics curves, operation region, pinch off region, Shockley equation. **Biasing:** Fixed – Bias, Self-Bias, Voltage-Divider Bias, Feedback Configuration, **applications:** switching circuits, amplifier circuits, oscillator circuits, current source circuits, cascaded systems, voltage variable resistors, op-amps, cascade amplifier, chopper, logic gates, current limiter, Three-Channel Audio Mixer, Silent Switching, Phase Shift Networks, Motion Detection System. **AC modelling:** transconductance, dynamic resistance, ac equivalent model, gain calculation for Fixed – Bias, Self-Bias, Voltage-Divider Bias, Feedback Configuration for JFET and MOSFETs. **OP-Amps: internal structure**, open loop and closed loop configurations, ideal and practical op-amps, characteristics of ideal op-amps, equivalent model, inverting and non-inverting amplifier, gain expressions, specifications sheets, input output offset parameters **applications:** inverting op-amp, non-inverting op-amp, unity follower, Summing amplifier, Integrator, Differentiator. Analysis of electronic circuits using Electronic Design Automation (EDA) software: Proteus, Multi-sim

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 6, 8)
3 Engineering Design (Course Outcomes 3, 5, 7, 9)
4 Investigations, Experiments and Data Analysis (Course Outcomes 8, 10)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5, 7, 9)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Three lecture periods per week for 14 weeks
- Two tutorial sessions per week for 14 weeks
- Face-to-face consultations wherever necessary.
- Laboratory demonstrations.

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The Continuous Assessment will be made up of the following assessment activities:
    - iii) Continuous 50% (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50)
    - iv) Examination 50% (1 x 3 hour paper).

Criteria for qualifying for the Examination:

- To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Prescribed Learning Resources

- Books
    - Electronic Devices and circuit theory: Robert L Boylestad.
    - Fundamentals of Analog Circuits: Thomas L Floyd.
    - -Analog Electronics*: Ian Hickman*
- Lecture notes
- Video lectures

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9.5.2.3 YEAR 2 SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS IV
Module Code	I3612IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**I3512IM Engineering Mathematics II**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Equip students with broad and advanced mathematical skills that will help them solve engineering problems.
Specific Learning Outcomes
On completing the module students should be able to:

- Solve systems of first order linear differential equations using the LT and the matrix approach.
- Define, classify and solve partial differential equations analytically and
- Apply integral calculus to functions of several variables and describe Green's theorem
- Describe the principal of numerical methods and computational linear algebra

Module Content
Systems of Linear Differential Equations: Homogeneous and nonhomogeneous systems and their methods of solutions: The Laplace Transform method and the matrix methods (eigenvalue-eigenvector approach). **Partial Differential Equations:** Partial differential equations classification; elliptic, parabolic and hyperbolic. Neumann, Dirichrit boundary conditions of PDEs. Method of separation of variables to the heat and wave equations; vibrations of a stretched elastic string fixed at both ends. **Integral Calculus of Functions of Several Variables**: Double and triple integrals, Double, triple and iterated integrals, Line integrals in the plane, Green's Theorem, Independence of path, Surface integral, Divergence theorem, Stoke's theorem, Irrotational and solenoidal fields, Physical and engineering applications. **Numerical Methods:** Zeros of functions, Polynomial interpolation and least squares approximation, numerical differentiation and integration. Numerical solution of first order ordinary differential equations and boundary value problems.
Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,3,4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3,4)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Books
  [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
  [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
  [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
  [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
- Lecture notes

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Module Title:	**MEASUREMENTS AND INSTRUMENTATION**
Module Code	I3622CI
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS /Week
Additional learning Requirements	Include any compulsory field trips / excursions (outside the normal practicals); attachments / group work /project etc.
NQF Credits	8
(Co-requisites)	(I3502EE Fundamentals of Electrical Engineering)
Prerequisite	**None**
Semester Offered	1

Module Purpose
This module aims to provide the necessary and fundamental, theoretical and practical knowledge on measuring techniques.

Overarching Learning Outcome
Discuss the characteristics of measuring instruments and operate them in a lab environment as well as analyse and interpret measurement results.

Specific Learning Outcomes
On completing the module students should be able to:
8. Distinguish different types and methods of measurements.
9. Discuss static and dynamic characteristics of an instrument.
10. Explain the importance of signal generators and signal analysers in measurements.
11. Calculate errors and reduce them in measurements.
12. Discuss the concept of instrument calibration.
13. Explain the use of sensors and transducers.
14. Measure different quantities, analyse and interpret the measurement results.

Module Content
Systems of Units and Standards of Measurement: Absolute, derived and fundamental units. Advantages of electronic and electrical measurements. **Standards and types of standards**. International Standards, Primary Standards, Secondary Standards, Working Standards**. Errors**: sources of error. Types of errors, statistical analysis of error. **Performance characteristics of Instruments: Static characteristics** (Accuracy, Precision, Sensitivity, Reproducibility, and Tolerance etc.) **Dynamic characteristics** (Speed of response, Fidelity, Lag, dynamic error etc.). **Calibration:** Principles of calibration, calibration chain, calibration records. **Elements of generalized measurement system**, Functional elements of an instrument: Primary sensing element, variable conversion element (analogue to digital conversion), variable manipulation / conditioning element- (data amplification, attenuation) - data processing element (filtering), data transmission element, data storage element (chart recorders, computers, memory storage devices etc.), data presentation element/ termination stage**. Instrument classification:** active or passive instruments, null and deflection type instruments, analogue and digital instruments, indicating instruments and instruments with a sound output, smart and non-smart instruments. **Bridge measurement** (Wheatstone, Kelvin, Maxwell Anderson, Wien etc.) **Electrical indicating and test instruments:** Construction and operation of Digital meters (Voltage-to-time conversion digital voltmeter, Dual-slope integration digital voltmeter), Analogue meters **-** Construction and operation of Analogue meters: Moving-coil meters, moving iron meter, clamp on meter, techniques for measurement of high frequency signals. **Noise in Measurement Instruments**: Causes/ sources of Noise (Capacitive/ electrostatic, Inductive, multiple earth, thermoelectric potentials, shot noise,). Noise reduction techniques. **Measurements of electrical and non-electrical quantities: Sensors and transducers**: Transducer Characteristics, Mechanical vs electrical transducers. **Transducer classification**: active and passive transducers, on the basis of transduction principle used, analogue and digital transducers, primary and secondary transducers, **Transducer types:** potentiometric transducers, LVDT, thermocouple, capacitive, inductive, piezoelectric. **Transducer circuits:** temperature sensors, fire detector etc. **Oscilloscopes:** Internal architecture and operation, principle of signal display, voltage, current, period and frequency measurement. **Signal generators:** Requirements of a signal generator, sine wave generator, basic theory of oscillators (Wien bridge, RC phase shift, Hartley and Colpitts), RF signal generation, Lab type signal generator, function generator (specification and principle of operation), Spectrum **analysers:** characteristics and principle of operation**.**

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 7)
- 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes): 5%
    - Lab practical (At least 4 labs): 35%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% continuous assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
   [1] Measurement and Instrumentation. Theory and Application, 2nd Edition: Alan S. Morris, Reza Langari.
   [2] Introduction to Instrumentation and Measurements, 2nd Edition: Robert B. Northrop
2. Lecture notes

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Module Title	**ELECTRICAL CIRCUIT ANALYSIS II**
Code	I3692EC
NQF Level	Level 7
Notional Hours	120
Contact Hours	3L + 1T or 1PS /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(TECE3691 Electric Circuit Analysis I)
Prerequisite(s)	NONE
Semester Offered	1

Module Purpose
The purpose of this module is to provide students with an understanding of the basic methods that are used for the time and frequency domain analysis of linear electric circuits.

Overarching Learning Outcomes
Analyse and model electrical ac circuits and their frequency response characteristics using Fourier and Laplace transformation

Specific Learning Outcomes
On completing the module students should be able to

- Apply linear algebra and differential equations techniques in electric circuit analysis.
- Apply Fourier series and Fourier transforms for circuit analysis.
- Utilize Laplace transforms for circuit analysis.
- Derive, draw Bode plot frequency domain transfer functions for circuits and interpret them.
- Determine the frequency response of a given circuit.
- Design simple electrical filters that satisfy specific functional requirements.
- Characterize linear networks with two-port parameters.
- Simulate linear electric circuits and measure their properties.
- Synthesize network circuits to meet specifications.

Module Content:
Introduction: Review of Fourier series and Fourier transform, physical significance of the Fourier Transform and its application to electrical circuits. **Laplace transform:** Review Laplace transformations and its properties, Waveform synthesis. Initial and Final value theorems. Laplace Transform of network and time domain solution for RL, RC and RLC networks for ac and dc excitations. **Network functions:** Concept of complex frequency; terminal pairs/ports; driving point functions; analysis of ladder networks; analysis of non-ladder networks; poles and zeros of network functions; bode plot; **Two port network parameters:** Impedance; admittance; transmission; inverse transmission; hybrid; inverse hybrid; inter-relationships between the parameters; interconnection of two port networks; T and Pi networks; **Network Synthesis:** Hurwitz polynomials; positive real functions; realizations of LC and RC functions – Foster and Cauer Forms; Solving electric circuits using relevant **Computer aided tools** such as MATLAB, Pspice e.t.c.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2,3,4)
3 Engineering Design (Course Outcomes 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2,3,4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination.
- The Continuous Assessment will be made up of the following assessment activities:
  iv) Assignments (at least 2), 20%
  v) Tests (at least 2 tests): 50%
  vi) Labs (at least 3): 30%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the CA.

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Students' evaluation
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Books
  - C. Alexander and M. Sadiku, "Fundamentals of Electric Circuits," 5th ed., McGraw Hill, 2013.
  - Introduction to circuit analysis and design by Tildon Glisson. Jr, Springer Publications.
  - Network synthesis: Van Valkenburg; Prentice-Hall
  - Network Theory Analysis and Synthesis by Smarajit Ghosh, PHI publications
  - Networks and Systems by D. Roy Choudhury, New Age International publishers
  - J. Tront, "PSpice for Basic Microelectronics," McGraw Hill, 2008.
- Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**DIGITAL ELECTRONICS**
Module Code	I3632CD
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 2 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(TETE3691 Analogue Electronics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
This course aims to provide the necessary and fundamental knowledge and skills for analysis and design of digital electronic circuits.
Overarching Learning Outcome
Design and analyze combination and sequential logic circuits; design and analyze internal circuitry of different logic families and interfaces.
Specific Learning Outcomes
On completing the module students should be able to:

- Discuss fundamental digital terminology.
- Perform different number systems and coding conversions.
- Describe the operation of different logic gates.
- Analyse and simplify logic equations.
- Analyse and design different combinational and sequential logic circuits.
- Discuss the operation of Programmable Logic Devices (PLDs)
- Implement and validate combinational and sequential digital circuits using VHDL and FPGAs.
- Compare the performance of different logic family devices.
- Discuss and analyse the internal circuitry of different logic family technologies.
- Design interfaces between circuits of different logic families.

Module Content
Review of fundamental Digital concepts: Logic levels, number systems and digital codes. **Combinational Logic:** logic gates, Boolean algebra, logic simplification, combinational logic functions (including arithmetic circuits, encoders and decoders, multiplexers and demultiplexers, comparators, parity checkers and generators). **Programmable Logic Devices:** SPLDs, CPLDs, FPGAs, Schematic Entry, VHDL implementation and validation. **Sequential Logic:** latches flip-flops, counters, shift registers. **Design of Digital Systems**. **Logic gate circuits:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 8, 9, 10)
3 Engineering Design (Course Outcomes 5, 6, 10)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4,7)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:

- Four lecture periods per week for 14 weeks
- Two tutorial sessions per week for 14 weeks
- Face to face consultations
- Laboratory demonstrations, experiment documentation

Student Assessment Strategies

3. Students will be assessed through continuous assessments activities and a final examination
4. The Continuous Assessment will be made up of the following assessment activities:
    i) Assignments (At least 2 assignments): 20%
    ii) Practical reports (At least 4 Labs: 30%
    iii) Tests (At least 2 tests): 50%

Criteria for qualifying for the Examination:

- To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Books:
    - Digital Fundamentals: *Thomas L Floyd*
    - Digital Electronics and Logic Design: *B. Somanathan Nair*
    - Digital Electronics, Principles, Devices and Applications: *Anil K Maini*
- Lecture notes
- Video lectures

Issue Date: September 2023
Next Revision: September 2028

Module Title:	SIGNALS AND SYSTEMS
Module Code	I3692CS
NQF Level	6
Notional Hours	120
Contact hours	3L + 2T or 1PS /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	None
Prerequisite	**TEGM3592 Engineering Mathematics II**
Semester Offered	*2*

Module Purpose:
The purpose of this module is to provide the fundamental knowledge and skills for analysis of continuous and discrete-time signals and Linear Time Invariant (LTI) systems using the time and frequency domain analysis techniques.

Overarching Learning Outcome
Apply transform techniques and various analysis approaches to signals and linear time invariant systems in the time and frequency domain as well as continuous and discrete time filters.

Specific Learning Outcomes
On completing the module students should be able to:
- Discuss the classification and properties of signals and systems as well as their representations.
- Discuss the parameters of a continuous and discrete-time signal as well as LTI system.
- Use time domain and frequency domain analysis techniques to determine the response of an LTI system for a given input signal.
- Design continuous and discrete time LTI filters.
- Use MATLAB or any other simulation and visualisation tool to carry out computer-based simulations related to generating a system model, verifying system's properties as well as perform signal operations.

Module Content:
Representation of Continuous-time Signals: Introduction to typical signals; Time-domain operations; Continuous-time signal characteristics (periodicity, frequency, symmetry, energy, and power); Analogy between vectors and signals. **Signal representation and analysis:** Review of Representation of continuous-time periodic signals by trigonometric functions (Trigonometric Fourier Series) and Exponential Fourier series; Dirichlet's conditions; Properties of Fourier series. **Fourier Transform:** Definition of Fourier transform, test signals, Properties of Fourier transforms, Parseval's theorem. **Laplace transforms:** Importance and definition of Laplace transform, Properties, Laplace transform of elementary signals, Inverse Laplace transform, Region of convergence (ROC), Constraints on ROC to various classes of signals, Relationship between LT and FT of a signal. **Time domain analysis of LTI Systems:** Classification of systems, system description and parameters, Signal transmission through linear systems, Convolution and correlation of signals, Energy and Power spectral density (PSD), Relation of PSD to Autocorrelation. Applications of LT to LTI System analysis. **Analog Filter design:** Continuous-time and Discrete-time ideal and real filters (Low-pass, high-pass, band-pass, and notch filters) in the time and frequency domain (frequency, impulse, and step response); Practical RC filter circuits: Butterworth, Chebyshev, and Bessel approximations. Finite impulse response (FIR), Infinite Impulse Response (IIR) filter, **Statistical signal processing**: Random signal, White noise and its Power spectrum, Linear system with white noise input, Signal to noise ratio, Detection: Likelihood ratio test, Estimation: Maximum Likelihood estimation, MMSE.
Computer simulation software (e.g., MATLAB/PYTHON or equivalent).

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3 Engineering Design (Course Outcomes 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies
- Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (at least 2 Assignments): 20%,
  - Labs (at least 2 labs): 30%
  - Tests (At least 2 tests): 50%

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Effective and efficient supervision and monitoring of assignments, tests and examinations.
- Weekly consultation hours

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Signals and Systems, Models and Behaviours. M. L. Meade and C. R. Dillon. Kluwer Academic Publishers. Latest Edition.
- Signals and Systems, Tarun Kumar Rawat. Oxford University Press
- Lecture Notes

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Module Title:	**ELECTRICAL MACHINES I**
Module Code	I3682EM
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1PS /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3502EE Fundamentals of Electrical Engineering)
Prerequisite	**None**
Semester Offered	2

Module Purpose:

The purpose of the module is to introduce students to basic theory, characteristics, construction operation and application of both static and rotating electrical machines. The construction and operation are based on magnetic theory.

Overarching Learning Outcome

Demonstrate an understanding of basic electrical machine construction and terminology, be able to explain the operation of a Transformer, DC Machines, Three phase induction motor and their applications

Specific Learning Outcomes

On completing the module students should be able to:

1. Demonstrate the principle of operation of electrical machinery.
2. Analyse the principle of operation of DC machines such as DC motors, generators.
3. Explain the operation and applications of transformers and AC windings.
4. Model the operation of three-phase induction machines.
5. Identity Industrial applications of Electric Motor drives.
6. Explain Industrial applications of Electric Motor drives

Module Content:

Introduction to electric machinery (review of magnetism); Principles of rotating machines, Principle of Magnetism (Magnetic field lines and their Properties, Flux and Flux density), Production of Rotating magnetic field (EMF and Faradays laws of Electromagnetic induction, Review of Magnetic circuit. **DC machines (DC generator and Motor**); Construction and principle of operation, EMF equation of DC Machine, armature reaction, commutation, Equivalent circuit of DC Generator and DC Motor, Characteristic of DC. Generators (Types of DC Generators, Characteristics of DC. Motors (Types of DC Motors), Power Flow and DC Machines Efficiency. **Single Phase Transformers;** Construction and Principle of operation, Transformer EMF Equation, Ideal Transformer and its characteristics, Classification of Transformer and Applications, Practical Transformer and its characteristics, Transformer tests (Open circuit and short circuit), Transformer efficiency, Auto- transformer (Characteristic and principle of operation). **Three phase induction motor;** Construction and principle of operation, EMF equation, Equivalent circuit, Power flow and motor efficiency , Torque-slip characteristic, Motor Tests (No load test and Blocked rotor test), Starting and speed control techniques of Induction motor, Applications, Motor Drives (DC drives principle of operation and industrial Applications).

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1, 2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4,5)
- 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2,4,5)
- 6 Professional and Technical Communication (Course Outcomes 4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 60% Continuous Assessment and 40% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (at least 2): 20%,
    - Labs (at least 3): 30%,
    - Tests (at least 2): 50%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 60% in the design project.

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Books:

[1] Stephen J. Chapman, "Electric Machinery and Power System Fundamentals", 5th Ed., McGraw Hill, Feb. 2014.
[2] Theodore Wildi, "Electric Machines, Drives and Power Systems", 6th Ed., Prentice Hall, Jan. 2000

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9.5.3 YEAR 3 SEMESTER 1 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

9.5.3.1 YEAR 3 SEMESTER 1

Module Title	MICROPROCESSOR SYSTEMS
Code	I3771CM
NQF Level	7
Notional Hours	80
Contact Hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	8
(Co-requisites)	None
Prerequisite(s)	**I3632CD DIGITAL ELECTRONICS**
Semester Offered	1

Module Purpose
This course aims to provide knowledge for the architecture of microprocessors and skills for developing assembly language applications for microprocessors.

Overarching Learning Outcomes
Discuss the architecture of microprocessors as well as design, implement and analyse microprocessor-based systems and assembly language applications.

Specific Learning Outcomes
1. Discuss microprocessor architecture.
2. Write assembly language programmes for microprocessors for different applications.
3. Design memory interfacing circuits for microprocessors.
4. Design input/output peripherals interfacing circuits for microprocessors.
5. Analyse given assembly language programme to determine functionality and/or correct syntax and semantic errors.
6. Develop assembly applications capable of switching external devices ON/OFF and monitoring binary signals on microprocessor I/O ports.
7. Design interrupt generating circuit for microprocessor.
8. Develop a microprocessor-based application (incorporating digital electronics, analogue electronics, and assembly language).

Module Content:
Computer Systems: History of microprocessors-based systems, elements, and organisation of computer systems, instruction cycle. **Memory Devices:** RAM (SRAM, DRAM, DRAM cell arrays), ROM (EPROM, EEPROM), flash memory, memory addressing, address multiplexing, bus contention. **Microprocessors and architecture:** types of microprocessors, registers (general purpose register, special function registers), arithmetic and logic unit, execution unit, control unit, internal bus, external buses (address bus, data bus, control bus, bus timing), pipelining, segmentation, memory banks, pin diagram, maximum/minimum mode configuration. **Timing Diagrams:** T-cycle, machine cycle, instruction cycle, bus cycle, execution cycle and execution time of instructions. **Addressing Modes:** data addressing modes, programme memory addressing modes, I/O ports addressing, stack addressing modes. **Instruction set:** data transfer, arithmetic, logical, string manipulation, process control, control transfer instructions etc. **Microprocessor Programming:** Assembly language programming and programme structure, assembler directives compilers, debuggers, linkers, loaders etc., macros, procedures, code optimisation. **Memory interfacing:** Memory organisation, memory capacity, memory address decoder circuit, memory map design, memory interfacing. **Input/output interfacing:** Interfacing IC (e.g. 8255 PPI) architecture, pin diagram and configuration, I/O memory mapping, port address decoder circuit, command/control words, modes of operation, I/O interface programming clock generator circuits. **Interrupt mechanism:** sources, types, interrupt procedure, vector table, interrupt priority, non-maskable interrupt, maskable interrupt, priority modes, interrupt control/command words, interrupt service routines.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6)
3 Engineering Design (Course Outcomes 3 - 5)
1 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Two lecture periods per week for 12 weeks
- One tutorial or one practical session per week for 12 weeks
- Weekly consultation sessions

Students Assessment Strategies
1. Students will be assessed through continuous assessments activities.
2. The Continuous Assessment will be made up of the following assessment activities:

a) Assignments (at least 2), 10%
b) Practical work (at least 4), 30%
c) Tests (At least 3 tests), 40%
d) End of semester project, 20%

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. Invite students for one-one consultation to find the root cause of the problem.
2. Offer extra reading materials where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Textbooks
    - K. M. Bhurchandi and A. K. Ray, Advanced Microprocessors and Peripherals, 3rd ed. Tata McGraw Hill Education Pvt Ltd, 2013.
    - Y. Liu and G. A. Gibson, Microcomputer systems: the 8086/8088 family: architecture, programming, and design. Prentice-Hall, 1986.
2. Lecture presentation slides.
3. Microprocessor datasheets.
4. Microprocessors development boards.

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Module Title:	**MACHINE LEARNING**
Module Code	I3701CM
NQF Level	Level 7
Notional Hours	120
Contact hours	3Lectures + 1 Tutorials and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Pre-requisite)	**Statistics for Engineers (TEGS3661), Computer Programming I (TCME3621), Engineering Mathematics (II)**
Co-requisites	**None**
Semester Offered	1

Module Purpose

This module will introduce the field of Machine Learning (ML). ML techniques enable us to automatically extract features from data so as to solve numerous predictive tasks, such as speech/object recognition, machine translation, anomaly detection, medical diagnosis and prognosis, automatic algorithm configuration, and robot control, etc. Thus, this course introduces some of the basic concepts of mathematics and optimization required for machine learning. It also covers different learning paradigms (supervised, unsupervised learning, reinforced, and deep learning) and some of the more popular algorithms and architectures used in each of these paradigms. Students will learn the algorithms, which underpin many popular ML techniques, as well as applying mathematical/Engineering Knowledge in developing and understanding of the theoretical relationships between these algorithms. The practical labs will concern the application of ML to a range of real-world problems using computer aided software tools.

Overarching Learning Outcome

Demonstrate ability to develop algorithm and apply ML to real life problem.

Specific Learning Outcomes

On completing the module students should be able to:

1 Discuss necessary numerical computation and optimization techniques.
2 Understanding of the fundamental issues and challenges of machine learning
3 Discuss important paradigms of supervised, un-supervised, reinforced learning.
4 Apply mathematical and Engineering Knowledge in developing machine learning models.
5 Understand how to evaluate models generated from data.
6 Explain Biological motivations for neural networks.
7 Estimate the parameters effecting neural networks and deep learning.
8 Design and implement various ML algorithms to solve real world problems using Computer aided software tools.

Module Content

Introduction: Importance of Machine Learning techniques, Review of Basic Mathematics required for ML (Analytic Geometry, Matrix decomposition, Dimensionality reduction, Bayes theorem), Numerical computation and optimization, Machine Learning packages; Learning approaches: Supervised, Unsupervised, Reinforced learning techniques with examples. Linear and Logistic Regression: Bias/Variance Trade-off, Regularization, Variants of Gradient Descent, MLE, MAP; Classical ML Techniques: Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, k-Means clustering, kNN, Expectation Maximization. Neural Networks: Introduction, Early models, Biological neural network, Artificial neuron, Artificial neural network (ANN) architecture, Multilayer Perceptron learning, Backpropagation, Initialization, training and Validation, Parameter estimation. Convolutional Neural Networks: CNN Operations, CNN architectures, Training, Transfer Learning. Deep Learning: Introduction, parameters affecting DL, Deep convolutional neural networks, Recurrent neural networks, feature extraction, Autoencoders, Training of deep neural networks. **Applications:** Speech/Image (1D/2D) processing data sets.
LAB: Computer aided software (MATLAB/Python/TensorFlow/Keras).

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
i) At least 2 assignments, and at least 2 lab reports: 50%
ii) Mini-project and presentation (at least 2 presentations): 50%

Criteria for qualifying for the Examination:
1. A student must obtain a minimum of 50% in the assessments activities.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources
1. Books
2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**APPLIED ELECTROMAGNETICS**
Module Code	I3751CE
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 2 Tutorials and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Pre-requisite)	(I3582IM) Engineering Mathematics II
Co-requisites	None
Semester Offered	1

Module Purpose:
The purpose of this module is to provide an understanding of electromagnetic field (EM) and wave theory in the context of applications in electrical engineering. To cover the concepts of EM wave radiation, propagation, reflection and refraction in linear media. To introduce radiation from simple structures and basic calculations of EM field parameters at a distance from a radiating antenna. To provide the theory required for more specialized EM topics like microwave engineering and antenna design.

Overarching Learning Outcome
This module aims at equipping students with advances scientific knowledge of the important principles of electromagnetic wave propagations and theory.

Specific Learning Outcomes
On completing the module students should be able to:
1. Interpret visualizations of electric fields, electric scalar potentials, and magnetic fields in terms of the forces that charged particles or currents would experience.
2. Apply electromagnetic laws, Columbus, Gauss, Biot - Savart, Amperes laws to compute electric forces and fields, magnetic forces and fields due to charge or current distributions with appropriate symmetry.
3. Distinguish the behaviour of magnetic and electric fields in the presence of dielectric and magnetic materials.
4. Analyse electromagnetic wave propagation in generic transmission line geometries.
5. Compute the reflection coefficient, VSWR, reflected and transmitted power in a transmission line with various loads. Determine these values mathematically and using a Smith chart.
6. Formulate and analyse problems involving lossy media with planar boundaries using uniform plane waves.
7. Characterize the radiation of an antenna in terms of radiation pattern, directivity, beam width, and radiation resistance.

Module Content:
Review of Vector Algebra: Classification of vector fields. **Electrostatics**: Coulomb Law and Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equations for static EM fields. Electric potential; **Electric Field in Material Space**: Polarization in Dielectric; dielectric constant and strength; Continuity Equation and Relaxation Time; Boundary Conditions; **Magnetostatics**: Biot-Savart's Law; ampere Circuital Law; Maxwell Equation for time varying fields; Application of Ampere's Law Magnetic Flux Density; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices; Magnetic Boundary Conditions. Maxwell's equations in time-varying fields; Waves and phasors. Transmission lines; infinite transmission line; terminated transmission line; input impedance; standing and travelling waves; VSWR; power flow.
Basics Concept of Mode: TEM, TE and TM Modes and their characteristics Smith Chart: Development; use; matching-single and double stub. **Plane waves**: Plane wave propagation; Wave reflection and transmission; **Radiation and antennas**: Basic radiation fundamentals; launching and receiving radiating waves.

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2,3,5,6,7)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 5)

Learning and Teaching Strategies/Activities
1. The course will be facilitated through the following teaching learning activities:
2. Three lecture periods per week for 14 weeks
3. One tutorial or one practical session per week for 14 weeks
4. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes): 20%
   ii. Tests (At least 3 tests): 60%
   iii. Labs (lab reports): 20%

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 40% in the CA.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Books
   - i. Fawwaz T. Ulaby and Umberto Ravaioli, Fundamentals of Applied Electromagnetics, 7th Edition, Pearson Education International, 2015.
   - ii. M. N. O. Sadiku, Elements of Electromagnetics, 5th Ed., Oxford University Press, 2010.
   - iii. J. Edminster, Schaum's Outline of Electromagnetics, 3rd Ed., McGraw Hill Professional, 2010.
   - iv. Karl E. Lonngren, etc., Fundamentals of Electromagnetics with MATLAB, 2nd Edition, Scitech Publishing, Inc., 2007.
   - v. Nannapaneni Naraynan Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson Education International, 2006.
   - vi. W.H. Hayt and J.A. Buck, Engineering Electromagnetics, 8th Edition, Boston: McGraw Hill, 2012.
2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**POWER ELECTRONICS**
Module Code	I3731EP
NQF Level	Level 7
Notional Hours	160
Contact hours	4L + 2T or 1PS /Week
Additional learning requirements	None
NQF Credits	16
(Pre-requisite)	**I3631CA Analogue Electronics I**
Co-requisites	**None**
Semester Offered	1

Module Purpose:
The course aims to equip students majoring in electrical engineering with knowledge of power electronic components, converters and drives.

Overarching Learning Outcome
Select, design and analyse power electronics circuits, converters and drives.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the operation of controlled and uncontrolled power electronic circuits
2. Demonstrate an understanding of the basic concepts of switched-mode power supplies and control principles
3. Analyse the steady state operating characteristics of switching converters
4. Illustrate the operation and apply power electronic devices in linear DC power supplies
5. Analyse the operation and application of switching converters in switch mode power supplies
6. Design and implement practical power electronics circuits
7. Design and simulate simple converter circuits for particular applications using appropriate software like PSIM.
8. Design and analyse DC and AC drives

Module Content:
Introduction: History and main features of Power Electronics, Power Electronics vs Linear Electronics. Scope, applications and the role of *Power Electronics* in sustainable energy. Semiconductor Basics, pn junction and conduction process. Power Electronic Devices: Power electronics circuits construction and principles of operation (Diodes, BJTs, SCRs, GTOs, MOSFETs, IGBTs, TRIACs, and IGCTs). Power Converter Analysis: AC-DC Converters (uncontrolled and controlled single and three phase rectifiers), DC-DC Converters (Buck, Boost, Buck-Boost, Full Bridge, Cuk and SEPIC converters, SMPS), DC-AC Converters (single and three phase inverters), and AC-AC Converters (single and three phase, cycloconverters). Drives: Motor drive applications, DC Motor Drives, AC Motor Drives (Induction and Synchronous drives) and their application in wind power systems. Industrial applications: UPS, HVDC and HVAC systems configurations. Practical issues in the design and operation of converters. Design and simulation of converter circuits using PSIM or equivalent software.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 3, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3. Engineering Design (Course Outcomes 6, 7 and 8)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Four lecture periods per week for 14 weeks.
2. Two tutorials or one practical session per week for 14 weeks.
3. Weekly consultation sessions.

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
   i. At least 2 assignments, and at least 2 lab reports: 40%
   ii. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 40% in the continuous assessments activities.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Books
   i. Mohan, Undeland and Robbins. (2003), Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley and Sons, USA
   ii. Rashid H. Muhammad. (2014), Power Electronics: Devices, Circuits and Applications, 4th Edition, Pearson Education, USA
2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**POWER SYSTEM I**
Module Code	I3731EP
NQF Level	Level 7
Notional Hours	160
Contact hours	4L + 2T or 1PS /Week
Additional learning requirements	None
NQF Credits	16
(Pre-requisite)	**I3681EC Electric Circuit Analysis I, I3692EC Electric Circuit Analysis II**
Co-requisites	None
Semester Offered	1

Module Purpose:

The course aims to deliver the basic principle and fundamental analysis techniques for generation, transmission and distribution components of a power system as a first course in power system, short circuit studies.

Overarching Learning Outcome

Design a power generation plant, and explain power transmission to the consumers.

Specific Learning Outcomes

On completing the module students should be able to:

1. Describe the important parts and components in power system and explain roles and functions of the parts and components in power system operation.
2. Explain effects of power system to environment.
3. Explain, and perform calculations related to various types of conventional and new energy sources for electricity generation.
4. Demonstrate an understanding of power transmission lines design concepts.
5. Derive and apply suitable equations related to parameters, models and performances of transmission lines.
6. Describe configurations and perform calculations for factors related to power system loads.
7. Discuss basic concepts related to energy utilization, generation planning, tariff, power quality, energy efficiency, and demand side management.
8. Perform component modelling and power system analysis using per unit system.

Module Content

Introduction to Power System: Power System Evolution; Generation, Transmission and Distribution Components; Energy Sources- hydro, thermal, Nuclear etc.; Basic introduction to renewable energy- Photovoltaic, Wind, geothermal etc.; Major electrical components in power station- Alternators, transformers, bus bars, voltage regulators, switch and isolators, metering and control panels; Infinite bus concept; Voltage levels; AC vs DC Transmission; single-phase and three-phase power delivery. Transmission Lines: Types of lines – overhead and underground, HVAC and HVDC. Line parameters (derivation of formulae and use of tables) - resistance, inductance, and capacitance, Line modelling (using line formulae and ABCD parameters) - short, medium and long Line performance – power flow, efficiency voltage regulation. Methods of voltage control and reactive compensation, Electricity distribution systems: configurations and components. Types of ac and dc distributors, Flexible ac transmission systems (facts), Insulators and cables, Mechanical design of lines and grounding Substation layout, Underground substation. Component Representations in Power System One line diagram. Reactance and impedance diagram. Per unit system. Component modelling –generator, transformer, line, and loads. System analysis in steady-state condition using per-unit approach. Energy Utilization in Power System: Introduction, Types and characteristics of power system loads. Load factors - concept and calculations. Generation planning to fulfil load demand. Tariff. Supply quality – reliability and power quality. Energy efficiency. Introduction to Demand Side Management. Unbalanced System Analysis: Symmetrical components, Sequence impedances, Sequence components of the voltages and currents, Expression for power in terms of symmetrical components, Transformer voltages and currents; Application of software tools in modelling and simulation of power system networks (e.g.: CAD Electrical, MEP, DigiSilent, Power Factory, PSS, Power World and Herman–Beta Algorithm etc.).

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 3, 6, 8)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 7)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
9. Independent Learning Ability (Course Outcomes 5, 8)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Four lecture periods per week for 14 weeks
2. Two tutorials or one practical session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
   I. At least 2 assignments, and at least 2 lab reports: 40%
   II. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 40% in the continuous assessments activities.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 40% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Books
2. Lecture Notes

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Next Revision: September 2028

9.5.3.2 YEAR 3 SEMESTER 2 OF (32BHEI) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

Module Title:	**TECHNICAL WRITING**
Module Code	I3762VW
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Pre-requisite	Academic Literacy II
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with skills based in theory relating to professional and technical writing.
Overarching Learning Outcome
The overarching outcome of this module is to equip students with professional communication skills that will enable them to write good technical documents and to plan and present effective professional technical presentations individually and in teams.
Specific Learning Outcomes
On completing the module students should be able to:
1. Produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. Communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates and complying with constraints on document format.
3. Adapt content and rhetorical strategies according to audience and purpose for each document.
4. Select appropriate, credible sources to support the claims, findings or recommendations made in technical documents.
5. Incorporate ideas from source material, including images and figures.
6. Create and deliver technical briefings tailored to specific audiences, purposes and media.
7. Explain ethical considerations applicable to technical communication in engineering and computer sciences.

Module Content
Introduction: academic vs technical communication; introduction to a various technical and business writing theories and practices designed to be applicable to the production of business communication in the real world. **Technical writing**: fundamentals of good business/technical writing, including protocols for business letters, memoranda, electronic mail, good and bad messages; persuasive messages and formal reports and proposals. **Technical reports**: planning, structure, style and language for purpose and audience; effective graphical support. **Professional Oral communication**: structure, style and language; academic and professional discourse; group presentations to industry professionals. **Posters and e-portfolios**.

Contribution to Exit Level Outcome
Professional and technical communication (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Face-to-face consultations wherever necessary.
3. Case studies.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Assignments: 20%.
2. Group oral presentations: 10%.
3. Individual reports: 40%.
4. Tests (at least 2): 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of project reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
English, J. (2013). Professional Communication: Deliver effective written, spoken and visual messages, 3rd Edition, Juta Academic. ISBN 978-0702177927.

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Next Revision: September 2028

Module Title	**MICRONTROLLER ARCHITECTURE AND PROGRAMMING**
Code	I3772CM
NQF Level	7
Notional Hours	80
Contact Hours	2L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	8
(**Co-requisites**)	None
Pre-requisite(s)	**I3771CM MICROPROCESSOR SYSTEMS**
Semester Offered	1

Module Purpose
This course aims to provide knowledge for the architecture of microcontrollers and skills for developing assembly language applications for microcontrollers.
Overarching Learning Outcomes
Discuss the architecture of microcontrollers as well as design, implement and analyse assembly language applications for 8-bit microcontrollers.
Specific Learning Outcomes
1. Analyse given assembly language programme to determine functionality and/or correct syntax and semantic errors.
2. Develop assembly applications capable of switching external devices ON/OFF and monitoring binary signals on microcontroller's I/O ports.
3. Develop interrupt based assembly applications.
4. Develop assembly applications that incorporate microcontroller built-in EEPROM memory.
5. Develop assembly applications capable of converting analogue voltage to digital form.
6. Develop assembly application that incorporate microcontroller USART module.
7. Develop assembly application that capable of interacting with liquid crystal displays (LCD) and keypads.
8. Develop a microcontroller application (incorporating digital electronics, analogue electronics, and assembly language) as an end of semester project.

Module Content:
Microcontroller Architecture (for one selected 8-bit microcontroller family i.e., PIC or Atmel – with internal ADC): Pinout, port structure, Microcontroller Memory Organisation and Memory Mapping: SRAM organisation, general purpose registers, pointer registers, I/O registers, stack memory; programme memory organisation, programme memory counter; EEPROM organisation, additional microcontroller internal peripherals. Microcontroller Applications Development Tools: Development board (datasheet), development environments, assemblers, programme uploading and verification. Assembly Language (for one selected 8-bit Microcontroller family): Assembly vs Machine language, assembly file structure, assembler directives, include files, sub-procedures and macros. Instruction Set (for selected 8-bit Microcontroller family): Instruction set, arithmetic logic instructions, branch instructions, data transfer instructions, bitwise instructions, CPU control instructions, stack pointer initialisation. Application Design Principles and tools: Pseudocode, flowcharts, design to code translation. I/O register access, on/off control of external components e.g LEDS, dc motors etc., monitoring of digital input voltage e.g., from push buttons, or other external digital circuits; Analysis and design of delays (without built-in timers): Machine cycles, long delay implementation. Interrupts: Interrupt vectors, external interrupt setup, interrupt service routines. Internal EEPROM: EEPROM registers, writing to internal EEPROM, reading from internal EEPROM. Internal Analogue to Digital Conversion (single ended only): ADC features, Internal ADC operation, ADC registers, ADC sampling frequency selection, single conversion ADC operation, free running ADC operation, interrupt-based ADC operation. USART: USART registers, configuration, reading and writing to USART devices.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6)
3 Engineering Design (Course Outcomes 3 - 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or one practical session per week for 12 weeks
3. Weekly consultation sessions

Students Assessment Strategies
1. Students will be assessed through continuous assessments activities.
2. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (at least 2), 10%
   ii. Practical work (at least 4), 30%
   iii. Tests (At least 3 tests), 40%
   iv. End of semester project, 20%

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem.
2. Offer extra reading materials where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. Textbook
   - Programming and Customizing the AVR Microcontroller by Dhananjay V. Garde, McGraw Hill Education TAB; 1st edition (October 9, 2000), ISBN-13 : 978-0071346665.
2. Lecture presentation slides.
3. Microcontroller datasheets.
4. Microcontroller development boards.

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Module Title:	**RENEWABLE ENERGY TECHNOLOGIES**
Module Code	I3772ER
NQF Level	7
Notional Hours	160
Contact hours	4L + 2T or 1PS /Week
Additional learning requirements	None
NQF Credits	16
(Pre-requisite)	TEGT3542 Fundamentals of Electrical Engineering
Co-requisites	**None**
Semester Offered	2

Module Purpose:
The course aims to equip students majoring in electrical engineering with knowledge of renewable and emerging energy technologies, energy storage systems and sustainable energy solutions.
Overarching Learning Outcome
Select, design and develop renewable energy and energy storage systems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Design and analyse energy systems to supply the electricity/heat/cooling requirements using appropriate renewable energy technology.
2. Describe in detail the main characteristics principle of operations of solar energy, wind energy, bio-energy, etc. and their differences compared to fossil fuels.
3. Describe in detail the main components of the different renewable energy systems
4. Explain the technological basis for harnessing the renewable energy sources
5. Recognize the effects that conventional energy systems based on fossil fuels have over the environment and the society
6. (Optimize) different renewable energy technologies and select the most appropriate based on local technical and meteorological conditions
7. Design and size technological solutions based on renewable energy technologies to meet specific energy demands while maintaining economic feasibility and viability and a minimal environmental impact.

Module Content:

Introduction: RE technologies, differences and applications. Current status of RE technologies in Namibia and globally. Factors influencing RE technologies transition. Renewable Energy Technologies: Solar PV systems (the solar resource, solar cell, solar modules and arrays, types of PV systems, inverters types and configurations, battery storage) CSP technologies (Linear parabolic trough, Linear Fresnel, Solar towers or central receivers and parabolic dish, Carnot cycle and Carnot heat engine, Heat Transfer Fluids and Thermal Energy Storage), Wind Power Systems (wind energy resource, operating principles of wind turbines, wind energy systems design and performance analysis, and environmental impacts), Wave Energy, Tidal Power, Hydroelectric power (types, turbines, configurations and operating principle, pumped hydro) , bioenergy for electricity, Geothermal Power, and heat pump systems. Energy storage technologies and systems. Renewable Energy technology selection, system design, installation and performance analysis of a range of renewable energy systems. Grid integration of Renewable Energy systems and power quality issues. (Fuel cell/Hydrogen).

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 7)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3. Engineering Design (Course Outcomes 1, 7)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 7)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4, 5, 6, 7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

13. Four lecture periods per week for 14 weeks.
14. Two tutorials or one practical session per week for 14 weeks.
15. Weekly consultation sessions.

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:

i) At least 2 assignments, and at least 2 lab reports: 40%.

ii) Tests (At least 2 tests): 60%.

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 40% in the continuous assessments activities.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Books

o Masters Gilbert M. (2013), Renewable and Efficient Electric Power Systems, 2nd Edition, Wiley-IEEE Press, USA

2. Lecture Notes

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Module Title:	**ELECTRICAL MACHINES II**
Module Code	I3752EM
NQF Level	7
Notional Hours	160
Contact hours	4L + 2T or 1PS /Week
Additional learning requirements	None
NQF Credits	16
(Pre-requisite)	**I3682EM Electrical Machine I**
Co-requisites	**None**
Semester Offered	2

Module Purpose:
The aim of the module is to provide students with sound knowledge on physical interactions of electrical, magnetic, and mechanical phenomena in different electrical machines and skills to design an electrical machine according to requirements. The course will deal with different aspects in electrical machines: theory, characteristics, dynamics, applications, and design. (Knowledge and Skills)

Overarching Learning Outcome
To be able to analyse and design the Electrical Machines (static and rotating) used in deferent industrial applications.

Specific Learning Outcomes
On completing the module students should be able to:
1. Interpret and Analyse Machine Nameplate data.
2. Analyse and apply the concept of steady state analysis and electrical transients in Synchronous machines.
3. Apply theoretical engineering knowledge to practical designs.
4. Demonstrate the operation of electrical machines in a power system network.
5. Demonstrate understanding of the electromechanical energy conversion process.
6. Design a system component of various electrical machines or process to meet desired needs within realistic constraints.
7. Develop design concepts in a written report.
8. Explain the operation of electrical machines in a power system network.
9. Apply Software Design tools.

Module Content:
Three phase transformers; Advantages and disadvantages of three phase transformers, (Three Phase Transformer connections and phase shift, parameter determination, efficiency and voltage regulation of three phase transformers, Safely Parallel connection of three phase transformers, **Synchronous machines** (Synchronous Generators and Motors (both steady state and transient operation); Construction and Principle of Operation, Excitation systems, Determination of synchronous reactance and equivalent circuit. Starting methods of Synchronous motor, Synchronous machines on load and phasor diagrams, Power and Torque, Stability analysis of Synchronous generator in power network, effect of change of excitation current and mechanical torque on synchronous machines, Synchronization of machine on infinite bus ,
Electrical machine design and modelling: Machine windings and winding design. Design of the magnetic circuit of electrical machines. Machine main dimensions, Machine design procedure, Design of dc machines, design of three-phase induction motors, design of synchronous machines, design of transformers. Development of models.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 5, 6, 7)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 5, 8)
3. Engineering Design (Course Outcomes 1, 2, 3, 5, 7)
4. Investigations, Experiments and Data Analysis (Course Outcomes 1)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 9)
6. Professional and Technical Communication (Course Outcomes 6, 7)
9. Independent Learning Ability (Course Outcomes 8)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
16. Four lecture periods per week for 14 weeks
17. Two tutorials or one practical session per week for 14 weeks
18. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
i) At least 2 assignments, and at least 2 lab reports: 40% of the final CA marks
ii) Tests (At least 2 tests): 60% of the final CA marks

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 40% in the continuous assessments activities.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources
1. Stephen J. Chapman, “Electric Machinery and Power System Fundamentals”, 5th Ed., McGraw Hill, Feb. 2014.
2. Theodore Wildi, “Electric Machines, Drives and Power Systems”, 6th Ed., Prentice Hall, Jan. 2005

Issue Date: September 2023
Next Revision: September 2028

Module Title	**CONTROL ENGINEERING**
Code	I3832EC
NQF Level	8
Notional Hours	160
Contact Hours	4L + 2T or 1PS/Week
Additional learning requirements	None
NQF Credits	16
Assessment	Continuous 50% (At least 1 Assignment, At least 2 Tests and a mini-project), Examination 50% (1 x 3 hour paper)
(Co-requisites)	(I3611IM Engineering Mathematics III)
Prerequisite(s)	None
Semester Offered	2

Module Purpose

Aim of this Module is to introduce students to modelling, analysis, and design of linear feedback control systems from both classical and modern viewpoints, with a strong emphasis on the design of performance-oriented controllers under typical practical implementation constraints

Overarching Learning Outcomes

Analyse the performance of feedback control systems and design controllers to meet the required system specifications.

Specific Learning Outcomes
1. Evaluate different control theory terminologies.
2. Formulate basic electrical systems as control systems or part of control systems.
3. Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
4. Design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Explain the industrial applications of Controllers and compensators (PD, PI and PID)
6. Apply engineering software for modelling, analysis and design of control systems

Module Content:

Control Systems Basics: Fundamentals of control Theory, Components of a control system, applications of control systems, open and closed loops, and examples of modern control systems. **Modelling of dynamic Systems**: Laplace transform review, Models of dynamic systems in differential equation form; electrical, mechanical, electro-mechanical systems, hydraulic systems, gear-trains and rotational systems. Modelling of the system using block diagrams. Transfer functions; transfer function representation of a model. **Time Domain Analysis**: Laplace transform review, system response to typical input signals, Step response performance Steady state errors in unity and non-unity feedback systems. Static error constants and system type,

Feedback control system concept and stability: Essential principles of feedback. Sensitivity of control systems to parameter variation. Disturbance signals in feedback signals. Stability analysis; concept of stability, Routh_ Hurwitz stability criterion, other stability criterion, relative stability of feedback systems, stability of closed loop systems. **Root Locus method**: Root loci, plotting of root loci, System poles and zeros. Rules for root locus construction, **Frequency Response Concept**: asymptotic approximation (Bode Plots), Nyquist stability criterion, gain and phase margins. Stability using Nyquist diagram and bode plots.

State space analysis: State variable system description, state vector differential equation, state equation form block diagram, and transfer function, Solution of state equation; characteristic equation of a state model, Control of multivariable systems; controllability and observability. **Control Systems Design and compensation techniques**: improving transient response and steady- state response using cascade compensation. Feedback compensation. System compensation using phase- lead, phase – lag and phase lead – lag networks on the Bode diagram and root locus, Dynamic compensation using; proportional (P), derivative (D), integral (I) proportional and derivative (PD), proportional and integral (PI), proportional derivative and integral (PID) controllers, Design of Feedback Controllers using PI, PD and PID Controllers.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1,2, 3, 4, 5,6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4,5)
3. Eng Design (Course Outcomes 4)
4. Investigations, Experiments and Data Analysis (Course Outcomes 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorials or one practical session per week for 14 weeks
3. Weekly consultation sessions
4. A group design project at the end of the modules
5. At least one field trip to a road construction site
6. Invitation of at least 2 experts from the industry to give guest lecturers

Student Assessment Strategies
1. Students will be assessed through continuous assessment activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (tutorials, quizzes, lab and field reports): 5%
ii) Tests (At least 2 tests): 15%
iii) Design project (oral presentation and design report): 30%

Criteria for qualifying for the Examination:
1 To qualify for the exam, a student must obtain a minimum of 50% in total CA marks

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour)

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Learning Resources
1. Norman S. Nise, "Control System Engineering"- 6th Ed, John Wiley and Sons, USA, 2011.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control system" 12th Ed, Pearson, UK, 2010.

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Next Revision: September 2028

9.5.4 YEAR 4 OF (19BECE) BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

9.5.4.1 YEAR 4 SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 100% (at least 2 Assignments 20%, at least 3 Tests (covering the aspects: Law, Professionalism, Health and Safety) 80%).
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: Engineering societies and registration procedure for different Engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** Its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace.**

Learning Outcomes: On completing the course students should be able to:

1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace.
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 7 (health and safety), 8)

10 Engineering Professionalism (Course Outcomes 1, 2, 3)

ECN Exit Level Outcomes Assessed:

10 ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).***Where and how is this exit outcome assessed?***

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitutes satisfactory performance?

After consideration of the 3 tests and 2 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Module Title:	PROJECT MANAGEMENT
Code	TEGM3891
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (at least 2 Assignments 20%, at least 2 Tests 30%, group project presentation 20% and group project report 30%). The group must consist of students from a minimum of two different disciplines.
Pre-requisite(s)	**TEGT3761 Fundamentals of Economics**

Content: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing Engineering projects**: medium to large scale and community based projects, inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation;
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team.

CONTRIBUTION to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

8 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**
Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**
Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:
Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.
To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitutes satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project

management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitutes satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"****excellent****".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title	**CONTROL ENGINEERING**
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50% (At least 1 Assignment, At least 2 Tests and a mini-project), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGT3671 Engineering Mathematics III**

Contents: Control Systems Basics: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems:** Laplace transform review**,** transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of electrical systems. **Control System Analysis:** system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques:** Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators.

Learning Outcomes: On completing the course students should be able to:

1. Discuss different control theory terminologies.
2. Model basic electrical systems as a control systems or part of parts of control systems.
3. Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control Engineering.
4. Analyse and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Use Engineering software for modelling, analysis and design of control systems

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
3 Engineering Design (Course Outcomes 4, 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5)

Module Title	COMPUTATIONAL METHODS IN POWER ENGINEERING
Code	TECE 3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	100% continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%)
Pre-requisite(s)	**TECE3731 Fundamental of Power Systems**,
Co-requisite(s)	(TECP3831 Power Systems Protection)

Content: Electric power system operation; development of models of transmission line components and networks; computer methods for solving linear and nonlinear systems of network equations; operating problems in load flow, scheduling and economic dispatch. Load flow analysis – classification of system variables and generation to B – Bus system. Load flow solution using Gauss-Seidel and Newton-Raphson methods. Computer-aided short circuit analysis of large systems; transient stability analysis; overvoltage calculations and power system protection. Power system stability and methods of improving stability, Application of software tools in modelling and simulation of power system networks (e.g.: CAD Electrical, MEP, DigiSilent, Power Factory, PSS, Power World and Herman–Beta Algorithm etc.).

Learning Outcomes: On completing the course students should be able to:

1. Perform the power system analysis using software package.
2. Use system models for unsymmetrical fault analysis and load flow studies
3. Demonstrate knowledge of major Engineering problems associated with building high power Engineering systems and how they are solved.
4. Use a range of software tools to synthesize electrical power systems

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 4)

ECN Exit Level Outcomes Assessed:

2. **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**

   Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies

The assessment will constitute the following: At least 2 Assignments and at least 2 Tests all making **50%,** Examination (1 x 3 hour paper) making **50%.** To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, basic science and Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the use of mathematical, numerical analysis and statistical knowledge and methods to bear on Engineering problems; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of Engineering science at a fundamental level and in at least one specialist area.

What constitutes satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be allowed to take the supplementary exam, after which if the minimum competence is still not obtained, then the student is considered to have failed the course.

Module Title	POWER SYSTEMS PROTECTION
Code	TECP3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 Assignments - 30%, At least 2 Tests - 70%), Exam 50% (1 x 3 hour paper)
Pre-requisite(s)	**TECE3791 Electric Circuit Analysis II**,

Content: **Faults and abnormal operating conditions, General philosophies of power system protection:** objectives of power system protection; Protective zones; primary and back-up protection; typical relay and circuit breaker connections; factors affecting the protection system; classification of relays and their operating characteristics; circuit breakers; isolators; switchgears and fuses, **Relay input sources:** current transformers; characteristics and performances of current transformers; voltage transformers; optical sensors**, Protection schemes:** overcurrent protection; directional and distance protection; differential protection**, Applications of protective schemes to power system equipment:** busbar protection; generator protection; transformer protection; transmission line protection; motor protection; pilot protection**,**

Power system stability considerations, Load shedding, Reclosing, Digital (numerical) protection, Distribution and protection systems.

Learning Outcomes: On completing this course, students should be able to:

1. Illustrate the operation of a modern electricity network, under both steady-state and fault conditions, and the techniques used for network analysis and design
2. Describe the principles of switching and protection of power systems and components
3. Describe the protection equipment used in the switching and protection of electrical power systems,
4. Analyse the response of a power system to demand conditions and corrective measures for its control

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)

Module Title:	**MICROPROSSESSORS AND PROGRAMMABLE LOGIC CONTROLLERS**
Code	TECP3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (Quizzes, 2 practical exercises, assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TETD3692 Digital Electronics**

Content: Microprocessors: history, types of microprocessors, microprocessors fabrication process, cost of microprocessors. Microprocessor structures: registers, arithmetic and logic unit, control unit, internal bus. External buses: address bus, data bus, control bus, bus timing. Memory interfacing: memory map design, memory address decoder circuit. Input/output interfacing: port mapping, port address decoder circuit. Clock generator circuits. Interrupt mechanism: interrupt priority, non-maskable interrupt, maskable interrupt, interrupt modes. Execution cycle and execution time of instructions. Programme execution time calculation. Translation of mnemonics to machine codes.

PLCs :Definition of PLCs, need for the PLCs and principles of operation, Ladder diagrams and the PLC, advantages of PLC base system over relay based system and Logic concepts, PLC Architecture: Processors, Power supply and Programming device. Memory systems and I/O interactions. Digital I/O modules, Analogue I/O Modules Special Functions I/O and serial communication interface. PLC Programming: Programming Languages, IEC Standard. PLC based system programming and implementation. PLC system documentation, PLC Process

Applications: data measurement and transducers, output devices, process controllers and tuning. Installation and start-up procedures: PLC start-up and maintenance, PLC Selection.

Learning Outcomes: On completing the course students should be able to:

1. Plan and implement Memory organization including static and dynamic semiconductor memory, optical and magnetic memory, memory hierarchy and caches.
2. Design memory circuit for microprocessors.
3. Design input/output circuit for microprocessors.
4. Design interrupt generating circuit for microprocessor
5. Calculate exact execution time of programmes.
6. Describe the architecture and principles of operation of PLCs
7. Demonstrate an understanding of IEC standard and languages
8. Describe the PLC programming techniques and languages
9. Design PLC Programmes for PLC based control applications
10. Programme and troubleshoot the PLC based control systems

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 10)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 6, 7, 8)
3. Engineering Design (Course Outcomes 2, 3, 4, 9)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 10)

9.5.4.2 YEAR 4 SEMESTER 2

Module Title:	ELECTRICAL RESEARCH PROJECT
Code	TECR3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	**Continuous 100%** Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s)	TECR3792 Research Proposal; All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:

1. Demonstrate skills necessary to carry out a technological or engineering investigation.
2. Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
3. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
4. Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Contribution to Exit Level Outcome:

4. Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5. Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6. Professional and Technical Communication (Course Outcomes 5)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8. Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9. Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Demonstrate competence to formulate and conduct investigations and experiments.

5. ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

9. INDEPENDENT LEARNING ABILITY

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: one Seminar presentation (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 4, 5, 9 assessed as follows:

ECN Exit Level Outcome 4 - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 9 – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. In the course of the research project, students are supposed to show their ability to engage in independent learning through well-developed learning skills and awareness of up-to-date tools, techniques and new developments in Engineering and technology as well as the need to access, comprehend and apply knowledge acquired outside formal instruction and guidance from the supervisor.

What constitutes satisfactory performance?

After consideration of student's individual conduct in the course of the research project, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** The supervisor will be expected to give examples of cases where the student demonstrated independent learning skills in the course of the research project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report to beef up independently learned components, within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title	ELECTRICAL DESIGN PROJECT
Code	TECD3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s)	All third year modules

Content: An essential element of Engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated Engineering drawings or computer source codes consistent with professional Engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
1. Identify and formally state problems that can be solved using Engineering knowledge and skills.
2. Demonstrate practical skills in the design of Engineering components, assemblies and/or systems.
3. Demonstrate knowledge of creativity, innovation, safety, ergonomics and good Engineering practice in the design process.
4. Develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4, 6)
9 Independent Learning Ability (Course Outcomes 2, 6)
10 Engineering Professionalism (Course Outcomes 4, 7)
11 Engineering Management (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:
1. PROBLEM SOLVING
Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively.
3. ENGINEERING DESIGN
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.
6. PROFESSIONAL AND TECHNICAL COMMUNICATION
Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.
Assessment Strategies
The assessment will be **100% Continuous** constituting of the following: Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 1, 3, 6 assessed as follows:
ECN Exit Level Outcome 1 – PROBLEM SOLVING
Where and how is this exit outcome assessed?
Students are expected to competently Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.
What constitutes satisfactory performance?
After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "***Problem Solving***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60%

of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 – ENGINEERING DESIGN

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognize and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimization.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with "***Engineering Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " ***Engineering Design***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "***Engineering Design***" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 6 - PROFESSIONAL AND TECHNICAL COMMUNICATION

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final design report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of design report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitutes satisfactory performance?

After consideration of the section of the final design report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised design report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate Engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
2. Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3. Discuss the role of engineers in the management and organization of Engineering enterprises
4. Discuss in details the main technical activities undertaken during the attachment.

10 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) -- EXTENDED

YEAR 1 OF (32BHNX) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING HONOURS – EXTENDED 132 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Mechanical Engineering	13500NI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Mechanical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Mathematics support I	I3401MS	4	0	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Physics for Engineers Support I	I3421PS	4	0	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Chemistry for Engineers Support	I3441CS	4	0	None
Total credits 1st Semester BSc Mechanical Engineering				**44**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Engineering Mathematics support II	I3402MS	4	0	(None)/**None**
2	Physics for Engineers II	I3582NP	5	12	I3581NP
2	Physics for Engineers Support II	I3422PS	4	0	None
Total credits 2nd Semester BSc Mechanical Engineering				**24**	

YEAR 2 OF (32BHNX) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING HONOURS – EXTENDED 136 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Mechanical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Drawing	I3530ID	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Engineering Economics	I3661IE	6	8	None
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
Total credits 1st Semester BSc Mechanical Engineering				**52**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Fundamentals of Electrical Engineering	I3522EE	5	8	I3511IM
2	Statistics for Engineers	I3582IS	5	12	I3511IM
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM,** I3611IM
Total credits 2nd Semester BSc Mechanical Engineering				**60**	

10.1 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

10.2 DEGREE NAME: BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) (32BHNI AND 19BMEE)

10.3 AIM

The curriculum for the degree of Bachelor of Science in Mechanical Engineering (Honours) aims at producing Graduate Engineers with knowledge, skills and abilities in mechanical Engineering design, manufacturing technology, industrial management, production systems, applications of fluid and thermal machines and research techniques.

10.4 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Mechanical Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) main semesters and two core semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study is common to all Engineering disciplines. In Years 2 to 4, students take discipline-specific modules and a few common modules. There are no taught modules in Semester VIII since this semester is fully dedicated to Research and Design Projects.

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Session. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some assignments and Lab reports, where applicable.

YEAR 1 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) – 164 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Mechanical Engineering	I3500NI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Mechanical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Drawing	I3530ID	5	16	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Chemistry for Engineers	I3511NC	5	16	None
Total credits 1st Semester BSc Mechanical Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Physics for Engineers II	I3582NP	5	12	(I3521NP)
2	Fundamentals of Electrical Engineering	I3522EE	5	8	(I3511IM)
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	(I3511IM)
Total credits 2nd Semester BSc Mechanical Engineering				**68**	

YEAR 2 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) – 156 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	U3583AL
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Mechanical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) I3511IM
1	Engineering Economics	I3661IE	6	8	None

1	Computer Programming I	I3691CP	6	12	(I3551CC)
1	Strength of Materials	I3681VM	6	12	(I3532NM)
1	Engineering Mechanics II	I3641NM	6	8	(I3582NM)
1	Engineering Materials	I3661NM	6	8	(I3572IS)
Total credits 1st Semester BSc Mechanical Engineering				**64**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics IV	I3612IM	6	16	(I3611IM) **I3512IM**
2	Computer Programming II	I3692CP	6	12	(I3631CP)
2	Electrical Machines I	I3682EM	6	12	(I3502EE)
2	Fluid Mechanics I	I3692NF	6	12	(I3532NM)
2	Mechanical Engineering Design I	I3622ND	6	8	I3532NM
2	Measurements and Instrumentation	I3622CI	6	8	(I3502EE)
Total credits 2nd Semester BSc Mechanical Engineering				**68**	

YEAR 3 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) – 136 CREDITS

SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Solid Mechanics	I3751NS	7	16	**I3651VM**
1	Control Systems	I3781NM	7	12	(I3622CM)
1	Fluid Mechanics II	I3721NF	7	8	(I3632NF)
1	Thermodynamics	I3711NT	7	16	**I3521NP**
1	Machine Tools	I3791NT	7	12	**I3661NM**
Total credits 1st Semester BSc Mechanical Engineering				**64**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Technical Writing	I3762VW	7	8	U3683AL
2	Heat Transfer	I3762NH	7	8	(I3711NT)
2	Computer Aided Engineering and Manufacturing	I3792NC	7	12	**I3531ID** (I3701NT)
2	Manufacturing Technology	I3792NM	7	12	I3701NT) **I3661NM**
2	Mechatronics	I3742NM	7	8	(I3731NM) **I3622CM**
2	Operations Management	I3722NO	7	8	(I3701NT)
2	Mechanical Engineering Design II	I3752ND	7	16	(I3622ND)
Total credits 2nd Semester BSc Mechanical Engineering				**72**	

YEAR 4 OF (19BMEE) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) – 140 CREDITS

SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** and CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Mechanical Vibrations	TMER3861	7	8	**TEGT3641**
1	Project Management	TEGM3881	8	12	**TEGT3761**
1	Renewable Energy	TMEE3841	8	8	**TMED3642**
1	Thermal Machines	TMEE3831	8	16	TMER3791
1	Fluid Machinery	TMEE3851	8	16	**TMEE3611**
1	Mechanical Engineering Design III	TMEM3821	8	8	**TMER3781**
Total credits Semester 1				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** and CO-REQUISITE
2	Research Project	TMER3892	8	30	All 3rd Year Modules TMER3792
2	Mechanical Engineering Design Project	TMED3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total credits Semester 2				**64**	

Total credits for BSc in Mechanical Engineering (Honours) **596**

10.5 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

10.5.1 YEAR 1 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

10.5.1.1 YEAR 1 SEMESTER CORE

Module Title:	SKILLS PORTFOLIO
Module Code	U3403FS
NQF Level	5
Notional Hours	N/A
Contact hours	N/A
Additional learning requirements	None
NQF Credits	0
Prerequisite	None
Semester Offered	Core

Module Purpose
The purpose of this module is to determine, develop and maintain individual students' academic motivation, needs and strengths for effective learning ensuring academic success.
Overarching Learning Outcome
Apply skills relevant to their academic journey at the University in terms of successful attainment of professional and personal goals.
Specific Learning Outcomes
On completing the module students should be able to:

1. Apply motivational theories to demonstrate positive attitudes in their professional and academic life.
2. Identify and manage needs and factors that may negatively impact their academic work including the design of action plans to motivate and guide them.
3. Identify and make use of the different learning styles to promote learning in a more efficient manner using various study methods and skills.
4. Manage time effectively
5. Design and make use of various test taking and examination preparation strategies.
6. Identify and use tools to improve and maintain Mental Health and wellbeing.
7. Apply the dynamics of interpersonal communication.
8. Manage their finances.
9. Identify violence as a social problem in the Namibian context to manage and prevent the occurrence thereof in their life.
10. Recognize the importance of skills training and upgrading in career planning and development to improve their classroom experiences.
11. Create a career plan, set clear, realistic and attainable career goals and engage in activities to enhance their CVs.

Module Content
UNIT 1: Academic Planning and Goal Setting
Individual Needs and Values; Steps in Reaching a Personal Vision; Proactive Approach Towards Learning; Self-Regulated Learning; Personal and Academic Goal Setting; Receptiveness to Learning; Exploring Self-Development and Self- Awareness.
UNIT 2: Attitude and Motivation
Understanding Motivation; Personal Attitudes, Behaviours and Interests; Self-Reflective Process; Approaches to Dealing with Negative Factors; Class Attendance and Participation; Procrastination; Self-Reliance; Discipline; Accountability; Healthy Habits.
UNIT 3: Learning styles
Understanding Personal Approaches to Learning; Dynamics of the Learning Process; Learning Styles and Strategies.
UNIT 4: Study Methods and Skills
Study Habits and Strategies; Learning Styles and Techniques; Effective Study Methods and Skills; Note Taking; Memory and Reading Skills; Critical Thinking.
UNIT 5: Time Management
Effective Time Management; Planning; Decision-making; Prioritization; Setting Boundaries; Time for Self – care; Procrastination.
UNIT 6: Assessment Preparation
In class exercise; Test and Examination preparation; Organizing academic workload; Setting daily study goals; Staying physically active; Study groups.
UNIT 7: Mental well-being
Understanding mental health; Signs and indicators of poor mental health; commonly experienced mental health challenges; psychosocial stressors; Seeking professional help; Coping strategies.
UNIT 8: Interpersonal Communication
Effective Communication Skills; Verbal and Non-Verbal Communication; Listening Skills; Problem Solving; Assertiveness; Negotiation Skills; Practicing Empathy in Communication; Self-Confidence; Receptiveness to Feedback; Building Trust; Teamwork; Leadership; Public Speaking Skills.

UNIT 9: Financial matters and management

Financial Literacy; Budgeting; Available Finance Options and Assistance; Managing Financial Resources.

UNIT 10: Student Violence

Types of Violence; Individual Roles in Violence; Myths, Forms; Consequences of Violence; Prevention Measures; Seeking for Help.

UNIT 11: Career Planning and Development

Defining and Selecting Career Goals; Career Exploring Different Strategies; Soft Skills Training.

Learning and Teaching Strategies/Activities

The course will be facilitated through, but not limited to, the following learning activities:

- **Online teaching**: Self-study on theoretical foundations and concepts of the Skills Portfolio module
- **Discussion forums (peer review):** reflecting on own contexts, experiences and sharing perspectives
- **Inquiry:** carrying out research to explore and understand scenarios and problems relating to self
- **Portfolio writing:** writing reflective learning journals related to the Skills Portfolio module

Student Assessment Strategies

- 100% continuous assessment
- Reflective journal on each unit (portfolio)

Learning and Teaching Enhancement Strategies

- Student – lecturer evaluations, conducted twice a year
- Moderation of assessment tools

Learning Resources

[1] Feldman, R. S. and Chick, S. (2005) Power learning: Strategies for Success in Higher Education and Life. Toronto: McGraw Hill Ryerson Limited.

[2] Light, R. J. (2001). Making the most out of College: Students Speak their Minds. Cambridge, Mass: Harvard University Press.

[3] Tracy, E. (2002). The student's guide to exam success. Philadelphia: Open University Press

[4] Toft, D. (2005). Mastering Student Guide to Academic Success. Boston: Houghton Mifflin Company.

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Module Title:	**ACADEMIC LITERACY I**
Module Code	U3583AL
NQF Level	5
Notional Hours	80
NQF Credits	8
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial/ week
Semester Offered	Core

Module Purpose

The purpose of Academic Literacy I is to introduce students to sources of information required to contribute to academic discourse to enhance their receptive and productive language skills through exposure to different academic genres.

Overarching Learning Outcome

Apply information searching techniques with academic skills necessary to fulfil tasks and cope with academic reading, listening, speaking and writing demands at university level.

Specific Learning Outcomes

On completing the Module students should be able to:

1. Identify potential sources of information
2. Articulate the need of information and behavioural approaches.
3. Identify required skillset to solve academic tasks or work.
4. Develop concept mapping and task-based learning themes.
5. Integrate summaries, paraphrases and quotations to avoid plagiarism.
6. Apply features of academic writing and other academic conventions in own writing.
7. Apply patterns of text organization to academic writing.
8. Summarise main ideas or relevant parts of texts.
9. Apply appropriate reading comprehension strategies.
10. Illustrate the correct use of vocabulary and grammar in speaking and writing.

Module Content

The module will cover study skills, reading (including extensive reading), listening, speaking, writing, referencing, and language usage and text organisation.

Contribution to Exit Level Outcome:

- 6 Professional and Technical Communication (Course Outcomes 3, 4, 6, 7 and 9)
- 9 Independent Learning Ability (Course Outcomes 5, 8 and 10)

Learning and teaching strategies

The course will be facilitated through, but not limited to, the following learning activities:

- Blended instruction: Face-to-face and online
- Tests and assignments
- Tutorials/ Academic support
- Presentations

Student assessment strategies

Assessment will be based on Continuous Assessment.

Learning and teaching enhancement strategies

- Students shall be exposed to library user-based services and training.
- Students that might experience performance difficulty in the module will be identified and the necessary support and guidance as an intervention strategy will be provided by the teaching staff.
- Statistics of the module pass and failure rate will be continuously monitored.
- Student-lecturer evaluation
- Lecturer-peer evaluation
- Curriculum review
- Moderation of assessment tools

Recommended Learning Resources

- Bailey, S. (2015). *Academic writing: A handbook for international students* (4th ed.). NY: Routledge.
- Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). *Academic literacy* (2nd ed.). Cape Town: Juta and Company (Pty) Ltd.
- Gaetz, S and Phadke, S. (2018). *Academic English: Reading and writing across the disciplines* (3rd ed.). London.UK: Pearson.
- Machet, M. (2013). Mastering Information Skills for the 21st Century. 2nd Edition, UNISA Press, South Africa.
- Piscitelli, S. (2009). Study skills: do I really need this stuff? (2nd ed). N.J. Pearson Prentice Hall,
- UNAM Library Subject Specific Guides https://unam-na.libguides.com/?b=gandd=a

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Module Title:	**INTRODUCTION TO MECAHNICAL ENGINEERING**
Module Code	I3500NI
NQF Level	5
Notional Hours	60
Contact hours	2 Lectures
Additional learning requirements	Group work and Project.
NQF Credits	6
(Co-requisites) **Prerequisite**	(None) **None**
Semester Offered	Core

Module Purpose

The purpose of this module is to prepare the students to mechanical engineering profession at an early stage

Overarching Learning Outcome

Describe the field mechanical engineering, its branches, career opportunities and key theories underpinning the field of mechanical engineering.

Specific Learning Outcomes

On completing the module students should be able to:

1. Describe the various branches of mechanical engineering, possible careers, and job prospects.
2. Explain the roles played by mechanical engineers in the design, manufacture and management of systems for energy generation using renewable, hydro and nuclear energy.
3. Identify real word mechanical engineering products.
4. Understand the basic theories in statistics, manufacturing technology, dynamics, mechanics and heat transfer
5. Describe the importance of technology in the field of mechanical engineering.

Module Content

Introduction to Mechanical Engineering: What is mechanical engineering, historical perspective, the modern era and mechanical engineering. Critical skills for a mechanical engineering of today: software engineering and probability and statistics**. Branches of mechanical engineering. Typical jobs of a mechanical engineer**: Product design and manufacture, research and development, systems design and management, troubleshooting, safety and maintenance. **Important Skills**: Estimation in engineering, Problem solving and communication skills, Presenting engineering calculations. **Basic principles of mechanical engineering**: Introduction to mechanics (statics and dynamics), fluid mechanics, manufacturing and materials, Introduction to mechanisms, thermodynamics energy, Introduction to heat transfer. New fields of mechanical engineering and the impacts of technology.

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 5 Eng Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities

- Two lecture periods per week for 6 weeks

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments, Project and Presentation: 60%
   ii) Tests (at least 2 tests):40%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

- Books:

[1] Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.

[2] Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

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Module Title:	DIGITAL LITERACY
Module Code	U3583DD
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial/ week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Prerequisite	None
Semester Offered	Core
Module coordinator and Contact Details	Mr Erkkie Haipinge ehaipinge@unam.na, Tel: +264 612064906

Module Purpose

The purpose of this module is to equip students with competencies to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment and entrepreneurship.

Overarching Learning Outcome

Apply digital literacy skills for effective learning across the curriculum and for successful attainment of their personal and professional goals.

Specific Learning Outcomes

On completing the module students should be able to:

16 Use ICT-based devices, basic productivity software, a web browser and search engines, email and other digital communication services
17 Carry out digital productivity activities such as download and upload materials to the internet or cloud or institutional shared spaces, and use digital tools to fit learning
18 Discover, organise and manage relevant digital information using relevant search engines, indexes or tag clouds, and evaluate digital information trustworthiness and relevance
19 Access and make sense of messages in a range of digital media, and appreciate how digital messages are designed
20 Design new digital materials, make decisions and solve problems and adopt new digital tools for learning
21 Participate in a range of digital communication media, work in digital teams and projects, and participate in a range of online networks
22 Identify, choose and participate in digital learning opportunities
23 Manage and maintain digital profiles suitable for different networks that consider digital reputation

Module Content

Digital Proficiency: ICT-based devices (laptops, tablets, smartphones, desktop computers, digital instruments and equipment); a mouse, keyboard, touch screen, voice control and other forms of input; screens, audio headsets and other forms of output; digital capture devices; University digital learning systems and a range of personal digital services such as social media, cloud storage services, sharing sites **Digital Productivity:** Basic productivity software (text editing, presentation, spreadsheets, image editing); email and other digital communication services; Internet or cloud or institutional shared spaces for organising, managing and backing up digital files; software/apps and services suitable for learning-related tasks; digital tools fit learning and managing learning time. **Information Literacy:** search engines, indexes or tag clouds; wikis, blog posts, scholarly journals, e-books and the open web; file spaces and folders, bookmarks, reference management software and tagging; copyright, and digital citizenship issues. **Data and Media Literacy:** Digital data using spreadsheets and other media; data security and privacy; digital media messages – text, graphics, video, animation, audio and multimedia. **Digital Creation and Innovation:** digital materials (video, audio, stories, presentations, infographics); new digital tools for learning in digital settings. **Digital Communication, Collaboration and Participation**: digital communication; differences between media, norms of communicating in different spaces; false or damaging digital communications; collaborative tools and online environments; online networks. **Digital Learning and Development:** digital learning opportunities; digital learning resources; digital tools/materials for organising, planning and reflecting on learning (mind-mapping, note-taking, e-portfolio/ learning journal/ blog). **Digital Identity and Wellbeing:** online profiles for different networks (personal, professional, academic); digital reputation; managing personal data and privacy; digital CV or portfolio of work; digital technologies for personal development; online etiquette; wellbeing and safety online; internet addiction; cyberbullying and other damaging online behaviour.

Contribution to Exit Level Outcome:

- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4 and 6)

Learning and Teaching Strategies/Activities

- **Lectures**: presentation on concepts and other theoretical foundations of Digital Literacy
- **Discussion forums:** reflecting on own contexts and sharing perspectives
- **Collaborative learning:** group learning and activities carried as part of projects
- **Inquiry:** carrying out of research to explore and understand scenarios and problems
- **Projects:** carry out projects on digital literacy
- **Presentations and demonstrations:** presentation of outcomes of projects (products, processes, impact)
- **Portfolio writing:** writing reflective learning journals related to digital literacy

Student Assessment Strategies

- **Collaborative assessment tasks**
  - Digital productivity: *cloud based collaborative digital media creation using cloud platforms*
  - Project: Digital communication, collaboration and participation/ Digital Wellbeing
- **Individual assessment tasks**
  - Assignment: information literacy assignment
  - Test x 2
- **Practical**
  - Digital proficiency
  - Data and Media literacy
- **No written examination**

Learning and Teaching Enhancement Strategies

- **Student feedback:** feedback from students using focused feedback instruments
- **Peer feedback:** student feedback on peer evaluation of each other's collaboration, participation and contribution
- **Self-evaluation:** quizzes and students' reflective journal/ portfolio on their own learning
- **Learning analytics:** use of learning management tools on student participation and online learning activities, and analyse assessment performance

Prescribed Learning Resources
Textbook

[1] Schwartz, M., Bali, M., Blocksidge, K., Brown, C., Caines, A., Dermody, K., and Peters, J. (2020). *Digital Citizenship Toolkit*. Retrieved from https://pressbooks.library.ryerson.ca/digcit/ (online version); https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/3/Digital-Citizenship-Toolkit-1598899274.pdf (PDF version) https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/2/Digital-Citizenship-Toolkit-1598899308.epub (eBook)

Digital Resources

[1] JISC. (2019). Jisc digital capabilities framework: The six elements defined. Retrieved from https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf

[2] JISC. (2017). Digital capabilities framework. Retrieved from https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF

[3] Joint Research Centre (European Commission). (2019). *The Digital Competence Framework 2.0*. Retrieved from https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

[4] Carretero, S., Vuorikari, R., and Punie, Y. (2017). The digital competence framework for citizens. *Publications Office of the European Union*. Retrieved from http://svwo.be/sites/default/files/DigComp%202.1.pdf

Course resources (videos and SCORM package)

[1] Microsoft. (2021). *Microsoft digital literacy courses and resources (videos and SCORM packages)*. Available at https://www.microsoft.com/en-us/digital-literacy

[2] Microsoft. (2021). *Microsoft digital literacy: Teaching guides*. Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWBupo

[3] OER Commons. (2021). *Digital Literacy (learning objects)*. Retrieved https://www.oercommons.org/curated-collections/347

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Module Title:	NATIONAL AND GLOBAL CITIZENSHIP
Module Code	U3420CN
NQF Level	4
Notional Hours	20
Contact hours	Up to 1 contact lecture period per week for 6 Weeks
Mode of Delivery	Blended: Face to face and Online
Additional learning requirements	Each student will be required to work on a personal project which will include a site visit
NQF Credits	2
Semester Offered	Core
Module coordinator Contact Details	Dr Romanus Shivoro, rshivoro@unam.na ; Ext. 3378

Module Purpose
The purpose of this Module is to equip UNAM students with knowledge to understand the interconnectedness of local and global issues. Students will become acquainted with perspectives on, global citizenship, globalization and civic engagement. The module will enable students to reflect on issues affecting their communities and the world by providing a platform where students can meet and learn from one another and from external sources of information. It will guide students to determine how they can contribute to bring positive changes in their communities in relation to the Sustainable Development Goals. Furthermore, it will provide knowledge and understanding of cultural diversity and intercultural communication to enable students to become thoughtful stewards in a globalized world.

Overarching Learning Outcome
Demonstrate understanding of global citizenship and initiate action towards the betterment of local, national and global conditions, as informed and responsible citizens with a civic duty in their personal and professional lives.
Specific Learning Outcomes
On completing the module students should be able to:

- Explain the importance of the National Constitution;
- Express understanding of National and Global Citizenship;
- Participate in community engagement activities as part of community upliftment;
- Express understanding of globalization;
- Apply intercultural communication skills; and
- Interpret SDGs to initiate personal action towards contribution of their achievement.

Module content
UNIT 1: Constitution and its Importance
What is a constitution; Functions of a constitution; What it contains; Constitution and democracy
UNIT 2: Global Citizenship
The meaning of global citizenship; Importance of global awareness; World issues of concern to global citizens.
UNIT 3: Civic Engagement
What do we mean by civic engagement; Dimensions of civic engagement; Indicators of civic engagement; Promoting civic engagement.
UNIT 4: Globalization
Understanding globalization; Cultural construction of neoliberal globalization; Major players; Major domains; Major Issues; Futures of Globalization
UNIT 5: Intercultural Communication
Dealing with difference; Levels of culture; Stereotypes and generalizations; Intercultural communication Processes
UNIT 6: Sustainable Development Goals and individual action
Introduction to SDGs; Contributing to achievement of SDGs through action
Learning and Teaching Strategies/Activities
Student learning in this module will be supported by provision of subject knowledge; engaging students in class discussions, and individual awareness and action portfolios. It will expose students to real life situation through formal lectures, guest lectures, experiential activities such as engaging local civic organizations; Students will engage in active and participatory learning in which they generate ideas and share their knowledge on a topic. Material will include journal articles, videos, PowerPoint presentations, as well as handouts for students' reflection.
Student Assessment Strategies
Continuous assessment of 100% - Assessment will be done by completing online pop-up quizzes; and developing their online portfolios of personal action as response to tasks assigned in class.
Learning and Teaching Enhancement Strategies:
Strategies will include: Continuous Module Review, and Lecturer/student evaluations.

Student progress will be monitored by observing class participation during live lectures, and submission of feedback material. Including online portfolios.

Recommended Learning Resources

- Adler, R.P and Goggin, J. (2005). What do we mean by Civic Engagement? A Journal of Transformative Education. 3 (3) 236 – 253
- Bennett, M.J (1998). Intercultural Communication: A current Perspective. In Milton J. Bennett (Ed.) Basic Concepts of Intercultural Communication: Selected Readings. Yarmouth: ME Intercultural Press
- Green, M. (2012). Global Citizenship: What are we talking about and why does it matter. NAFSA Association of International Education
- International IDEA (2014). What is a Constitution? Principles and Concepts. Constitution-building Primers.
- Perception Change Project. 170 Daily Actions to Transform our World. United Nations Office in Geneva
- Ritzer, G. (Ed.)(2007). The Blackwell Companion to Globalization. Blackwell Publishing: USA
- United Nations. Transforming our World: the 2030 Agenda for Sustainable Development. UNDP

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10.5.1.2 YEAR 1 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS I
Module Code	I3511IM
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad basic mathematical skills to solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

- Solve basic mathematics and engineering problems using vectors and matrices.
- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Perform functions transformations (Cartesian/polar), sketch and name some polar graphs.
- Use various mathematical functions and apply them to engineering.
- Apply trigonometry in solving mathematical and engineering problems.
- Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Manipulate sequence and series of numbers
- Define, interpret complex numbers and to perform elementary complex numbers algebra.

Module Content

Lines and Planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersection of lines and planes. **Matrix Algebra:** Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. Eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Sequences and series of numbers:** Introduction to sequences and series. Absolutely convergent series, tests for convergence. Power series. Radius of convergence and interval of convergence. **Functions:** Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions. **Polar coordinates/Graphs:** Definition of polar coordinates, relate Cartesian and polar coordinates, sketch and name different types of polar graphs. **Differentiation:** Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, the chain rule, differentiation of algebraic functions. **Integration:** Anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, basic integration techniques, integration of trigonometric functions. **Introduction to complex numbers:** Definition of complex numbers and the complex plane, complex number representation on argand diagrams, complex number algebra. Demoivre's theorem.

Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,3,5,6,7)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5,6,7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes): 40%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Books:

  [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
  [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
  [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
  [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.

- Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT I**
Module Code	I3401MS
NQF level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Prerequisite	None
Semester Offered:	1

Module Purpose
The purpose of this module is to consolidate school curriculum computation skills whilst creating a wider context in which students can contextualise mathematical knowledge.

Overarching Learning Outcome
Consolidate numeracy and problem solution skills in a wide range of mathematics fundamentals.

Specific Learning Outcomes
Upon completion of this module, a student should be able to:
1. Explain and conduct deductive arguments involving sets and relations.
2. Identify and correlate intervals.
3. Solve systems of linear equations methodically.
4. Handle matrix calculus.
5. Identify types of real valued functions.
6. Compute the domain and range of a real valued function.
7. Assess properties of real-valued functions.

Module Content:
Number system: Natural, integers, rational, irrational, real and complex numbers. Sets: cardinal number, operations on a set (equality, intersection, union, relative compliment, de Morgan's law, power set, application of cardinality (inclusion-exclusion formula), Cartesian products, ordered pairs and relations), intervals and inequalities. Solving equation and inequalities: linear and quadratic equation, inequalities involving two variables. System of linear equations: Matrices and matrices operations (addition, subtraction, multiplication, associativity, distrutivity, determinant, invertible, Gaussian row and column operations, rank, solution to system of linear equations). Real-valued function: definition, relation, domain and range, injective, bijective, inverse, odd and even, piecewise defined, graphs. Coordinates system: polar, polar graph, cylindrical, cylindrical graph.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	ENGINEERING DRAWING
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	None
NQF Credits	16
Semester Offered	1

Module Purpose
The purpose of this module is to teach students how to visualize, create and interpret engineering drawing principles in two and three dimensions by applying of geometrical and engineering methods, and introduce students to computer aided drawing, with a focus on AutoCAD software,
Overarching Learning Outcome
Create and interpret basic drawings and communicate technically, as well as to use AutoCAD software to create two - and three - dimensional technical engineering drawings
Specific Learning Outcomes
On completing the module students should be able to:
- Use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts and assembly drawings of various engineering components
- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD
- Create three - dimensional objects

Module Content
Foundations of Representing Technical Bodies: drawing equipment, drawing formats, types of lines, construction geometry, simplified representations, scales, lettering, tittle block, elaboration of part drawings, Principle of orthographic projection, sectioning, dimensioning. **Isometric and oblique representations**. **Sections, Interpenetrations and developments**: cones, cylinders, pyramids. **Free hand techniques**: Introduction to free-hand sketching of machine parts. **Assembly Drawing**. **Introduction to AutoCAD:** Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; **Working in two - dimensional space:** Creating objects; Drawing with precision; Controlling the drawing display; Editing methods; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; Managing content with AutoCAD design Centre; Creating a layout to plot; Plotting (model and paper spaces). **Working in three - dimensional space**: Creating three-dimensional objects using solid primitives, and from 2D profiles; editing of 3D objects. **Practical Exercises.**

Contribution to Exit Level Outcome:
- 3 Engineering Design (Course Outcomes 4 and 5)
- 5 Engineering methods, skills, Tools and including technology (course outcome 1 and 3)
- 6 Professional and Technical Communication (Course Outcomes 2, 3, 4 and 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical exercises
- Face to face consultations

Student Assessment Strategies
- Students will be assessed through Continuous Assessments activities
- The final mark will be made of 100% Continuous Assessment.
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (At least 4 assignments): 40%
    - Mini project: 20%
    - Tests (At least 3 tests): 40%

Criteria for qualifying for the Examination:
No Examination
Criteria for passing the module
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

- Books
  [1] Parker M. A., and Pickup F., 1992. Engineering drawing with worked examples, vol1, 3rd Edition
  [2] David A. Madsen, Engineering drawing and design, 5th Edition
  [3] Colin H. Simmons, Neil Phelps, Manual of Engineering Drawing 3rd Edition
  [4] Terry Wohlers., Applying AutoCAD, 2010
- Design Software: AutoCAD
- Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS I**
Module Code	I3581NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of physics as they relate to engineering.
Overarching Learning Outcome
Prepare students to apply fundamental physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:

- Do unit conversions
- Solve problems regarding one- and two-dimensional kinematics.
- Solve problems regarding the dynamics of linear motion via Newton's laws.
- Solve problems regarding the dynamics of linear motion using energy methods.
- Solve simple problems in rotational kinematics and dynamics.
- Solve basic problems in statics and Newtonian gravitation.
- Solve problems using the principles of fluids.
- Solve basic problems regarding heat and gasses.
- Demonstrate entry-level general laboratory skills including elementary data analysis.
- Demonstrate abilities to communicate ideas and facts using equations, graphs and principles.

Module Content
Measurements and Units: Instruments and Uncertainty, Standards and Units. **Kinematics:** One Dimensional Motion, Vectors, Projectile Motion, Circular Motion, Relative Motion. **Dynamics:** Newton's Laws of Motion, Newton's Law of Gravitation, Free-Body Diagrams, Friction. Work, Energy and Power. **Momentum:** Collisions, Impulse, Centre of Mass. **Rotational Dynamics:** Rolling Motion, Torque, Rotational Inertia and Energy, Angular Momentum. **Planetary Motion:** Kepler's Laws of Planetary Motion. Elasticity: Hooke's Law. **Fluids:** Pressure, Buoyancy, Fluid Dynamics: Flow Rates, Equation of Continuity and Bernoulli's Equation. **Heat and Thermodynamics:** Thermal Expansion, Ideal Gas, Specific Heat, Heat Capacity, Latent Heat, Calorimetry, Heat Transfer: Laws of Thermodynamics, Entropy, Enthalpy, Gibbs Free Energy.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical exercises
- Face to face consultations

Student Assessment Strategies
- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes): 40%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
    [1] Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson - ISBN-13: 978-1-292-31473-0, e-Textbook ISBN-13: 978-1-292-31481-5
    [2] Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
    [3] Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT I**
Module Code	I3421PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	Entry requirements
Semester Offered	1

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course.
Overarching Learning Outcome
Solve problems, in single-particle mechanics, Newtonian gravity, fluids, and heat.
Specific Learning outcomes
On completing the module students should be able to:
1. Employ units, do unit conversions, express uncertainties use significant figures, use vectors in 2 dimensions.
2. Solve basic problems regarding one and two-dimensional kinematics.

3. Apply Newton's laws of motion and energy principles to a variety of basic problems in dynamics.
4. Discuss and solve simple problems in rotational kinematics and dynamics.
5. Discuss the principles of waves and sound.
6. Solve basic problems in statics, Newtonian gravitation, fluids, heat, and gasses.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Measurement and estimation; Kinematics in 1D; Kinematics in 2D; Vectors; Dynamics/Newton's Laws; Circular motion; Gravitation; Work and Energy; Linear Momentum; Rotational Motion; Static Equilibrium; Fluids; Oscillation and Waves; Sound; Temperature and Kinetic Theory; Heat; The Laws of Thermodynamics.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
    b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**COMPUTING FUNDAMENTALS**
Module Code	I3581CC
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures +1 Tutorial and/or 1Practical /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose:
The purpose of this module is to introduce students to general computer literacy, the basic principles of problem-solving using computers, advanced Microsoft Excel skills for data analysis, computer programme planning, basic data communication and computer networks and the basic skills on modern web development tools. It also introduces students to the basic tools and environments needed for machine learning programming.

Overarching Learning Outcome
Demonstrate understanding of the windows and Unix based computer working environment; skills on how to develop a computer-based problem-solving plan; basic knowledge of modern web development tools; and application of advanced spreadsheets and related tools to engineering related problems.
Specific Learning Outcomes

On completing the module students should be able to:

- Relate with computers under the Windows and Linux operating environment for information processing and presentation.
- Recall basic features of common computer hardware architectures.
- List the basic communication architecture of a computer.
- Show algorithms for solving basic problems using flowcharts and pseudocode.
- Recall advanced spreadsheet tools and functions.
- Match basic web applications using modern web development tools and frameworks to simple real-life problems.
- Define basic concepts of networking.

Module Content:
Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored programme concept. Von-Neumann architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. **Computer Arithmetic**: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). **Introduction to CISC and RISC architecture**: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types). **Introduction of computer operating environment** Windows and UNIX based systems. **Computer Architecture:** The design and structure of a computer. **Information Processing and Data Analysis tools**: Equations and Formulas Creation, Diagram Creation and Editing, PowerPoint Presentations Creation Advanced Spreadsheets Skills. **Computer Programme Planning**. Flowcharts and Pseudocode **Introduction to Computer Networking**: Basics of Communication Systems and Computer Networks. **Web Developments:** Front-End Web Development, Web Page Styling and Website logic development with scripting languages such as JavaScript. **Overview of memory system**, memory chip organization and error correction, cache memory, memory storage devices. **Introduction to Data Science Tools:** Installation and basic use of Anaconda and Jupyter Notebooks.

Contribution to Exit Level Outcome:
- 1 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2, 3,5,6)
- 2 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1,2, 3, 4, 5,6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.

Student Assessment Strategies
- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes, reports, practical assignments): 20%
  - Tests (At least 2 tests): 50%
  - Semester Mini project (prototype oral presentation and development report): 30%

Criteria for qualifying for the Examination:
No Examination
Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
- Peer-review of course outlines and teaching.
- Student's evaluation
- Regular review of the course content
- Face-to-face consultations
- Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- Invite students for one-one consultation to find the root cause of the problem
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

[1] F. Wempen: Computing Fundamentals: Introduction to Computers First Edition Wiley, 2015
[2] W. Palm: MATLAB for Engineering Applications 4th Edition, Mc-GrawHill, 2019
[3] J. L. Hennessy; Computer Architecture, Fifth Edition, Morgan Kaufmann, 2012.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS**
Module Code	I3511NC
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1T or 1PS /Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose

The purpose of this module is to enable students to understand the basic concepts of chemistry as they relate to engineering.

Overarching Learning Outcome

Equip students with firm grasp of fundamental chemistry principles which are applicable in engineering industries.

Specific Learning Outcomes

On completing the module students should be able to:

- Describe the fundamental techniques used for chemical analysis in industrial processes.
- Explain the basic concept of batteries and fuel cells and their applications.
- Describe the processing of high polymers and their applications.
- Explain different methods for water analysis and purification.
- Describe different ways of dealing with pollution and managing solid waste.

Module Content

Spectroscopic techniques and Applications: Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet and Visible and Raman spectroscopy. **Electrochemistry:** Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system. **Battery Technology;** Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life. Basic requirements for commercial batteries. Construction, working and applications of: $Zn\text{-}Ag_2O$, Ni-Cd, Zn-air and Lithium-ion battery. Fuel Cells- Differences between battery and a fuel cell, Classification of fuel cells - based on type of fuel, electrolyte and temperature. Construction, working and applications of solid oxide fuel cell. **Water Analysis;** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method), Alkalinity - determination, Determination of dissolved oxygen, Determination of chemical oxygen demand, Boiler scales-formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis. **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methods). Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapor deposition. **Polymers;** Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (BunaS, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. **Environmental Chemistry;** Air Pollution, Water Pollution, Radioactive Pollution, Solid Waste Management, Green Chemistry.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning and teaching activities:

- Four lecture periods per week for 14 weeks (face to face or blended)
- One practical session per week for 14 weeks relating the theory to practice
- One tutorial period per week for 14 weeks
- Face-to-face and/or online consultation

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes, lab and field reports): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

Books:

[1] Mukhopadhyay, Raghupati, and Sriparna Datta. Engineering chemistry. New Age International Pvt. Limited, Publishers, 2008.
[2] Garwal, Shikha. Engineering chemistry: Fundamentals and applications. Cambridge University Press, 2019.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS SUPPORT**
Module Code	I3441CS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	None
Semester Offered	1

Module Purpose

To introduce the student to general chemistry, lay the foundation of basic facts necessary for further studies in Chemistry and acquaint students with safety rules and regulations in a chemical laboratory.

Overarching Learning Outcome

Apply and interpret knowledge on basic facts in Chemistry for further studies.

Specific Learning outcomes

On completing the module students should be able to:

1. Use scientific notation and significant figures when doing all calculations
2. Define and explain the mass number (A), atomic number (Z) and isotope and also state the symbol for an isotope given its mass number and atomic number
3. Define the terms molar mass, relative molecular mass (Mr) and relative atomic mass (Ar) and carry out calculations involving these
4. Define and explain the terms empirical formula and molecular formula and also to determine the empirical and molecular formulae of a given compound
5. Use balanced chemical equations to obtain information about the amounts of reactants and products
6. Prepare dilute solutions from concentrated stock solutions and solve solution stoichiometry problems
7. Describe and explain data from experiments to distinguish between strong and weak acids and bases
8. Differentiate between oxidation and reduction reactions and balance redox reactions by the half-reaction method (acid and basic medium)
9. Apply quantum theory to predict the electron configuration of elements and explain the variation of properties across the periodic table
10. Explain the structure and bonding in molecules and ions and draw their Lewis structures
11. Apply Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) to describe molecular geometry as well as physical and chemical properties of some compounds

Module Content

Introduction: Matter, Measurement and Molecules; Stoichiometry: Calculations with Chemical Formulae and Equations; Aqueous Reactions and Solutions Stoichiometry; Electronic Structure of Atoms; Periodic Properties of the Elements and Relationships Among Elements; Basic Concepts of Chemical Bonding; Intermolecular Forces; Basic Molecular Geometry and Bonding Theories; Gases.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Brown T. L., LeMay H.E, Bursten B.E., Murphy C., Woodward P., Langford S., Sagatys D. and George A. (2014). Chemistry: The Central Science. (3rd Ed.). Pearson Australia. Australia
2. Chang, R. (2010). Chemistry. (10th Ed.) McGraw Hill Higher Education. New York. ISBN:978-0-07

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Next Revision: September 2028

10.5.1.3 YEAR 1 SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS II
Module Code	I3582IM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Apply broad mathematical skills to solve engineering problems.
Specific Learning Outcomes
On completing the module students should be able to:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique.
- Apply calculus to trigonometric functions to solve mathematical and engineering problems.
- Solve engineering problems using 1st order and 2nd order differential equations
- Define and analyse Fourier series of real-valued functions.
- Use Laplace and Fourier transforms in solving differential equations.

Module Content
Further Matrix Algebra: eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Further Integration:** Integration by parts technique. Integration by substitution. Integration of trigonometric functions. Integration of powers of trigonometric functions. Integration of trigonometric functions by substitution. Reduction formula. **Applications of integration:** areas, volumes of revolution, etc. **Differential Equations:** Meaning and solutions of differential equations. First order ordinary differential equations (separable, homogenous, Exact and linear types) and their applications. Solutions of second order linear ordinary differential equations with constant coefficients; initial or boundary value problems using the methods of undetermined coefficients and variation of parameters. **Integral Transforms:** Laplace Transforms (LT), Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st and 2nd ordinary differential equations. **Fourier Series and Transforms:** Fourier series. Fourier sine and cosine series. Introduction to Fourier transforms and its applications in solving boundary value problems.

Contribution to Exit Level Outcome:
- o 1 Problem solving (Course Outcomes 1,2,4,5)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
- o 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies
- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - o Assignments (tutorials, quizzes): 40%
    - o Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies
- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.

- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
   [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
   [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
   [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
   [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT II**
Module Code	I3402MS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Prerequisite	None
Semester Offered:	2

Module Purpose

The purpose of this module is to equip students with an intuitive grasp of the behaviour of a real-valued function as well as the analytical techniques to test their intuition.

Overarching Learning Outcome

Gather sufficient information about the behaviour of a real valued function to sketch its graph with accuracy.

Specific Learning Outcomes

Upon completion of this module, a student should be able to

1. Employ the exact definitions of limit and continuity.
2. Use various differentiation techniques and assess differentiability.
3. Apply those tools to study local extrema, end behaviour, and asymptotic behaviour of function graphs.
4. Use integration to compute the area below a curve.
5. Handle complex numbers.

Module Content:

Solving equation: Exponentials and logarithms. Graph of a function: polynomial, rational, exponential, logarithmic, trigonometric functions. Limit of a function: definition, continuity, differentiation, sum, product, quotient, chain rules, examples from the engineering sciences. Integration: Definition and basic properties of the Riemann integral, the Fundamental Theorem of calculus, integrals of simple function, substitution rule and integration by parts; applications to the computation of areas and (rotational) volumes.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.

2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. B. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS II**
Module Code	I3582NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3521NP Physics for Engineers II)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of physics as they relate to engineering.
Overarching Learning Outcome
Prepare students to apply fundamental physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:
- Solve problems on electric and magnetic fields
- Sketch electric circuits and solve problems on capacitors and resistors
- Discuss and solve problems in geometrical optics, radioactivity and sound.
- Prepare and perform experiments related to the contents of the module.
- Demonstrate entry-level general laboratory skills including elementary data analysis.
- Demonstrate abilities to communicate ideas and facts using equations, graphs and principles

Module Content
Electrostatics: Electric charge, Current and Current Density, Electric field, Electric Potential, Resistance and Resistivity, Capacitance and Dielectrics**. Magnetostatics:** Biot-Savart law, Magnetic field, Magnetic materials, Motion of a Charged Particle in a Magnetic Field, Magnetic force, Ampere's Law; Torque and Magnetic Moments; **Electromagnetic Induction:** Electromagnetic Force (EMF), Faraday's Law of Electromagnetic Induction, Lenz's Law, Fleming's Right-Hand Rule, Inductance and Mutual Inductance. **Vibrations and Waves:** Simple harmonic motion, Oscillations, Wave Motion, Types of Waves, Standing Waves and Resonance. **Sound:** intensity of Sound, interference of Sound Waves, Doppler's Effect. **Light and Optics:** Reflection, Refraction and Diffraction, Snell's Law, Lenses, Lens Equation. **Radioactivity:** types of radioactivity.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books

[1] Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson, ISBN-13: 978-1-292-31473-0, eTextbook ISBN-13: 978-1-292-31481-5
[2] Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
[3] Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT II**
Module Code	I3422PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Pre-requisites	Entry requirements
Semester Offered	2

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course. This course focuses on Electricity and Magnetism, Optics and Radioactivity

Overarching Learning Outcome
Solve problems in electricity and magnetism, optics, and radioactivity.

Specific Learning outcomes
On completing the module students should be able to:

1. Discuss and solve basic problems on electric field and magnetic field.
2. Find currents and resistances in simple electric circuits.
3. Analyse DC and AC circuits involving capacitors, resistors, and inductors.
4. Resolve problems involving electromagnetic induction.
5. Solve simple problems in geometrical optics and nuclear physics.
6. Explain concepts pertaining to radioactivity and the effects of radiation.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Electric charge and electric field; Electric Potential; Electric Currents; DC Circuits; Magnetism; Electromagnetic induction; Electromagnetic waves; Geometric optics; Light; Radioactivity; Effects and Use of Radiation.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
4. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
5. Tests (at least 2 tests): 60%

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Module Code	I3522EE
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose:
The module aims to equip students majoring in all branches of engineering, with the understanding of basic principles of electric circuits and networks. A further purpose is to introduce common technical vocabulary.

Overarching Learning Outcome
Demonstrate ability to analyse basic electric circuits using laws and theorems.
Specific Learning Outcomes
On completing the module students should be able to:
- Distinguish between real and ideal voltage and current sources
- State and apply the laws and rules of electric circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving of DC circuits
- Apply the principles of circuit analysis to series and parallel R, L, C circuits
- Perform a range of measurements in an electrical laboratory environment and be able to interpret the measured data to derive supplementary information
- Describe the principles of operation of a transformer and the basic AC generator and DC motors
- Conduct basic circuit analysis using appropriate CAD software (MATLAB, MultiSIM, etc.)

Module Content:
Introduction: SI Units and notations, Basic Electric Circuit (resistance, voltage and current). **Resistance:** Resistor coding, Series and parallel resistor networks, Y and delta resistor networks. **Sources:** Voltage and Current sources, dependent and independent sources, source transformations. **DC Circuit Analysis Techniques:** Ohm's law, Power and Energy, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, **DC Circuit Theorems:** Superposition Theorem, Thevenin's and Norton's Theorem, Maximum power transfer theorem. **Capacitors:** Capacitance, capacitors in series and parallel, Capacitor charging and time constant. **Inductors:** Inductance and mutual inductance. **AC Voltage:** AC voltage generation, AC Resistive circuit, AC capacitive circuit, AC inductive circuit. Electrical Machine Basics: Basics principles of transformers, AC generators, DC motors, three phase voltage generation and mathematical expression. Basics of circuit simulation using CAD software.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
- 3 Engineering Design (Course Outcomes 4)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 4)
- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment.
- The Continuous Assessment will be made up of the following assessment activities:
  - At least 2 quizzes, and at least 2 lab reports: 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of assessment activities.
- Peer-review of course outlines and teaching.
- Students' lecturer evaluation
- Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

3. Book

[1] Boylestad Robert. (2015), Introductory Circuit Analysis, 13th Edition, Pearson Education, USA
[2] Alexander K. Charles and Sadiku N.O. Mathews. (2013), Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, USA
[3] Hughes Edward. (2016), Electrical and Electronic Technology, 12th Edition, Pearson Education, USA

4. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MATERIALS SCIENCE**
Module Code	I3592IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None.
NQF Credits	12
(Co-requisites) / Prerequisite	(None)
Semester Offered	2

Module Purpose

The purpose of this module is to enable the students to understand the relationship between the structure and properties of engineering materials and practical skills in metallography and materials testing.

Overarching Learning Outcome

Identify the right engineering material for a particular application based on materials' structure and properties.

Specific Learning Outcomes

On completing the module students should be able to:

- Describe the molecular and crystal structure of materials.
- Perform calculations on elemental diffusion in metals.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Outline the various phase transformations in the Fe-Fe3C phase system and associated microstructures.
- Explain how materials properties depend on structure and crystal defects.
- Demonstrate practical basic skills in metallography and report writing.
- Explain the relationship between Materials Science and the Fourth Industrial Revolution.

Module Content

Materials for Engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. **Structure of materials**: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Solidification, Crystalline Imperfections and Diffusion in solids**; Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; **Equilibrium phase diagrams:** unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **Properties of Materials:** review of Mechanical, Electrical, Optical and Thermal properties of materials. **Mechanical properties of materials**: Stress and Strain, Tensile testing, True stress and True strain, Deformation modes; Yield and Fracture, Hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. **Effects of environment on materials:** corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. **Real-world applications of Engineering materials:** Functional Materials and Devices; The Relationship between Materials Science and the Fourth Industrial Revolution. Basic criteria for the selection of materials for engineering applications.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical sessions.
- Face-to-face consultations wherever necessary.

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes, lab and field reports): 40%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.
Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

- Books:
  [1] Callister, W. D., Rethwisch, D. G., Materials Science and Engineering, An Introduction, 10th Edition, Wiley and Sons, 2018
  [2] Donald R. Askeland, Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2nd Edition, 2008
- Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MECHANICS I**
Module Code	I3582NM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	((I3581NP Physics for Engineers I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with the knowledge to analyse system of forces on engineering components and to develop an approach to solving engineering problems.
Overarching Learning Outcome
Analyse the effect of static forces and equilibrium on systems and structural bodies.
Specific Learning Outcomes
On completing the module students should be able to:

- Express force operations and force systems using vectors
- Apply the laws of static equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Determine the centroid and moment of inertia for plane and composite cross-sectional areas.

Module Content

System of forces and moment forces: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Equilibrium in three dimensions**. **Forces in submerged surfaces**. **Distributed Forces: Centroid and Centre of Gravity, Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams. **Analysis of forces in a truss:** Method of joints, method of sections.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1-6)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 3-7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
- Assignments (At least 4 assignments): 20%
- Tests (At least 2 tests): 60%
- Practical and Report: 20%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books

[1] Robert W. Soutas-Little and Daniel J. Inmand, Engineering Mechanics Statics, copyright 1999 by Prentice-Hall, Inc.
[2] R. C. Hibbeler, Engineering Mechanics Statics, Ninth Edition, copyright 2001, 1998, 1995, 1992, 1989, 1986, 1983, 1978, and 1974 by R. C. Hibbeler.
[3] Irving H. Shames, Engineering Mechanics Statics, Second, Volume 1, copyright 1958, 1959, 1966.
[4] J. L. Meriam and L. G Kraige, Engineering Mechanics Statics, Fifth Edition, copyright 2003, John Wiley and sons.

2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**STATISTICS FOR ENGINEERS**
Module Code	I3582IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the concept of probability theory, statistical modelling and inference in Engineering.
Overarching Learning Outcome
Conduct statistical data analysis, modelling and apply decision-making skills in engineering.
Specific Learning Outcomes
On completing the module students should be able to:

- Describe the theory of probability.
- Analyse data using probability distribution and densities.
- Use principles of sampling distribution and densities.
- Apply linear regression and correlation to a set of data.
- Apply analysis of variance to solve engineering problems.
- Analyse data using the statistical software

Module Content
Probability: Theory (Random experiments, Random events), conditional probability and Bayes theorem, mathematical expectation and decision making. **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, uniform, Gamma, Beta and Weibull. **Sampling Distributions:** Mean, variance, inferences concerning mean and proportions: point and interval estimations, parametric tests, nonparametric tests. **Regression and Correlation:** Simple and multiple linear regressions, correlation. The logistic regression model. **Analysis of Variance:** Completely randomized and randomized block designs, multiple comparisons**. Introduction to Data Analysis with R:** Lab 1: Measures of Central Tendency: Mean, median and other quantiles, mode. Saving and Using Graphics etc. Lab 2: Measuring Variability: variance and standard deviation, median, Interquartile Range, coefficient of variation, covariance and correlation of variables. Lab 3: Measuring Symmetry: skewness, kurtosis, etc. Frequency distributions: histograms, bar charts, pie charts, box plots, line graphs, scatterplots.

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2,3,4,5)
- 4 Investigation, Experiments and Data Analysis (Course Outcomes 4,5,6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (Lab assessment): 40%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] William Navidi., Statistics for Engineers and Scientists, 2nd Edition, 2008.
[2] Jay L. Devote., Probability and Statistics for Engineering and the Sciences, 7th Edition, 2008
[3] Samprit Chatterjee and Ali S. Hadi., Regression Analysis by Example, 4th Edition, 2006

2. Lecture notes
3. Software: R-Studio

Issue Date: September 2023
Next Revision: September 2028

10.5.2 YEAR 2 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

10.5.2.1 YEAR 2 SEMESTER CORE

Module Title:	ACADEMIC LITERACY II
Module Code	U3683AL
NQF Level	6
Notional Hours	80
NQF Credits	8
Prerequisite	U3583AL
Contact Hours	2 Lectures + 1 Tutorial per week
Semester Offered	0

Module Purpose
The purpose of Academic Literacy IB is to introduce students to sources of information and to academic literacy practices in a university setting.
Overarching Learning Outcome
Students should be able to apply information searching techniques with academic skills necessary to fulfil tasks and cope with academic reading, listening, speaking and writing demands at university level.

Specific Learning Outcomes
On completing the Module students should be able to:
- Articulate the need of information and behavioral approaches.
- Identify required skillset to solve academic tasks or work.
- Develop concept mapping and task-based learning themes.
- Practice academic integrity to avoid plagiarism.
- Apply features of academic writing and other academic conventions in own writing.
- Use patterns of text organization to academic writing.
- Summarise main ideas or relevant parts of texts.
- Read and critique academic texts.
- Apply appropriate reading comprehension strategies.
- Use information from listening materials to complete writing and speaking tasks.

Module Content
The module will cover study skills, reading, listening, speaking and writing, referencing, language usage and text organisation.

Contribution to Exit Level Outcome:
- 6 Professional and Technical Communication (Course Outcomes 3, 4, 6, 7 and 9)
- 9 Independent Learning Ability (Course Outcomes 5, 8 and 10)

Learning and teaching strategies
The course will be facilitated through, but not limited to, the following learning activities:
- Blended instruction: Face-to-face and online
- Tests and assignments
- Tutorials/ Academic support
- Oral presentations

Student assessment strategies
Assessment will be based on Continuous Assessment.

Learning and teaching enhancement strategies
- Students shall be exposed to library user-based services and training.
- Students that might experience performance difficulty in the module will be identified and the necessary support and guidance as an intervention strategy will be provided by the teaching staff.
- Statistics of the module pass and failure rate will be continuously kept.
- Student-lecturer evaluation
- Lecturer-peer evaluation
- Curriculum review
- Moderation of assessment tools

Prescribed Learning Resources
Academic Literacy IB Study Guide.

Recommended Learning Resources

- Bailey, S. (2015). *Academic writing: A handbook for international stu*
- *ents* (4th ed.). NY: Routledge.
- Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). *Academic literacy* (2nd ed.). Cape Town: Juta and Company (Pty) Ltd.
- Gaetz, S and Phadke, S. (2018). *Academic English: Reading and writing across the disciplines* (3rd ed.). London.UK: Pearson.
- Machet, M. (2013). Mastering Information Skills for the 21st Century. 2nd Edition, UNISA Press, South Africa.
- Piscitelli, S. (2009). Study skills: do I really need this stuff? (2nd ed). N.J. Pearson Prentice Hall,
- UNAM Library Subject Specific Guides https://unam-na.libguides.com/?b=gandd=a

Issue Date: September 2023
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Module Title:	**ENGINEERING ENTREPRENEURSHIP**
Module Code	I3620IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	Core

Module Purpose

The purpose of this module is to enable the students to understand the concept entrepreneurship and innovation in the engineering field and the different aspects that makes an entrepreneur.

Overarching Learning Outcome

Apply entrepreneurship skills to innovate and manage entrepreneurial ventures.

Specific Learning Outcomes

On completing the module students should be able to:

- Discuss the concept of entrepreneurship
- Describe key attributes of entrepreneur
- Carry out a feasibility study and draw up a business development plan
- Discuss the process of innovation (transformative and incremental) and product development
- Relate economic challenges and business creation
- Describe the procedures followed in starting a new business venture including some regulations guiding the process
- Explain the risk management process
- Discuss the theory of motivation
- Discuss the roles of strategic business and marketing management
- Explain the importance of change management theory in entrepreneurship.

Module content

Entrepreneurship: - concept of entrepreneurship, characteristics of an entrepreneur, examples of good local and international entrepreneurial ventures, feasibility studies and business plan development and its components, government policies and regulations for starting new business ventures. **Entrepreneurship opportunities in Engineering:** innovative ideas and process of innovation, transformative and incremental innovations, innovation and business development, product development process and market research. **Risk management:** types of risk, risk management process, risk control and mitigation, risk response. **Change management:** Importance of change management, group dynamics and communication. **Strategic business management:** Management functions, strategic planning and management, resource management plan. **Strategic marketing management:** Marketing functions, marketing mix, innovative marketing, competitor analysis

Contribution to Exit Level Outcome:

- 7 Sustainability and Impact of Engineering Activity (Course Outcomes 3)
- 11 Engineering Management (Course Outcomes 4 and 6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Two lecture periods per week for 6 weeks
- One tutorial or practical session per week for 6 weeks
- Face to face consultations

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments: 20%
  - Tests (At least 3 tests): 50%
  - Written reports: 30%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

2. Books:

[1] Nieuwenhuizen, C. and Nieman, G. (2018). Entrepreneurship: A South African Perspective 4th ed. Van Schaik Publishers

[2] Sibanda, M. (2021). Nuts and Bolts, Strengthening Africa's Innovation and Entrepreneurship Ecosystems. Tracey McDonald Publishers

[3] Botha, T. (2019). Entrepreneurship and how to establish your own business. 6th ed. Juta Legal and Academic Publisher

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**WORKSHOP PRACTICE**
Module Code	I3640IW
NQF Level	6
Notional Hours	80
Contact hours	3 PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	Core

Module Purpose

The purpose of this module is to enable the students to understand engineering workshop practices.

Overarching Learning Outcome

Carryout basic fabrications in an engineering workshop in a professional manner.

Specific Learning Outcomes

On completing the module students should be able to:

- Work collaboratively in a team setting and use modern engineering tools and practices.
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.
- Describe the general operation of air-conditioning and refrigeration systems.

Module Content

Safety procedures applicable to engineering workshops: Safety equipment; Protective clothing; Signage. **Use of workshop hand tools. Principles and practices of**: Masonry and brickwork; Machining Operations (cutting, drilling, turning, milling, shaping); Sheet metal and fitting; Welding fabrication; Auto mechanics; Electrical wiring and installation; Soldering and de-soldering of electronic components; Carpentry and woodwork; Plumbing and pipe fitting; Refrigeration and air-conditioning systems and their installation.

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 5 and 10)
- 5 Engineering Methods, Skills, and Tools including Technology (Course Outcomes 2, 4, 6, 9)

Learning and Teaching Strategies/Activities

- Three practical session per week for 6 weeks
- Practical demonstrations
- Supervised practical, use of hand tools and machine tools
- Fabrication of simple components using various workshops and tools

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment
- The Continuous Assessment will be made up of the following assessment activities:
    - At least 5 practical reports: 40%
    - Fabricated Components: 60%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books:

[1] Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
[2] Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

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Next Revision: September 2028

10.5.2.2 YEAR 2 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Module Code	I3611IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3512IM Engineering Mathematics II)
Prerequisite	**I3511IM Engineering Mathematics I**
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad and advanced mathematical skills to solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Apply differential vector calculus to solve mathematical and engineering problems.
2. Apply functions of several variables in solving engineering problems.
3. Approximate solutions to 2nd order differential equations using power series.
4. Describe the basis for complex analysis in engineering problem solving.
5. Apply the residual theorem to engineering problems.

Module Content

Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binomial, torsion, curvature. Functions of several variables: limits, continuity, derivatives, differentials, the Jacobian, matrix and determinants, composite functions, higher order derivatives. Applications: optimization on surfaces, constrained optimization. The gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Power Series and their applications: Power series. Radius of convergence and interval of convergence. Power series representation of functions, Taylor and Maclaurin series, the Binomial theorem. Power series solutions to ODEs with variables coefficients. Analytic Functions: Complex functions, derivatives, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem and evaluation of complex integrals.

Contribution to Exit Level Outcome:

- o 1 Problem solving (Course Outcomes 1,2,3,4,5)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3)
- o 5 Engineering Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.

[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.

[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.

[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.

2. Lecture notes

Issue Date: September 2023

Next Revision: September 2028

Module Title:	ENGINEERING ECONOMICS
Module Code	I3661IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the students to key economic concepts and how they are applied in the different sectors of the economy and in engineering in particular.

Overarching Learning Outcome

Apply key economic concepts in the different sectors of the economy and in engineering in particular.

Specific Learning Outcomes

On completing the module students should be able to:

- Discuss the fundamentals of microeconomics
- Apply the concept of time value of money
- Apply investment analysis techniques for projects (NPV, ROR, IRR, CBA, Payback Period, etc.)
- Apply depreciation methods on assets for valuation
- Discuss the fundamentals of macroeconomics
- Apply financial accounting principles in engineering projects
- Discuss the principles of marketing engineering products

Module content

Microeconomics: economic concepts, economic problems, demand and supply, consumer choice and demand theory, production functions, production costs, profit maximisation: **Time value of Money:** time value of money, investment analysis (NPV, ROR, IRR, ROI, CBA, etc.), depreciation methods (straight line, reducing balance, some of digits) **Macroeconomics:** inflation and deflation, business cycle, monetary and fiscal policies, unemployment, international trade. **Financial accounting:** product costing, cost accounting, Cost estimation, financial statements and budgeting. **Introduction to marketing:** marketing principles.

Contribution to Exit Level Outcome:

- 11 Engineering Management (Course Outcomes 3, 6 and 7).

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Consultations

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - i) Assignments: 40%
  - ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Books:

[1] Goodwin, N., Harris, J., Nelson, J.A., Roach, B. and Torras, M. (2020). Principles of Economics in Context 2nd ed. Routledge
[2] Mohr, P. (2015). Economics for South African Students 5th edition, Van Schaik Publishers

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Module Title:	**COMPUTER PROGRAMMING I**
Module Code	I3691CP
NQF Level	6
Notional Hours	150
Contact hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	None
Prerequisite	**I3551CC Computing Fundamentals**
Semester Offered	1

Module Purpose:

The course aims to equip students with general principles of programme ing, skills, theories, and techniques for computer programmes design and solutions.

Overarching Learning Outcome

Design and analyse computer programme.

Specific Learning Outcomes

On completing the module students should be able to:

- Design algorithms and data structures for solving mathematical and engineering problems using pseudo code, flowcharts, and related tools.
- Differentiate different programme ing paradigms (structural, functional and object-oriented).
- Discuss the concept of compiled and interpreted languages.
- Use different data types in the design of programmes.
- Apply arithmetic, logical and bitwise operations on different data types in programme ing.
- Compile computer programmes in different integrated development environments.
- Apply and test the three basic programme ing structures (Sequential, Decision and Looping) using specific programme ing languages (e.g., MATLAB, Python, C, etc.

Module Content:

Programme design: programme ing problem definition, programme requirements elicitation and analysis, specification development, design methods, design tool (pseudo code, flow charts etc.).
Programming Paradigms: Structural, functional and object-oriented programme ing concepts.
Introduction to programme compilation and interpretation: Definition and differences between compiled and interpreted languages, Compilation process, Execution of compiled code, Interpretation process, Examples of compiled and interpreted language, Advantages and disadvantages of each type of languages.
Introduction to programme ing: variables, operators, data types, iteration, branching
Data Structures: Arrays, lists, stack and queues, structures and enumeration/hash maps.
Fundamental concepts of programme ing: Data types, variables, programme flow control (decisions and loops), string manipulation, functions, data structures and their operations

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 5)
5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 12 weeks
- One tutorial or one practical session per week for 12 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.
- Special soft skills lecture that may be done on-site or via video demos.

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
- The Continuous Assessment will be made up of the following assessment activities:

d) Assignments (tutorials, quizzes, reports, practical assignments): 20%
e) Tests (At least 3 tests): 50%
f) Semester Mini project (prototype, oral presentation and development report): 30%

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 100% Continuous Assessment

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation
- Regular review of the course content
- Face-to-face consultations
- Effective and efficient supervision and monitoring of assignments, tests and projects.

Prescribed Learning Resources

[1] Cay Horstmann, Rance Necaise; Python for Everyone, Second Edition, Wiley, 2016.
[2] William J. Palm III; Introduction to MATLAB for Engineers, Third Edition, Mc-Graw Hill, 2011.
[3] Gregg Perry and Dean Miller; C Programming Absolute Beginner's Guide, Third Edition, Pearson, 2014.

Issue Date: September 2023
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Module Title:	**STRENGTH OF MATERIALS**
Module Code	I3681VM
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1PS /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3582NM Engineering Mechanics I)
Pre-requisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the fundamental concepts of stress and strain and the geometrical properties of plane sections. This foundational module equips the student with fundamental knowledge of structural analysis and design.

Overarching Learning Outcome
Analyse stresses and strains in 1-, 2- and 3-dimensional planes, determine geometrical properties of plane sections and common material failure theories and mechanisms.

Specific Learning Outcomes
On completing the module students should be able to:

1. Analyse the state of stress and strain in one-, two-and three-dimensional planes.
2. Execute the transformation of stresses in two- and three- dimensional planes.
3. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
4. Analyse the geometrical properties of plane sections.
5. Solve problems involving shear stresses and shear flow in beams and thin-walled open sections.
6. Analyse stresses and strains due to bending, torsion and thermal effects.

7. Describe the failure theories of materials and use them in the prediction of failure.
8. Analyse the buckling loads of struts subjected to various end conditions.
9. Relate stresses in thin cylinders and spheres subjected to internal pressure.
10. Test the mechanical properties and sectional properties of materials.

Module Content

Stresses and strains in one-dimension: introduction to stresses and strains; direct tensile test; Hooke's law and Modulus of Elasticity; ductility; Normal stress and strain; Poisson's ratio; Thermal stresses and strains; Axially-loaded bars, composite bars, axially-loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars; Shear stresses and strains; Modulus of rigidity. **Stresses and strains in two and three dimensions:** analysis of two- and three-dimensional state of stress; transformation of stresses and strains; principal stresses and maximum shear stresses; analysis of two and three-dimensional state of strain; Mohr's circle of stress and strain; Volumetric strain; Bulk modulus. **Geometrical characteristics of plane sections:** centroids of simple and complex areas; second moment of area; polar moment of area; section modulus; parallel axes theorem; perpendicular axes theorem. **Bending and shear stresses in beams:** theory of beam bending; composite beams; shear stress distribution due to bending. **Combined bending and direct stresses in structural members**. **Unsymmetrical bending**. **Shear stress in thin-walled open sections**. **Shear centre**. **Material failure:** failure theories of materials; Creep; Fatigue; Fracture; Stress concentration. **Elastic instability:** buckling of struts. **Simple torsion:** pure torsion of circular bars; shear stress and shear strain in shafts; torsional rigidity; torsion of hollow shafts. **Stresses in thin cylinders and spheres:** thin cylindrical and spherical shells subjected to internal pressure; hoop stress; longitudinal stress. **Laboratory demonstrations:** direct tensile test; elastic modulus/ductility; torsion; fracture; stress concentration; buckling of struts.

Contribution to Exit Level Outcome

- 1 Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6 and 8).
- 2 Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).
- 4 Investigations, experiments and data analysis (Course Outcome 10).
- 5 Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face-to-face consultations wherever necessary.
- Laboratory demonstrations.

Student Assessment Strategies

1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Laboratory reports: 20% of CA.
   ii. Assignments: 20% of CA.
4. 2 Tests: 60% of CA.

End-of-semester examination: (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books

[1] Khurmi, R.S., and Khurmi, N. (2019). A Textbook of Strength of Materials. S Chand Publishing.
[2] Stephens, R.C. (2013). Strength of Materials: Theory and examples. Elsevier.
[3] Timoshenko, S. (2004). Strength of Materials, Part 1: Elementary Theory and Problems, 3rd Edition. CBS Publishers.
[4] Case, J., Chilver, A.H., and Ross, C.T.F. (1999). Strength of Materials and Structures, 4th Edition, Butterworth-Heinemann.

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Next Revision: September 2028

Module Title:	ENGINEERING MECHANICS II
Module Code	I3641NM
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS /Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3582NM Engineering Mechanics I)
Prerequisite	None
Semester Offered	1

Module Purpose

The purpose of this module is to equip students with fundamental principles and formulations of the kinematics and kinetics of Newtonian mechanics in the context of problems involving the dynamics of particles and rigid bodies.

Overarching Learning Outcome

Apply the fundamental principles and formulations to solve the kinematics and kinetics of Newtonian mechanics.

Specific Learning Outcomes

On completing the module students should be able to:

1. Competently express motion of a body in terms of position, velocity and acceleration.
2. Apply principles of kinematics and kinetics to describe motion and causes of motion.
3. Solve dynamics problems using rectangular, normal and tangential, polar and cylindrical coordinates.
4. Analyse linear, curvilinear, angular, rotational, projectile and relative motion of particles and systems thereof.
5. Apply equations of motion in rectilinear and plane curvilinear motion.
6. Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
7. Analyse kinetics of a system of particles using the work-energy principle and the impulse-momentum principle.

Module Content

Particle Dynamics: Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. Cylindrical coordinates systems. Kinetics of particles: Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. Kinetics of a system of particles. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

Contribution to Exit Level Outcome:

- o 1 Problem Solving (Course Outcomes 3, 4, 5 and 6)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5 and 6)
- o 5 Engineering Methods, Skills, and Tools information Technology (Course Outcomes 3, 4, 6 and 7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 3 assignments): 40%

ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books

[1] R.C. Hibbeler, Engineering Mechanics (Dynamics), 14th Edition or later, 2016, Prentice Hall Publishers

[2] Andrew Pytel and Jaan Kiusalaas., Engineering Mechanics (Dynamics), 2016, Brooks/Cole Publishing Company.

2. Lecture notes

Issue Date: September 2023

Next Revision: September 2028

Module Title:	**ENGINEERING MATERIALS**
Module Code	I3661NM
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3572IS Materials Science)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to familiarize students with the classification and characteristics of ferrous and non-ferrous metallic materials, polymeric materials, ceramics and composites and thereby enable the students to make suitable material selection for engineering applications.
Overarching Learning Outcome
Classify, identify and characterise engineering materials.
Specific Learning Outcomes
On completing the module students should be able to:

1. Distinguish between various classes of steels and cast irons and identify their specific characteristics
2. Describe key characteristics and typical applications of common non-ferrous metals and alloys
3. Demonstrate knowledge of engineering polymers and plastics and discuss applications of such materials
4. Describe the characteristics and uses of traditional and technical ceramics and identify their superior properties.
5. Demonstrate knowledge of composition and characteristics of composite materials and describe the procedures for stress analysis in longitudinal and transverse loaded composites.

Module Content

Classification and Characteristics of Steels: Review of the Iron-Iron Carbide phase diagram. Plain carbon steels, alloy steels, stainless steels, **Special heat treatments for steels:** Case hardening, austempering, martempering, Hardenability of steels, Jominy End-Quench test, Annealing and recrystallization. **Characteristics of Cast Irons**: Grey iron, nodular iron, austempered ductile iron (ADI). **Characteristics of Non-Ferrous Alloys**: Copper, aluminium, titanium, nickel and their alloys. Practical application of strain hardening and precipitation hardening on selected alloys**. Polymers and Plastics:** polymerization processes, degree of polymerization, classification of polymers, glass transition temperature. Common thermoplastics, common thermosetting plastics, common elastomers. **Ceramics**: Traditional ceramics, technical ceramics, structural and functional properties of technical ceramics. **Composite Materials:** Polymeric, metallic and ceramic matrices, fibres for reinforcement, effect of fibre volume fraction on properties. Longitudinal and transverse loading of composites: stress analysis and modulus of elasticity. Shear modulus of composites for parallel model (isostrain) and series model (isostress). **Nanomaterials -** Introduction of nanomaterials and nanotechnologies, Features of nanostructures, Background of nanostructures, Techniques of synthesis of nanomaterials, Mechanical properties of nanomaterials, Tools of the nanoscience, Applications of nanomaterials and technologies.

Contribution to Exit Level Outcome:

- 2 Application of fundamental and engineering knowledge (Course Outcomes 1, 2, 3 and 4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (At least 2 assignments): 20%
   ii) Practical reports: 20%
   iii) Tests (At least 2 tests): 60%
4. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Criteria for qualifying for the Examination
To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
   [1] Donald R. Askeland, Pradeep P. Fulay Essentials of Materials Science and Engineering, 2nd Edition, 2008.
   [2] William D. Callister Jr., David G. Rethwisch. Materials Science and Engineering, An Introduction, 8th Edition, 2010.

2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

10.5.2.3 YEAR 2 SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS IV
Module Code	I3612IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**I3512IM Engineering Mathematics II**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Equip students with broad and advanced mathematical skills that will help them solve engineering problems.
Specific Learning Outcomes
On completing the module students should be able to:

5. Solve systems of first order linear differential equations using the LT and the matrix approach.
6. Define, classify and solve partial differential equations analytically and
7. Apply integral calculus to functions of several variables and describe Green's theorem
8. Describe the principal of numerical methods and computational linear algebra

Module Content
Systems of Linear Differential Equations: Homogeneous and nonhomogeneous systems and their methods of solutions: The Laplace Transform method and the matrix methods (eigenvalue-eigenvector approach). **Partial Differential Equations:** Partial differential equations classification; elliptic, parabolic and hyperbolic. Neumann, Dirichrit boundary conditions of PDEs. Method of separation of variables to the heat and wave equations; vibrations of a stretched elastic string fixed at both ends. **Integral Calculus of Functions of Several Variables**: Double and triple integrals, Double, triple and iterated integrals, Line integrals in the plane, Green's Theorem, Independence of path, Surface integral, Divergence theorem, Stoke's theorem, Irrotational and solenoidal fields, Physical and engineering applications. **Numerical Methods:** Zeros of functions, Polynomial interpolation and least squares approximation, numerical differentiation and integration. Numerical solution of first order ordinary differential equations and boundary value problems.
Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,3,4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3,4)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes): 40%
    - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.

2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title	**COMPUTER PROGRAMMING II**
Code	I3692CP
NQF Level	6
Notional Hours	150
Contact Hours	4L + 1T or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	None
Prerequisite(s)	**I3631CP Computer Programming I**
Semester Offered	2

Module Purpose

The module aims at introducing advanced programming design knowledge and skill with emphasis on object-oriented programming.

Overarching Learning Outcomes

Design and implement efficient programmes to solve engineering and mathematical problems using the top-down stepwise object-**oriented** programming approach.

Specific Learning Outcomes

- Discuss various recognized programming standards, guidelines and models.
- Apply advanced problem-solving techniques on numerical computations and engineering problems.
- Discuss Object-Oriented Programming Techniques.
- Design, Implement and Test object-oriented programmes using various object-oriented programming language such as C++/C#/Java and Python.
- Employ encapsulation, inheritance, polymorphism, abstraction and abstract data types in Programming Solutions.
- Use programming to solve numerical differentiation and integration problems.
- Write programme to read from and write content to files.

Module Content:

Recognized standards, guidelines and models used in programming. Flowchart ANSI symbols and usage. Extensive examples, and programming exercises using pseudo-code/flowchart to solve practical problems in engineering.

Advanced Problem Solving: Top-down stepwise refinement approach, Code Tracing and Debugging techniques and the Try-Catch Clause.

Advanced Structured Programming: Standard Libraries, arithmetic and logical operators, Bitwise operators and bit masking; Precedence and Associativity of Arithmetic Operations; Unary Operators; application of Structs hash maps and Enums. Symbols, keywords, identifiers, data types

Selection and Repetition Structures: If Statement, Conditional Operator, Switch-Case Structure, For Loops, While Loops and other Loops;

Arrays, Strings, and Pointers: Arrays; Storing and accessing Values in Arrays; Pointers; Advanced string manipulation;

File Handling: Concept of a file, files and streams, standard file handling functions, binary files, random access files.

Advanced Functions: Functions definition; Functions declaration/prototyping; Functions calling; Functions arguments; Recursion. Object Oriented Programming: Classes and Objects; Inheritance; Encapsulating; Abstraction; Polymorphism; Operators and Functions Overloading and Overriding and Design Patterns

Numerical differentiation and integration using programming.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 5)

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)

3 Engineering Design (Course Outcomes 1)

5 Engineering Methods, Skills and Tools, Including Information **Technology (Course Outcomes 2, 3, 4, 5)**

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 12 weeks
- One tutorial session or one practical session per week for 12 weeks
- Weekly consultation sessions
- A mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.
- Special soft skills lecture that may be done **on-site or via video demos.**

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes, reports, practical assignments): 20%
  - Tests (At least 3 tests): 50%
  - Semester Mini project (prototype oral presentation and development report): 30%

Criteria for passing the course:

- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 100% Continuous Assessment.

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examinations.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- Invite students for one-one consultation to find the root cause of the problem
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

- Hejlsberg, M. Torgersen, S. Wiltamuth, and P. Golde: The C# Programming Language (Microsoft.NET Development Series), Fourth Edition, Addison Wesley, 2002.
- S. Nakov and V. Kolev; Fundamentals of Computer Programming with C#, Svetlin Nakov and Co. 2013.

Issue Date: **September 2023**

Next Revision: **September 2028**

Module Title:	**ELECTRICAL MACHINES I**
Module Code	I3682EM
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1PS /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3502EE Fundamentals of Electrical Engineering)
Prerequisite	**None**
Semester Offered	2

Module Purpose:
The purpose of the module is to introduce students to basic theory, characteristics, construction operation and application of both static and rotating electrical machines. The construction and operation are based on magnetic theory.

Overarching Learning Outcome
Demonstrate an understanding of basic electrical machine construction and terminology, be able to explain the operation of a Transformer, DC Machines, Three phase induction motor and their applications

Specific Learning Outcomes
On completing the module students should be able to:

- Demonstrate the principle of operation of electrical machinery.
- Analyse the principle of operation of DC machines such as DC motors, generators.
- Explain the operation and applications of transformers and AC windings.
- Model the operation of three-phase induction machines.
- Identity Industrial applications of Electric Motor drives.
- Explain Industrial applications of Electric Motor drives

Module Content:
Introduction to electric machinery (review of magnetism); Principles of rotating machines, Principle of Magnetism (Magnetic field lines and their Properties, Flux and Flux density), Production of Rotating magnetic field (EMF and Faradays laws of Electromagnetic induction, Review of Magnetic circuit. **DC machines (DC generator and Motor**); Construction and principle of operation, EMF equation of DC Machine, armature reaction, commutation, Equivalent circuit of DC Generator and DC Motor, Characteristic of DC. Generators (Types of DC Generators, Characteristics of DC. Motors (Types of DC Motors), Power Flow and DC Machines Efficiency. **Single Phase Transformers;** Construction and Principle of operation, Transformer EMF Equation, Ideal Transformer and its characteristics, Classification of Transformer and Applications, Practical Transformer and its characteristics, Transformer tests (Open circuit and short circuit), Transformer efficiency, Auto- transformer (Characteristic and principle of operation). **Three phase induction motor;** Construction and principle of operation, EMF equation, Equivalent circuit, Power flow and motor efficiency , Torque-slip characteristic, Motor Tests (No load test and Blocked rotor test), Starting and speed control techniques of Induction motor, Applications, Motor Drives (DC drives principle of operation and industrial Applications).

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1, 2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4,5)
- 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2,4,5)
- 6 Professional and Technical Communication (Course Outcomes 4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 60% Continuous Assessment and 40% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (at least 2): 20%,
    - Labs (at least 3): 30%,
    - Tests (at least 2): 50%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 60% in the design project.

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:

[1] Stephen J. Chapman, "Electric Machinery and Power System Fundamentals", 5th Ed., McGraw Hill, Feb. 2014.
[2] Theodore Wildi, "Electric Machines, Drives and Power Systems", 6th Ed., Prentice Hall, Jan. 2000

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Module Title:	**FLUID MECHANICS I**
Module Code	I3692NF
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3582NM Engineering Mechanics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the fluid mechanics sciences, and to enable students to understand of the mechanisms of fluid flow.
Overarching Learning Outcome
Understand fluid mechanics principles and apply the governing equations to solve fluid flow problems.
Specific Learning Outcomes
On completing the module students should be able to:
11. Describe properties of fluids and conditions for relative equilibrium in fluids.
12. Categorize one-dimensional mass and momentum conservation and applications of the continuity equation and the Bernoulli's equation.
13. Demonstrate skills for flow measurements in laboratory demonstrations.
14. Solve general hydraulic systems problems with respect to energy changes (pressure, velocity), pipe friction, and local hydraulic losses.

Module Content

Introduction to fluid mechanics; properties of fluids (density, viscosity, vapour pressure); fluid equilibrium; units. **Fluid Statics**: The governing differential equations; pressure distributions, manometric pressure measurement; fluids in relative equilibrium; forces on submerged surfaces; buoyancy. **One-dimensional flows with inertia**: 1-D mass conservation (Continuity equation); 1-D momentum conservation (Bernoulli equation); total head diagrams; flow measurement; **Flow states:** laminar vs turbulent, steady vs unsteady, uniform vs non-uniform, continuous vs discontinuous, sub-critical vs super-critical. **Hydraulic systems**: Energy changes in systems; pipe friction (continuous hydraulic energy losses: laminar and turbulent friction factors, Moody diagram); local hydraulic energy losses: loss coefficients and applications. **Lab practical:** 1. Hydrostatics, 2. Fluid dynamics: Discharge determination, 3. Fluid dynamics: Energy shares in a pressurised system (pressure and velocity dependencies) and 4. Fluid dynamics: Determination of continuous and local hydraulic losses.

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 and 4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory demonstrations and experiment documentation

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (At least 3 assignments): 20%
   ii) Practical reports: 40%
   iii) Tests (At least 2 tests): 40%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] Yunus A. Cengel and John M. Cimbala, Fluid Mechanics, Fundamentals and Applications, 3rd edition, 2014
[2] R. K Bansal, Fluid Mechanics and Hydraulic Machines,9th edition, 2010.
[3] Marcel Dekker, Turbomachinery Design and Theory, 2003

2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MECHANICAL ENGINEERING DESIGN I**
Module Code	I3622ND
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	**I3582NM Engineering Mechanics I**
Semester Offered	2
Module Purpose	

The purpose of this module is to introduce students to mechanical engineering design, with emphasis on communication of design ideas and mechanical design principles.

Overarching Learning Outcome

Understand and apply mechanical engineering design principles and communicate design ideas.

Specific Learning Outcomes

On completing the module students should be able to:

1. Discuss the methodology for engineering design
2. Discuss key features of mechanical engineering drawings
3. Use codes of practice for mechanical engineering drawing
4. Design mechanical engineering drawings utilize design software
5. Analyse stresses in machine components

Module Content

Design methodology: problem investigation and identification, the role of system requirements, solution development and assessment strategies, problem solving approaches, consideration of alternative options during the designs development, appropriate application of engineering sciences to a design problem. **Technical communication:** Introduction to computer aided design, part drawings, manufacturing drawings, assembly drawing, assembly and reading of drawings, particular dimensioning rules, surface finish symbols, semi-finished products, technical reports, presentations skills **Consideration for tolerances, fits and reliability**. **Stress analysis in machine components:** theories of stress analysis and failure to engineering design problems, application of shear force and bending moment diagrams, stress analysis and principal stresses and Mohr's circle in static and fatigue failure, factors of safety and analysis and sizing of various mechanical components.

Contribution to Exit Level Outcome:

- 3 Engineering Design (Course Outcomes 1, 2, 3, 4, 5 and 6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Mini design projects

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (At least 3 assignments): 20%
   ii) Mini design projects: 40%
   iii) Tests (At least 2 tests): 40%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:

[1] Neil Sclater Nicholas., P Chironis., Mechanisms and Mechanical Devices Sourcebook, 4th Edition, ISBN-13: 978-0071467612
[2] K. Venkata Reddy., Textbook of Engineering Drawing, 2nd edition, ISBN-13: 978-9352300440
[3] N.D Bhatt., Engineering drawing., 5th edition, 2011.

2. Lecture notes
3. Design and analysis software: SolidWorks and ANSYS

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MEASUREMENTS AND INSTRUMENTATION**
Module Code	I3622CI
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS /Week
Additional learning Requirements	Include any compulsory field trips / excursions (outside the normal practicals); attachments / group work /project etc.
NQF Credits	8
(Co-requisites)	(I3502EE Fundamentals of Electrical Engineering)
Prerequisite	**None**
Semester Offered	1

Module Purpose
This module aims to provide the necessary and fundamental, theoretical and practical knowledge on measuring techniques.
Overarching Learning Outcome
Discuss the characteristics of measuring instruments and operate them in a lab environment as well as analyse and interpret measurement results.

Specific Learning Outcomes
On completing the module students should be able to:
1. Distinguish different types and methods of measurements.
2. Discuss static and dynamic characteristics of an instrument.
3. Explain the importance of signal generators and signal analysers in measurements.
4. Calculate errors and reduce them in measurements.
5. Discuss the concept of instrument calibration.
6. Explain the use of sensors and transducers.
7. Measure different quantities, analyse and interpret the measurement results.

Module Content
Systems of Units and Standards of Measurement: Absolute, derived and fundamental units. Advantages of electronic and electrical measurements. **Standards and types of standards**. International Standards, Primary Standards, Secondary Standards, Working Standards**. Errors**: sources of error. Types of errors, statistical analysis of error. **Performance characteristics of Instruments: Static characteristics** (Accuracy, Precision, Sensitivity, Reproducibility, and Tolerance etc.) **Dynamic characteristics** (Speed of response, Fidelity, Lag, dynamic error etc.). **Calibration:** Principles of calibration, calibration chain, calibration records. **Elements of generalized measurement system**, Functional elements of an instrument: Primary sensing element, variable conversion element (analogue to digital conversion), variable manipulation / conditioning element- (data amplification, attenuation) - data processing element (filtering), data transmission element, data storage element (chart recorders, computers, memory storage devices etc.), data presentation element/ termination stage**. Instrument classification:** active or passive instruments, null and deflection type instruments, analogue and digital instruments, indicating instruments and instruments with a sound output, smart and non-smart instruments. **Bridge measurement** (Wheatstone, Kelvin, Maxwell Anderson, Wien etc.) **Electrical indicating and test instruments:** Construction and operation of Digital meters (Voltage-to-time conversion digital voltmeter, Dual-slope integration digital voltmeter), Analogue meters **-** Construction and operation of Analogue meters: Moving-coil meters, moving iron meter, clamp on meter, techniques for measurement of high frequency signals. **Noise in Measurement Instruments**: Causes/ sources of Noise (Capacitive/ electrostatic, Inductive, multiple earth, thermoelectric potentials, shot noise,). Noise reduction techniques. **Measurements of electrical and non-electrical quantities: Sensors and transducers**: Transducer Characteristics, Mechanical vs electrical transducers. **Transducer classification**: active and passive transducers, on the basis of transduction principle used, analogue and digital transducers, primary and secondary transducers, **Transducer types:** potentiometric transducers, LVDT, thermocouple, capacitive, inductive, piezoelectric. **Transducer circuits:** temperature sensors, fire detector etc. **Oscilloscopes:** Internal architecture and operation, principle of signal display, voltage, current, period and frequency measurement. **Signal generators:** Requirements of a signal generator, sine wave generator, basic theory of oscillators (Wien bridge, RC phase shift, Hartley and Colpitts), RF signal generation, Lab type signal generator, function generator (specification and principle of operation), Spectrum **analysers:** characteristics and principle of operation**.**

Contribution to Exit Level Outcome:
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 7)
- 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 7)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 5%
  - Lab practical (At least 4 labs): 35%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% continuous assessment.

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

4. One-on-one consultations with students during consultation hours.
5. Allocation of extra reading material where applicable.
6. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books
   [1] Measurement and Instrumentation. Theory and Application, 2nd Edition: Alan S. Morris, Reza Langari.
   [2] Introduction to Instrumentation and Measurements, 2nd Edition: Robert B. Northrop
2. Lecture notes

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Next Revision: September 2028

10.5.3 YEAR 3 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

10.5.3.1 YEAR 3 SEMESTER 1

Module Title:	**SOLID MECHANICS**
Module Code	I3751NS
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	**I3651VM Strength of Material I**
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to study the deformations or strains caused by external loads, to analyses the thermal and assembly stresses, to describe the general theories of failure and understand linear elastic fracture mechanics and failure criteria.

Overarching Learning Outcome
Analyze structural systems, stress and external loads on deformable and rigid bodies.

Specific Learning Outcomes
On completing the module students should be able to:

1. Analyse equilibrium of rigid bodies subjected to two- and three-dimensional force systems and demonstrate application to trusses, and machine frames.
2. Apply the method of virtual work for equilibrium and stability analysis.
3. Analyse and solve statically indeterminate problems.
4. Analyse thermal and assembly stresses
5. Analyse deflection of beams using integration, discontinuity functions and method of superposition.
6. Apply energy methods in stress and strain analysis, deflection and impact loading.
7. Analyse composite bodies using the principles of engineering mechanics.
8. Analyse stresses in asymmetric solids including cylinders and rotating discs.
9. Describe general theories of failure and demonstrate an understanding of linear elastic fracture mechanics and failure criteria

Module Content
Equilibrium of rigid bodies: Two- and three-dimensional force systems. Application of principles of rigid body equilibrium to trusses and machines frames. **Method of virtual work**: application to equilibrium and stability analysis of interconnected systems. **Moments and products of inertia**: first and second moments of area, polar moment of inertia, parallel axis theorem, radius of gyration, composite area method, product of inertia. **Mechanics of Solids**: Analysis of thermal and assembly stresses (applications and examples). Deflection of beams: Slope and deflection by integration, Discontinuity functions, statically indeterminate beams, method of superposition. **Energy methods**: Strain energy for various types of loading, Deflection by conservation of energy, Impact loading, Castigliano's theorem. **Mechanics of composite bodies:** Materials; Manufacturing methods; Micromechanics; Macro-mechanics of a lamina; Failure criteria; Laminate analysis; Design of composite structures. **Stress analysis of asymmetric solids**: Thick-walled and compound cylinders; Rotating discs and cylinders; Autofrettage. **Fracture Mechanics**: Theories of linear-elastic and elastic-plastic fracture mechanics and their applications. Crack propagation models. Failure criteria.

Contribution to Exit Level Outcome:

- o 1 Problem Solving (Course Outcome 3)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 11)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:

- o Four lecture periods per week for 14 weeks
- o One tutorial or one practical session per week for 14 weeks
- o Face to face consultations
- o Laboratory demonstrations, experiment documentation

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 3 assignments): 20%
ii) Practical reports: 40%
iii) Tests (At least 2 tests): 40%

Criteria for qualifying for the Examination
To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.

4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
   [1] James M. Kere, Mechanics of Materials, 7th edition, ISBN-13: 978-0010024951
   [2] Fatigue of structures and Materials in the 20th century and the state of the art, 2nd edition, springer
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CONTROL SYSTEMS**
Module Code	I3781NM
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3622CI Measurements and Instrumentation)
Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to provide knowledge and skills required for modelling, analysis, and design of control systems.

Overarching Learning Outcome
Model, analyse, and design control systems.

Specific Learning Outcomes
On completing the module students should be able to:

1. Apply different control theory terminologies.
2. Model basic mechanical and electrical dynamic systems as a control systems or components of control systems.
3. Analyse given mechanical and electrical dynamic systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
4. Analyses and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Model, analyse and design the control systems using engineering software.

Module Content
Control Systems Basics: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems**: Laplace transform review, transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of mechanical and electrical dynamic systems **Control System Analysis**: system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques**: Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators.

Contribution to Exit Level Outcome:

- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
- o 3 Engineering Design (Course Outcomes 4, 5)
- o 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities
- Mini design projects

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 60% Continuous Assessment and 40% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 3 assignments): 20%
ii) Practical report: 20%
iii) Mini design projects: 30%
iv) Tests (At least 2 tests): 30%

Criteria for qualifying for the Examination
To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
   [1] Norman S. Nise., Control Systems Engineering, 7th edition, 2014
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**FLUID MECHANICS II**
Module Code	I3721NF
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3632NF Fluid Mechanics I)
Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to instruct the students in advanced topics in fluid mechanics and develop problem-solving skills in areas of fluids-related mechanical engineering.
Overarching Learning Outcome
Apply advanced fluid mechanics principles to solve internal and external flows under pressure.
Specific Learning Outcomes
On completing the module students should be able to:

1. Explain fluid motions using Lagrangian and Eulerian descriptions
2. Distinguish between various types of flow visualizations
3. Analyse general two-dimensional potential flow
4. Analyse internal and external flows.
5. Analyse and describe flow over aerofoil profile.

Module Content
Introduction: Thermodynamic and dynamic principles applied to fluid behaviour, types of fluids: Newtonian, non-Newtonian, ideal and viscous. **Fluid kinematics**: Lagrangian and Eulerian Descriptions, Fundamentals of Flow Visualization. **Differential analysis of flow**: stream function, velocity potential, Two-dimensional potential flow, Navier- strokes equations (Newtonian versus Non-Newtonian Fluids, Derivation of the Navier–Stokes Equation for Incompressible). Internal flow: The Entrance Region, Laminar and Turbulent Flows, Minor Losses. **External flow**: Boundary layer, Drag and Lift, Friction and Pressure Drag, Flow over Flat Plates, Flow in channels, Flow over Cylinders and Spheres, vorticity and rotation of fluid particles, aerofoil theory and shocks. **Lab practical.**

Contribution to Exit Level Outcome:
- o 1 Problem Solving (Course Outcomes 1 and 2)
- o 5 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2 and 3)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:
- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 3 assignments): 20%
ii) Practical reports: 40%
iii) Tests (At least 2 tests): 40%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Yunus A. Cengel and John M. Cimbala, Fluid Mechanics, Fundamentals and Applications, 3rd edition, 2014
   [2] Dr. R. K Bansal, Fluid Mechanics and Hydraulic Machines, 9th edition, 2010.
   [3] Marcel Dekker, Turbomachinery Design and Theory, 2003
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**THERMODYNAMICS**
Module Code	I3711NT
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	I3521NP Physic for Engineers I
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to thermodynamic principles and to give students the knowledge required to perform analysis of thermodynamics systems and do appropriate calculations on steam, refrigeration, and air conditioning systems.

Overarching Learning Outcome

Apply thermodynamic laws and principles and use property diagrams and tables to analyse thermodynamics systems.

Specific Learning Outcomes

On completing the module students should be able to:
1. Apply the first law of thermodynamics to non-flow and flow processes.
2. Quantify the properties of working fluids.
3. Analyse thermodynamic processes by using property diagrams and tables.
4. Apply the equation of state of a perfect gas.
5. Apply the second law of thermodynamics to the heat engine, the Carnot cycle and entropy.
6. Analyse vapour systems and perform calculations on steam, refrigeration and air conditioning.
7. Analyse and perform calculations on refrigeration and heat pump cycles.
8. Apply psychrometric principles to air conditioning processes.
9. Solve reactive systems problems by applying first and second laws of thermodynamics.

Module Content

Definitions; system, process, state, property of a system, cycle, pressure, volume, temperature, work, heat. **First law of thermodynamics**: internal energy; non-flow energy equation; energy equation and reversibility. **Working fluids**: properties of fluids and vapours; thermodynamic properties of steam; properties diagrams. Avogadro's law, the equation of state of a perfect gas, specific heats and non-flow gas processes. **Application of first law to non-flow processes**; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. **Application of first law to flow processes**; continuity equation, application to boilers, condensers, turbines, compressors, nozzles, diffusers and throttling devices. **Second law of thermodynamics**: concept of the heat engine; cycle efficiency; Reversibility and irreversibility, Engine efficiency, The Carnot cycle, Absolute temperature scale. **Entropy**: determination and property diagrams. **Exergy analysis. Vapour power systems**: principles, energy analysis, steam calculations, boiler systems, Carnot and Rankine cycles. **Refrigeration and heat pump cycles:** principles, and energy analysis. **Thermodynamics of pure gases and vapour**: non-reactive mixtures and psychrometrics; analysis of air conditioning processes **Thermodynamics of reactive mixtures**: combustion, first and second laws of thermodynamics applications to reactive systems, heat of combustion, heating values, adiabatic flame temperature, dissociation. **Lab practical.**

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcome 3, 6, 7 and 8)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 6, 7 and 8)
- 5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 1, 4 and 9)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
    i) Assignments (At least 3 assignments): 20%
    ii) Practical reports (At least 2 practical labs): 20%
    iii) Tests (At least 3 tests): 60%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
    [1] Y. A. Çengel, and M. A. Boles, 2006, Thermodynamics: An Engineering Approach, Fifth Edition, McGraw Hill.
    [2] M. J. Moran, H. N. Shapiro, D. D. Boettner, and M. B. Bailey, Fundamentals of Engineering Thermodynamics, Fifth Edition, 2006, John Wiley, New York.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	MACHINE TOOLS
Module Code	I3791NT
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(None)
Prerequisite	**I3661NM Engineering Materials**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the methods of metal cutting including the design of cutting tools and computer numerical controlled (CNC) machines

Overarching Learning Outcome
Apply the principles of metal cutting to the use of machine tools in metal cutting operations.

Specific Learning Outcomes
On completing the module students should be able to:
1. Evaluate the principles of the various methods used in metal cutting
2. Perform calculations on machining parameters.
3. Differentiate between conventional and non-conventional machining operations
4. Apply the principles of computer numerical controlled machines

Module Content
Principal methods of metal cutting: Tool materials, Types of machine tools. Metal cutting parameters, chips formation, tool wear and life, surface finishes, cutting fluids, Economics of cutting. Features and operations of machine tools: Conventional: Lathe, shaping, milling, drilling, and boring machines. Unconventional: electron beam machining, electro-chemical machining, abrasive jet machining, chemical machining, electrical discharge, ultrasonic machining. Computer numerical controlled (CNC) machines: Construction features, programme generation. Automation in machine tools.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcome 2)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 and 4)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Mini design project

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (At least 4 assignments): 30%
   ii) Tests (At least 3 tests): 40%
   iii) Mini design Project: 30%

Criteria for qualifying for the Examination
No Examination

Criteria for passing the module
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books
   [1] Edward M, Trent, Paul K. Wright, Metal Cutting, 4th edition, 2000.
   [2] Steve F. Krar, Arthur R. Gill, Peter Smid, Technology of Machine Tools, 7th edition, 2011.
   [3] Richard Kibbe, Roland Meyer, Warren White, John Neely, Jon Stenerson, Kelly Curran, Machine Tool Practices, 10th edition, 2015, 2010, 2006, 2002, 1999, 1995, Pearson Education.
2. Lecture notes
3. Design and analysis software: Solid Works and Auto CADSEMESTER 2

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Next Revision: September 2028

YEAR 3 OF (32BHNI) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

10.5.3.2 YEAR 3 SEMESTER 2

Module Title:	**TECHNICAL WRITING**
Module Code	I3762VW
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Pre-requisite	**U3683AL Academic Literacy II**
Semester Offered	2

Module Purpose

The purpose of this module is to equip students with skills based in theory relating to professional and technical writing.

Overarching Learning Outcome

Equip students with professional communication skills that will enable them to write good technical documents and to plan and present effective professional technical presentations individually and in teams.

Specific Learning Outcomes

On completing the module students should be able to:

1. Produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. Communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates and complying with constraints on document format.
3. Adapt content and rhetorical strategies according to audience and purpose for each document.
4. Select appropriate, credible sources to support the claims, findings or recommendations made in technical documents.
5. Incorporate ideas from source material, including images and figures.
6. Create and deliver technical briefings tailored to specific audiences, purposes and media.
7. Explain ethical considerations applicable to technical communication in engineering and computer sciences.

Module Content

Introduction: academic vs technical communication; introduction to a various technical and business writing theories and practices designed to be applicable to the production of business communication in the real world. Technical writing: fundamentals of good business/technical writing, including protocols for business letters, memoranda, electronic mail, good and bad messages; persuasive messages and formal reports and proposals. Technical reports: planning, structure, style and language for purpose and audience; effective graphical support. Professional Oral communication: structure, style and language; academic and professional discourse; group presentations to industry professionals. Posters and e-portfolios.

Contribution to Exit Level Outcome

o 6 Professional and technical communication (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Face to face consultations
4. Case studies.

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments: 20%.
   ii) Group oral presentations: 10%.
   iii) Individual reports: 40%.
   iv) Tests (at least 2): 30%.

Criteria for passing the module

To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books

[1] English, J. (2013). Professional Communication: Deliver effective written, spoken and visual messages, 3rd Edition, Juta Academic. ISBN 978-0702177927.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	HEAT TRANSFER
Module Code	I3762NH
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3711NT Thermodynamics)
Prerequisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to give students the knowledge required to apply heat transfer principles based on conduction, convection and radiation.

Overarching Learning Outcome

Apply conduction, convection, and radiation principles to analyse and solve heat transfer problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Perform calculations by applying heat transfer principles
2. Solve heat transfer problems in external and internal flows
3. Evaluate the properties of the insulation materials and apply to thermal design.
4. Analyse and design heat exchangers

Module Content

Principles: conduction, convection, and radiation. **Conduction**: Thermal conductivity. Steady state and transient one-dimensional conduction. **Forced external Convection**: drag and heat transfer in external flows, parallel flow over flat plates and across tube banks**.** **Forced internal Convection**: average velocity and temperature, entrance region laminar and turbulent flows, and **natural convection**: equation of motion and the Grashof number, natural convection over surface. **Radiation**: Black and grey body thermal radiation. **Thermal insulation. Lagging materials. Heat transfer from finned surfaces**: fin equation, efficiency, effectiveness**. Boiling**: pool boiling. **Evaporation**: film evaporation on the vertical wall. **Condensation**: film condensation on the vertical wall**. Heat exchangers**: types, energy balance, analysis, design.

Contribution to Exit Level Outcome:

- o 1 Problem Solving (Course Outcome 1, 2 and 4)
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3 and 4)
- o 3 Engineering design and synthesis (Course Outcomes 4)
- o 5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 1, and 4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities
- Mini design projects

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 40% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 3 assignments): 20%
ii) Practical reports: 20%
iii) Mini design project: 30%
iv) Tests (At least 2 tests): 30%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books

   [1] William S. Janna, Engineering Heat Transfer, 3rd edition, 2009.

   [2] Y. A. Çengel and A. Ghajar, Heat and Mass transfer, Fundamentals and applications, 4th edition, ISBN-13: 978-0077366643

   [3] F. P. Incropera, D. P. DeWitt, T. L. Bergman, and A. S. Lavine, Fundamentals of Heat and Mass Transfer, 6th edition, ISBN-13: 978-0471457282, John Wiley, New York.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**COMPUTER AIDED ENGINEERING AND MANUFACTURING**
Module Code	I3792NC
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3701NT Machine Tools)
Prerequisite	**I3531ID Engineering Drawing**
Semester Offered	2

Module Purpose

The purpose of this module is to introduce students to the use of computers in several extended areas of product design and manufacturing.

Overarching Learning Outcome

Model, analyse, simulate and automate manufacturing processes.

Specific Learning Outcomes

On completing the module students should be able to:

1. Conduct 3-D automated modelling using various techniques
2. Design, simulate and analyse 3-D models using computer tools/ software
3. Categorize the principles of computer aided design
4. Elaborate the main features of computer integrated manufacturing

Module Content

Three-dimensional automated modelling: automated computer graphics, modelling and types of modelling, solid modelling and its limitations. Computer aided design (CAD): design constraints and requirements, flow models and analysis, conceptual design, evaluation of design, engineering analysis. Computer integrated manufacturing (CIM): computer-controlled machine tools, control systems for numerical controlled (NC) machines, NC programming with interactive graphics, tool path generation, cutter location source files, using Solid work/ Master CAM. Computer aided engineering (CAE): types of CAE, CAE process and applications, simulation, using Solid works and ANSYS.

Contribution to Exit Level Outcome:

- o 2 Engineering Methods, Skills, Tools and Technology (Course Outcomes 1 and 3)
- o 3 Engineering Design (Course Outcome 2)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Mini design projects

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 4 assignments): 20%
ii) Tests (At least 3 tests): 40%
iii) Mini design project: 40%

Criteria for qualifying for the Examination

No Examination

Criteria for passing the module

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Chang, T. C., Wysk, R. A., Wang, H. P, “Computer aided Manufacturing,” Prentice Hall, Pearson; 3rd edition (July 7, 2005)
   [2] Nanua Singh, Systems “Approach to Computer-Integrated Design and Manufacturing”, Wiley; 1st edition (August 1, 1995)
   [3] Mikell Groover, “Automation, Production Systems, and Computer-Integrated Manufacturing”, 5th edition, 2019, Pearson.
2. Lecture notes
3. Design and analysis software: SolidWorks, MasterCAM, Aut CAD, ANSYS

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MANUFACTURING TECHNOLOGY**
Module Code	I3792NM
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3701NT Machine Tools)
Prerequisite	**I3661NM Engineering Materials**
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with the knowledge and skills of modern manufacturing processes, production systems and quality management practices to turn a conceptual idea into a globally competitive the finished product.

Overarching Learning Outcome
Employ modern manufacturing processes, production systems and quality management practices.

Specific Learning Outcomes
On completing the module students should be able to:
1. Apply the knowledge of elastic and plastic behaviour of materials to metal forming, forging, extrusion, wire drawing and printing
2. Evaluate the principles of metal cutting, and non-conventional cutting techniques used in engineering
3. Analyse metal casting processes, defects and how to control defects
4. Evaluate the basic foundry operations for ferrous and non-ferrous metals
5. Experiment with various welding processes used in engineering and associated welding parameters
6. Apply the knowledge of powder metallurgy to composite materials
7. Assess the various techniques used in the processing and forming of plastics and rubber
8. Apply knowledge of prototyping, surface engineering and quality control to manufacturing.

Module Content
Elastic and plastic behaviour of materials: Technology of sheet metal forming, Forging, extrusion, stretching, wire drawing, hot and cold forming and printing. Annealing and recrystallization. **Introduction to physico-mechanical basis of metal cutting**: Shear, blanking, drawing. **Metal casting processes:** Special smelting processes. Continuous casting. Ferrous and non-ferrous foundry practice. Defects in castings and how to avoid them. **Welding Processes**: Manual and automated systems. Welding of mild steels, stainless steels and aluminium alloys. Robotics in welding. Weld defects and how to avoid them. Brazing. **Advanced cutting techniques**: Use of water jet, compressed air, ultrasound; Electro erosion; Cutting by penetration with a wire. Electro-chemical dissolution treatment**. Powder metallurgy**: basic processes, equipment, product properties, composite materials treatment. **Surface engineering**: applications, techniques. **Processing and forming of plastics and rubber**: Extrusion; Injection moulding; blow moulding, foaming processes. Rapid prototyping: materials, methods, tools. Tool making design (dies and stamps). **Nanotechnology**: Introduction of nanotechnologies, Material Synthesis, Fabrication and Applications of nanotechnologies. **Processing plant**: manufacturing processes, design and layout. Quality control: inspection, destructive and non-destructive testing. **Mini manufacturing project**: manufacturing drawings, bill of materials/ quantity, fabrication.

Contribution to Exit Level Outcome:
- o 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 7and 8)
- o 5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 5, 6, and 9)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities
- Mini manufacturing project

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (At least 3 assignments: 20%
ii) Practical reports: 20%
iii) Tests (At least 3 tests): 40%
iv) Mini manufacturing project: 40%
4. To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for qualifying for the Examination
To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books
   [1] E.R.P. Rajput, Manufacturing Technology (Manufacturing Processes), 2nd edition, 2007
   [2] D. K Singh, Fundamentals of Manufacturing Engineering, 2018.
2. Lecture notes
3. Design and analysis software: Solid Works, Auto CAD

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MECHATRONICS**
Module Code	I3742NM
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3731NM Control Systems)
Prerequisite	**I3622CI Measurements and Instrumentation**
Semester Offered	2

Module Purpose
The purpose of this module is to give students a thorough understanding of the essential elements of mechatronic systems.

Overarching Learning Outcome
Integrate mechanical, electrical, electronics and computer technologies to design mechatronic systems.

Specific Learning Outcomes
On completing the module students should be able to:
1. Apply knowledge of mechanical, electro-mechanical and digital elements of mechatronics, analogue electronics to model mechatronic systems
2. Integrate sensors, actuators and controllers in mechatronic systems
3. Analyse mechanisms and robots using MATLAB
4. Analyse and design simple mechatronic systems

Module Content

Introduction to mechatronics: mechanical, electro-mechanical and digital elements of mechatronics, analogue electronics and electronics devices. **Sensors in feedback systems**: Servo-systems. **Sensors and Actuators in mechatronic systems**: modelling, types, applications, selection, sizing, drives. **Control of mechatronic systems**: Distributed control, Digital control, PC, application of PLC and PID control. **Introduction to robotics**: Modelling of kinematic and dynamic mechanisms, Concepts of mechanisms and robots. Analysis and synthesis of mechanisms and robots using MATLAB.

Contribution to Exit Level Outcome:

- o 2 Application of Scientific and Engineering Knowledge (Course Outcome 1)
- o 3 Engineering Design Course Outcomes 4 and 5)
- o 5 Engineering Methods, Skills, Tools and including Technology (Course Outcome 4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 4 assignments): 20%
ii) Practical reports: 30%
iii) Tests (At least 2 tests): 50%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
   [1] William Bolton, Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering, 7th edition, 2019.
   [2] Musa Jouaneh, Fundamentals of Mechatronics, 1st edition, ISBN-13: 978-1111569020
2. Lecture notes
3. Design, analytical and analysis software: Lab View

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**OPERATIONS MANAGEMENT**
Module Code	I3722NO
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial or 1PS/Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3701NT Machine Tools)
Prerequisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with the knowledge on how the operations can be managed, scheduled, and improved, including the characteristic of quality control approaches.

Overarching Learning Outcome
Manage and schedule operations; and improve quality in operations.

Specific Learning Outcomes
On completing the module students should be able to:
1. Evaluate various techniques of operations management
2. Make decisions on the operation strategies.
3. Apply knowledge of maintenance, quality assurance and reliability measures in engineering projects.
4. Apply key features of total quality management and lean systems in production.
5. Evaluate and control the supply chain and schedule operations.

Module Content
Techniques of Operations Management: Production planning and control systems: material requirements planning; manufacturing resource planning (MRP); measures of performance; techniques for process planning; statistical methods for process control**. Introduction to project management:** feasibility study, Gantt chart, critical path methods, floating analysis, work break down structure. **Forecasting techniques**. **Maintenance:** types, Computerized Maintenance Management System (CMMS**)**. **Quality assurance and reliability**: Principles and philosophies of quality management. Quality planning and deployment; reliability testing; system reliability and availability; risk analysis and safety. **Total Quality Management (TQM):** International Standards. **Supply chain and scheduling**: inventory control, queuing, outsourcing.

Contribution to Exit Level Outcome:
o 11 Engineering Management (Course Outcomes 2, 4 and 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (At least 4 assignments): 20%
ii) Practical reports: 20%
iii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination
To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books
   [1] Jay Heizer and Barry Render, Operations Management (Sustainability and Supply Chain management) 12th edition, 2020.
   [2] William J. Stevenson, Operations Management, 14th edition, 2021.
   [3] S., N. Chary, Production and Operations Management, 5th edition, 2012.
   [4] Nigel Slack, Alistair Brandon-Jones, Robert Johnston, Operational Management, 8th edition, 2016.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MECHANICAL ENGINEERING DESIGN II**
Module Code	I3752ND
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or 1PS/Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3622ND Mechanical Engineering Design I)
Prerequisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to develop problem formulation and solution skills for designing selected machine components and systems, and an understanding of standards, tolerances and fits.
Overarching Learning Outcome
Design and analyze machine components and systems.
Specific Learning Outcomes
On completing the module students should be able to:
1. Design a range of machine elements as applicable to mechanical engineering
2. Present and communicate the design of machine elements as technical drawings and reports.
3. Apply the knowledge of dynamic loading and power transmission in the design of assemblies
4. Apply standards, codes, specifications in mechanical engineering.

Module Content
Analysis, synthesis and design of machine elements and components: Shafts, gears, hydrostatic, friction, hydrodynamic bearings, springs, clutches, braking systems, bolted joints, riveted joints, welded joints, pulleys, belts, keys and couplings. **Dynamic load systems: fluctuation and fatigue loading**: Gears, Shaft, Keyways, Springs, Bearings. **Mechanical power transmission systems**: types and elements. **Professional communication techniques**: standards, codes, specifications.

Contribution to Exit Level Outcome:
- o 2 Application of Scientific and Engineering Knowledge (Course Outcome 2)
- o 3 Engineering Design (Course Outcome 1)
- o 6 Professional and Technical Communication (Course Outcome 1)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:
- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Face to face consultations
- Mini design projects

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (At least 4 assignments): 25%
ii) Mini design project: 35%
iii) Tests (At least 3 tests): 40%

Criteria for qualifying for the Examination
No Examination

Criteria for passing the module
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books
   [1] Richard G. Budynas and J. Keith Nisbett, Shigley's Mechanical Engineering Design, 11th edition, ISBN-13: 978-0073398211
   [2] R.S. Khurmi and J.K. Gupta, A textbook of Machine Design, 14th edition, ISBN-13: 978-8121925372
2. Lecture notes
3. Design and analysis software: Solid Works, AutoCAD

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Next Revision: September 2028

10.5.4 YEAR 4 OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

10.5.4.1 YEAR 4 SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: Engineering societies and registration procedure for different Engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** Its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. Mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace.** Impact of Engineering activity social, economic, cultural, environmental and sustainability.

Learning Outcomes: On completing the course students should be able to:
1. Identify the role of various Engineering disciplines and societies
2. Paraphrase the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Illustrate the use of Engineering codes and standards
4. Justify general knowledge of procedural law, law of contracts, commercial law and employment law
5. Relate laws of arbitration
6. Classify technology policy on the acquisition of technological know-how
7. Summarise the strategies and methods for HIV/AIDS mitigation in the Engineering sector
8. Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

CONTRIBUTION to ECN Exit Level Outcome:

8 Individual, Team and Multidisciplinary Working (Course Outcomes 4 and 6)
10 Engineering Professionalism (Course Outcomes 4 and 7)

Module Title:	**MECHANICAL VIBRATIONS**
Code	TMER3861
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests, 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	**TEGT3641 Engineering Mechanics II**

Contents: **Fundamentals of vibrations**: Basic Concepts and definitions. Vibration Analysis, Harmonic Motion. **Single degree-of-freedom systems:** Equation of motion, Lagrange's equation, free vibration of undamped and damped systems; logarithmic decrement, other forms of damping. **Forced vibration**: Equation of motion, response to harmonic excitation, resonance, rotating unbalanced, base motion excitation, response to general non-periodic excitation, impulse response function. **Design for vibration control:** Vibration isolation, critical speeds of rotating shafts; practical isolation design. **Multiple degree-of-freedom systems:** Equations of motion; Lagrange's equations, free vibration, natural frequencies and mode shapes, forced vibration, response to harmonic excitations and normal-mode approach. **Continuous systems:** Introduction to continuous systems. **Vibration absorption:** Balancing of rotating machines.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Describe the fundamentals of vibration analysis
2. Distinguish between the various forms of vibration
3. Appraise the methods used to control vibration in practice including balancing techniques
4. Describe techniques used in vibration absorption

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcome 3)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1 and 3)
5 Engineering Methods, Skills, Tools and including Technology (Course Outcome 4)

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group project, 1 Test, 4 assignments/case studies)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Content: **Module Description: Basic principles of project management:** Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale Engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation.
2. Apply the processes, tools and techniques of project management in an Engineering context.
3. Discuss the principles of managing medium to large scale engineering projects.
4. Discuss the principles of managing community-based development projects.
5. Discuss the concepts of close-out phases of the project life cycle.
6. Integrate and balance overall project management functions and apply available software tools for project management.
7. Manage projects in multidisciplinary environment using techniques from economics, business management and project management as an individual or a member of a team.

Contribution to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2 and 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5 and 7)

ECN Exit Level Outcomes Assessed:

9 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**
Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**
Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitutes satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitutes satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**RENEWABLE ENERGY**
Code	TMEE3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (2 Tests, 2 Assignments and 1 Mini - Project work)
Pre-requisite(s)	**TMED3642 Engineering Thermodynamics I**

Content: Current energy demands, environmental effects, renewable energy resources, including photovoltaic, concentrated solar plant (CSP), thermal solar, wind, hydro, geothermal, bioenergy, magneto-hydrodynamics (MHD), tidal, ocean thermal and wave energies. Construction of simple solar arrays for energy production. Comparison between renewable and nuclear energy. Mixture of energy sources. Smart grid technology. Power station economics. Sustainable development. Greenhouse gases. Energy efficiency.

Learning Outcomes: Upon completion of t8his module, students should be able to:

1. Analyse the benefits and limitation of using different renewable energy resources.
2. Differentiate the underlying concepts, theory and applications of different renewable energy resources.
3. Build simple photovoltaic arrays or thermal solar arrays to produce electric or thermal energy for different uses.
4. Demonstrate an understanding of energy mix and smart grid technology.
5. Analyse economic principles applied to power generation systems.

CONTRIBUTION to ECN Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 1, 2, 3, 4 and 5)

ECN Exit Outcomes Assessed:

The Exit Level Outcomes are defined as follows:

7. **Sustainability and Impact of Engineering Activity**.

Assessment Strategies

Continuous assessment 100% (2 tests, 2 assignments and 1 mini - Project work)

ECN exit level outcome 7 - **Sustainability and Impact of Engineering activity.**

Where and how is this exit outcome assessed?

Students are expected to show critical awareness of the sustainability and impact of engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. The Final Design Report should show evidence of the student's ability to consider the impact and benefits of the design on social, legal, health, safety and environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitutes satisfactory performance?

After consideration of the section of the Final Design Report that deals with **Sustainability and Impact of Engineering activity** and with reference to how this knowledge are considered in the Engineering analysis and design considerations, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Sustainability and Impact of Engineering activity**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of final mark of 60% from tests, assignments and Mini-Project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

Module Title:	**THERMAL MACHINES**
Code	TMEE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (3 tests, 3 assignments and 2 practical reports), written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TMED3642 Engineering Thermodynamics I**

Content: **Vapour power cycles**. Principle of steam turbines, energy analysis in the steam turbines. Vapour flow in turbine blades and turbine phases. Turbine losses. **Gas power plants**. Internal combustion engines. Principles and applications. Principles of gas turbines. Thermal calculations of the gas turbine scheme, losses and performance. **Refrigeration**: Basic components, refrigeration agents. Refrigeration systems and their applications. Calculations on refrigeration machines. **Air-conditioning**: Basic components, air-conditioning systems and applications. Humidification of gases, Cooling towers. Air-conditioning cooling and heating load calculations. Fault diagnosis and maintenance. Environmental problems, alternative refrigerants.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Explain and analyse vapour power cycles
2. Explain the principles and characteristics of internal combustion engines; steam turbines and gas turbines
3. Solve problems on thermal machines
4. Explain the general design principle of power plants

5. Solve problems involving refrigeration and air conditioning
6. Illustrate knowledge of the various factors that are used to select or determine an appropriate air conditioning system

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcomes 3 and 5)
2 Application of Scientific and Engineering Knowledge (Course Outcome 1)
3 Engineering Design (Course Outcomes 4 and 6)

Module Title:	**FLUID MACHINERY**
Code	TMEE3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% % (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TMER3721 Advanced Fluid Mechanics**

Content: **Momentum principles applied to fluids**. Jet propulsion. Design of fluid machinery: **Centrifugal and axial flow machines**, (pumps, turbines, compressors, blowers and fans), pipe-machine characteristics, cavitation, water hammer. One directional flow, continuity, momentum and energy equations for steady inviscid, compressible, isentropic flow, wave phenomenon. **Power hydraulics**. Nozzles and diffusers. Turbulent flow. Supersonic flow. Pressure and temperature measurements in compressible flows. Fluid power tools: hydraulic and pneumatic tools.

Tribology: Inclined and tilting hydrodynamic thrust bearings, journal bearings. Hydrostatic thrust bearings. Contact between rigid bodies. The friction and adhesion of metals. The friction of plastics and some other materials. **Wear**; mechanism of wear, effects of wear on surface quality. **Lubrication**; mechanism of lubrication, significance of lubrication film. **Selecting a lubricant**; greases, lubricating oils and special condition lubricants (high temperature, pressure etc.).

Learning Outcomes: Upon completion of this module, students should be able to:

1. Explain the principles used in the design of jet engines and general fluid machinery
2. Formulate and solve problems in centrifugal and axial flow machines
3. Explain the principles and characteristics of power hydraulics
4. Distinguish tribological processes that take place due to the interaction of surfaces moving against each other
5. Explain the fundamentals of tribology with respect to friction, wear and lubrication
6. Apply tribological considerations in the design and maintenance of machines.

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcome 2)
2 Application of Scientific and Engineering Knowledge (Course Outcome 2)_
3 Engineering Design (Course Outcomes 1 and 6)
5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 3, 4 and 5)

Module Title:	**MECHANICAL ENGINEERING DESIGN III**
Code	TMEM3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports and mini project)
Pre-requisite(s)	**TMER3781 Mechanical Engineering Design II**

Content: **Design for manufacture**: Design optimisation. Material selection. Rapid prototyping techniques. Reliability. Standards and specifications. Safety aspects. **Material handling systems**: Belts, conveyors, lifting cranes, ropes and chains, bulk material movement. **Industrial design Engineering**. Ergonomics in design. Innovation. Product development. Design exercises. **Model design process:** Design exercises will be done in groups during Tutorial Classes whereby all steps in design methodology, including design realization, material selection, manufacturing and production process, technical and financial constraints, innovation and ergonomics will be demonstrated.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Apply knowledge of design features appropriate to a manufacturing undertaking
2. Distinguish the various equipment and machines used in handling bulk Engineering materials
3. Illustrate the roles of ergonomics, innovation and product development in industrial design Engineering
4. Illustrate an in-depth knowledge of design methodology and the entire design process

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4 and 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3 and 4)
3 Engineering Design (Course Outcomes 2, 4 and 6)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3 and 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4 and 6)
9 Independent Learning Ability (Course Outcomes 2 and 6)
10 Engineering Professionalism (Course Outcomes 4 and 7)

YEAR 4 OF (19BMEE) BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

10.5.4.2 YEAR 4 SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMER3892
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	30
Assessment	Continuous 100% (20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation).
Co-requisite(s)	TMER3792 Research Proposal, All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
1. Demonstrate skills necessary to carry out a technological or engineering investigation.
2. Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
3. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
4. Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Contribution to Exit Level Outcome:

4. Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5. Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6. Professional and Technical Communication (Course Outcomes 5)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8. Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**
Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively.

2 **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**
Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

4 **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYISI**
Demonstrate competence to formulate and conduct investigations and experiments.

6 **PROFESSIONAL AND TECHNICAL COMMUNICATION**
Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences the community at large.

Assessment Strategies

Continuous Assessment 100% (Progress report presentation 20%; Final Oral Presentation of Research Report 20%; Final Research Report 60%).
To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 4, 5 and 6 assessed in the final research report in the section dealing with the corresponding outcome.
The assessment for each of the outcomes 1, 2, 4 and 6 shall be as follows:

<u>ECN Exit Level Outcome 1</u> - PROBLEM SOLVING.

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN Exit Level Outcome 2</u> – APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE

Where and how is this exit outcome assessed?
Students are expected to demonstrate competence to apply knowledge of mathematics, natural sciences, and Engineering fundamentals and to solve complex Engineering problem from first principles during their research projects where they are expected to solve mechanical Engineering problems.

What constitutes satisfactory performance?
After consideration of the section of the final research report that deals with **Application of Scientific and Engineering Knowledge**, and with reference to demonstrate competence to apply knowledge of mathematics, natural sciences, Engineering fundamentals and to solve complex Engineering problem from first principles, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Application of Scientific and Engineering Knowledge**" in a manner that is considered: *"not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Application of Scientific and Engineering Knowledge**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course

<u>ECN Exit Level Outcome 4</u> - INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Where and how is this exit outcome assessed?
Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitutes satisfactory performance?
After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN exit level outcome 6</u> - PROFESSIONAL AND TECHNICAL COMMUNICATION

Where and how is this exit outcome assessed?
Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final research report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of research report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitutes satisfactory performance?
After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: *"not satisfactory", "satisfactory" or "excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	MECHANICAL ENGINEERING DESIGN PROJECT
Code	TMED3890
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	34
Assessment	Continuous 100% (Two Seminar Presentations of design (**20%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**60%**)]
Co-requisite(s)	All third year modules

Content: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a supervisor.

Learning Outcomes: On completing the course students should be able to:

1. Identify and formally state problems that can be solved using engineering knowledge and skills.
2. Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
3. Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
4. Develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4 and 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3 and 4)
3 Engineering Design (Course Outcomes 2, 4 and 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3 and 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2 and 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3 and 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4 and 6)
9 Independent Learning Ability (Course Outcomes 2 and 6)
10 Engineering Professionalism (Course Outcomes 4 and 7)
11 Engineering Management (Course Outcomes 4 and 6)

ECN Exit Level Outcomes Assessed:

3 **PRACTICAL KNOWLEDGE OF ENGINEERING DESIGN AND SYNTHESIS**
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

5 **ENGINEERIG METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**
Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

9 **INDEPENDENT LEARNING ABILITY**
Demonstrate competence to engage in independent learning through well-developed learning skills.

10 **ENGINEERING PROFESSIONALISM**
Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following:
Two Seminar Presentations of design (**20%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**60%**)]

To pass this module a student should obtain a minimum final mark of 50% and also meets the ECN exit level outcome 1, 3, 6 assessed as follows:

<u>ECN exit level outcome 3</u> – PRACTICAL KNOWLEDGE OF ENGINEERING DESIGN AND SYNTHESIS.

The student's competency of Engineering problem solving ability shall be accessed:
By the supervisor completing an assessment form indicating whether the student has demonstrated evidence in "practical knowledge of Engineering design and synthesis" in a manner that is considered: ***not satisfactory, satisfactory or excellent,*** based on the mark awarded by the examiners to the student on the section dealing with "practical knowledge of Engineering design and synthesis". The student is expected to obtain a minimum of 50% of the maximum mark allocated to the section dealing with this outcome in the submitted final design report before he or she is declared to have met the requirement of this competency satisfactorily.

<u>ECN Exit Level Outcome 5</u> - ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN Exit Level Outcome 9</u> – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. This will be assessed through tests, individual assignments, presentations and report writing, set in a way that allows evidence of the student's ability to engage in independent learning through well-developed learning skills showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology as well as need to access, comprehend and apply knowledge acquired outside formal instruction to be evaluated.

What constitutes satisfactory performance?

The lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a sub-minimum average continuous assessment mark of 50% before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

<u>ECN Exit Level Outcome 10</u> – ENGINEERING PROFESSIONALISM

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitutes satisfactory performance?

After consideration of the 3 term papers, 3 tests and 3 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Professionalism**" in a manner that is considered: "not satisfactory", "satisfactory" or "Excellent". The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Module Title:	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate Engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1 Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
2 Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3 Discuss the role of engineers in the management and organization of Engineering enterprises
4 Discuss in details the main technical activities undertaken during the attachment.

11. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS) - EXTENDED

YEAR 1 OF (32BHTX) BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING HONOURS – EXTENDED 132 CREDIT

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Metallurgical Engineering	13500TI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Metallurgical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Mathematics support I	I3401MS	4	0	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Physics for Engineers Support I	I3421PS	4	0	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Chemistry for Engineers Support	I3441CS	4	0	None
Total credits 1st Semester BSc Metallurgical Engineering				**44**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Engineering Mathematics support II	I3402MS	4	0	None
2	Physics for Engineers II	I3582NP	5	12	I3581NP
2	Physics for Engineers Support II	I3422PS	4	0	None
Total credits 2nd Semester BSc Metallurgical Engineering				**24**	

YEAR 2 OF (32BHTX) BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING HONOURS – EXTENDED 136 CREDITs

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Metallurgical Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Drawing	I3530ID	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Engineering Economics	I3661IE	6	8	None
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
Total credits 1st Semester BSc Metallurgical Engineering				**52**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Fundamentals of Electrical Engineering	I3522EE	5	8	I3511IM
2	Statistics for Engineers	I3582IS	5	12	I3511IM
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM,** I3611IM
Total credits 2nd Semester BSc Metallurgical Engineering				**60**	

11.1 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS)

11.2 DEGREE NAME: BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS) (32BHTI AND 19BMLE)

11.3 AIM

The curriculum for the degree of Bachelor of Science in Metallurgical Engineering (Honours) aims at producing Graduate Engineers with knowledge, skills and abilities in Extractive Metallurgy, Physical Metallurgy and Materials Engineering.

11.4 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Metallurgical Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters and two core semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study is common to all Engineering disciplines. In Years 2 to 4, students take discipline-specific modules

and a few common modules. There are no taught modules in Semester VIII is fully dedicated to Research and Design Projects and thus has no taught modules.
A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Session. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some assignments and Lab reports, where applicable.

YEAR 1 OF (32BHTI) BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS) – 164 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and (CO-REQUISITE)
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Metallurgical Engineering	I3500TI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Semester Core				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** and (CO-REQUISITE)
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Drawing	I3530ID	5	16	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Chemistry for Engineers	I3511NC	5	16	None
Total credits Semester 1				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** and (CO-REQUISITE)
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Physics for Engineers II	I3582NP	5	12	(I3521NP)
2	Fundamentals of Electrical Engineering	I3522EE	5	8	(I3511IM)
2	Materials Science	I3592IS	5	12	None
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	(I3511IM)
Total credits Semester 2				**68**	

YEAR 2 OF (32BHTI) BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS) – 148 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and (CO-REQUISITE)
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Semester Core				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** and (CO-REQUISITE)
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
1	Engineering Economics	I3661IE	6	8	None
1	Computer Programming I	I3691CP	6	12	(I3551CC)
1	Metallurgical Thermodynamics	I3611TT	6	16	(I3511NC)
1	Industrial Metallurgy	I3691TI	6	12	None
Total credits Semester 1				**64**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** and (CO-REQUISITE)
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM** (I3611IM)
2	Mineral Processing Technology I	I3682TP	6	12	(I3621TI)
2	Hydrometallurgy	I3682TH	6	12	(I3621TI)
2	Physical Metallurgy I	I3692TP	6	12	(I3572IS)
2	Measurements and Instrumentation	I3622CI	6	8	(I3502EE)
Total credits Semester 2				**60**	

YEAR 3 OF (32BHTI) BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS) – 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Materials Engineering	I3771TM	7	16	**I3572IS**
1	Transport Phenomena and Rate Processes	I3711TT	7	16	(I3611TT)
1	Mechanical Behaviour of Materials	I3781TB	7	12	**I3602TP**
1	Electrometallurgy	I3791TE	7	12	**I3611TT**
1	Energy Sources and Technologies	I3771TS	7	16	(I3621TI)
Total credits 1st Semester BSc Metallurgical Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Technical Writing	I3762VW	7	8	U3683AL
2	Physical Metallurgy II	I3712TP	7	16	(I3602TP)
2	Metallurgical Process Analysis, Simulation and Design	I3732TA	7	16	(I3672TH)
2	Pyrometallurgy	I3752TP	7	16	**I3711TT**
2	Corrosion and Wear	I3782TC	7	12	(I3611TT)
Total credits 2nd Semester BSc Metallurgical Engineering				**68**	

YEAR 4 OF (19BMLE) BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS)– 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3742
1	Project Management	TEGM3881	8	12	**TEGT3761**
1	Mineral Processing Technology II	TMLX3831	8	16	TMLP3692
1	Metallurgical Production Processes	TMLM3851	8	16	TMLN3791
1	Ferrous Extractive Metallurgy	TMLF3891	8	12	TMLX3641
1	Process Modelling and Control	TMLL3891	8	12	TMLN3732
Total credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	
2	Research Project	TMLR3892	8	30	All 3rd Year Modules
2	Metallurgical Design Project	TMLD3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total credits Semester VIII				**64**	

Total credits for BSc in Metallurgical Engineering (Honours) **592**

11.5 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS)

11.5.1 YEAR 1 OF (32BHTI) BSc IN METALLURGICAL ENGINEERING

11.5.1.1 YEAR 1 SEMESTER CORE

Module Title:	SKILLS PORTFOLIO
Module Code	U3403FS
NQF Level	5
Notional Hours	N/A
Contact hours	N/A
Additional learning requirements	None
NQF Credits	0
Prerequisite	None
Semester Offered	Core

Module Purpose
The purpose of this module is to determine, develop and maintain individual students' academic motivation, needs and strengths for effective learning ensuring academic success.

Overarching Learning Outcome
Apply skills relevant to their academic journey at the University in terms of successful attainment of professional and personal goals.

Specific Learning Outcomes
On completing the module students should be able to:

- Apply motivational theories to demonstrate positive attitudes in their professional and academic life.
- Identify and manage needs and factors that may negatively impact their academic work including the design of action plans to motivate and guide them.
- Identify and make use of the different learning styles to promote learning in a more efficient manner using various study methods and skills.
- Manage time effectively
- Design and make use of various test taking and examination preparation strategies.
- Identify and use tools to improve and maintain Mental Health and wellbeing.
- Apply the dynamics of interpersonal communication.
- Manage their finances.
- Identify violence as a social problem in the Namibian context to manage and prevent the occurrence thereof in their life.
- Recognize the importance of skills training and upgrading in career planning and development to improve their classroom experiences.
- Create a career plan, set clear, realistic and attainable career goals and engage in activities to enhance their CVs.

Module Content

UNIT 1: Academic Planning and Goal Setting
Individual Needs and Values; Steps in Reaching a Personal Vision; Proactive Approach Towards Learning; Self-Regulated Learning; Personal and Academic Goal Setting; Receptiveness to Learning; Exploring Self-Development and Self- Awareness.
UNIT 2: Attitude and Motivation
Understanding Motivation; Personal Attitudes, Behaviours and Interests; Self-Reflective Process; Approaches to Dealing with Negative Factors; Class Attendance and Participation; Procrastination; Self-Reliance; Discipline; Accountability; Healthy Habits.
UNIT 3: Learning styles
Understanding Personal Approaches to Learning; Dynamics of the Learning Process; Learning Styles and Strategies.
UNIT 4: Study Methods and Skills
Study Habits and Strategies; Learning Styles and Techniques; Effective Study Methods and Skills; Note Taking; Memory and Reading Skills; Critical Thinking.
UNIT 5: Time Management
Effective Time Management; Planning; Decision-making; Prioritization; Setting Boundaries; Time for Self – care; Procrastination.
UNIT 6: Assessment Preparation
In class exercise; Test and Examination preparation; Organizing academic workload; Setting daily study goals; Staying physically active; Study groups.
UNIT 7: Mental well-being
Understanding mental health; Signs and indicators of poor mental health; commonly experienced mental health challenges; psychosocial stressors; Seeking professional help; Coping strategies.
UNIT 8: Interpersonal Communication
Effective Communication Skills; Verbal and Non-Verbal Communication; Listening Skills; Problem Solving; Assertiveness; Negotiation Skills; Practicing Empathy in Communication; Self-Confidence; Receptiveness to Feedback; Building Trust; Teamwork; Leadership; Public Speaking Skills.
UNIT 9: Financial matters and management

Financial Literacy; Budgeting; Available Finance Options and Assistance; Managing Financial Resources.

UNIT 10: Student Violence

Types of Violence; Individual Roles in Violence; Myths, Forms; Consequences of Violence; Prevention Measures; Seeking for Help.

UNIT 11: Career Planning and Development

Defining and Selecting Career Goals; Career Exploring Different Strategies; Soft Skills Training.

Learning and Teaching Strategies/Activities

The course will be facilitated through, but not limited to, the following learning activities:

- **Online teaching**: Self-study on theoretical foundations and concepts of the Skills Portfolio module
- **Discussion forums (peer review):** reflecting on own contexts, experiences and sharing perspectives
- **Inquiry:** carrying out research to explore and understand scenarios and problems relating to self
- **Portfolio writing:** writing reflective learning journals related to the Skills Portfolio module

Student Assessment Strategies

- 100% continuous assessment
- Reflective journal on each unit (portfolio)

Learning and Teaching Enhancement Strategies

- Student – lecturer evaluations, conducted twice a year
- Moderation of assessment tools

Learning Resources

[1] Feldman, R. S. and Chick, S. (2005) *Power learning: Strategies for Success in Higher Education and Life*. Toronto: Mc Graw-Hill Ryerson Limited.
[2] Light, R. J. (2001). *Making the most out of College: Students Speak their Minds*. Cambridge, Mass: Harvard University Press.
[3] Tracy, E. (2002). *The student's guide to exam success.* Philadelphia: Open University Press
[4] Toft, D. (2005*). Mastering Student Guide to Academic Success*. Boston: Houghton Mifflin Company.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	ACADEMIC LITERACY I
Module Code	U3583AL
NQF Level	5
Notional Hours	80
NQF Credits	8
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial/ week
Semester Offered	Core

Module Purpose

The purpose of Academic Literacy IA is to introduce students to sources of information required to contribute to academic discourse to enhance their receptive and productive language skills through exposure to different academic genres.

Overarching Learning Outcome

Apply information searching techniques with academic skills necessary to fulfil tasks and cope with academic reading, listening, speaking and writing demands at university level.

Specific Learning Outcomes

On completing the Module students should be able to:

1. Identify potential sources of information
1. Articulate the need of information and behavioural approaches.
2. Identify required skillset to solve academic tasks or work.
3. Develop concept mapping and task-based learning themes.
4. Integrate summaries, paraphrases and quotations to avoid plagiarism.
5. Apply features of academic writing and other academic conventions in own writing.
6. Apply patterns of text organization to academic writing.
7. Summarise main ideas or relevant parts of texts.
8. Apply appropriate reading comprehension strategies.
9. Illustrate the correct use of vocabulary and grammar in speaking and writing.

Module Content

The module will cover study skills, reading (including extensive reading), listening, speaking, writing, referencing, and language usage and text organisation.

Contribution to Exit Level Outcome:

- 6 Professional and Technical Communication (Course Outcomes 3, 4, 6, 7 and 9)
- 9 Independent Learning Ability (Course Outcomes 5, 8 and 10)

Learning and teaching strategies
The course will be facilitated through, but not limited to, the following learning activities:

- Blended instruction: Face-to-face and online
- Tests and assignments
- Tutorials/ Academic support
- Presentations

Student assessment strategies
Assessment will be based on Continuous Assessment.

Learning and teaching enhancement strategies

- Students shall be exposed to library user-based services and training.
- Students that might experience performance difficulty in the module will be identified and the necessary support and guidance as an intervention strategy will be provided by the teaching staff.
- Statistics of the module pass and failure rate will be continuously monitored.
- Student-lecturer evaluation
- Lecturer-peer evaluation
- Curriculum review
- Moderation of assessment tools

Prescribed Learning Resources

1. Academic Literacy IA Study Guide.
2. Literature texts (still to be decided)

Recommended Learning Resources

1. Bailey, S. (2015). Academic writing: A handbook for international students (4th ed.). NY: Routledge.
2. Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). Academic literacy (2nd ed.). Cape Town: Juta and Company (Pty) Ltd.
3. Gaetz, S and Phadke, S. (2018). Academic English: Reading and writing across the disciplines (3rd ed.). London.UK: Pearson.
4. Machet, M. (2013). Mastering Information Skills for the 21st Century. 2nd Edition, UNISA Press, South Africa.
5. Piscitelli, S. (2009). Study skills: do I really need this stuff? (2nd ed). N.J. Pearson Prentice Hall,
6. UNAM Library Subject Specific Guides https://unam-na.libguides.com/?b=gandd=a

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**INTRODUCTION TO METALLURGICAL ENGINEERING**
Module Code	I3500TI
NQF Level	5
Notional Hours	60
Contact hours	2 Lectures
Additional learning requirements	Group work and Project.
NQF Credits	6
(Co-requisites) / Prerequisite	(None)
Semester Offered	Core

Module Purpose
The purpose of this module is to introduce the students to the metallurgical engineering profession at an early stage within the study programme.

Overarching Learning Outcome
Describe the field metallurgical engineering, its branches, career opportunities and key theories underpinning the field of metallurgical engineering.

Specific Learning Outcomes
On completing the module students should be able to:

1. Describe the various branches of metallurgical engineering, possible careers, and job prospects.
2. Explain the roles played by metallurgical engineers in the design and management of systems for metal extraction and processing.
3. Identify real word metallurgical engineering products.
4. Understand the basic theories in concentration of ore; extraction, processing and refining of metal, and metallurgical thermodynamics
5. Describe the importance of technology in the field of metallurgical engineering.

Module Content
Introduction to Metallurgical Engineering: What is metallurgical engineering, historical perspective, the modern era and metallurgical engineering. Critical skills for a metallurgical engineering of today: software engineering and probability and statistics**. Branches of Metallurgical Engineering. Typical jobs of a metallurgical engineer**: Product design and manufacture, metal processing, refining and extraction, research and development, systems design and management, troubleshooting, safety and maintenance. **Important Skills**: Estimation in engineering, Problem solving and communication skills, Presenting engineering calculations. **Basic principles of metallurgical engineering**: Concentration of ores, extraction and refining of metals, and fundamentals of metallurgical thermodynamics. New fields of metallurgical engineering and the impacts of technology.

Contribution to Exit Level Outcome:
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 5 Eng Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities
- Two lecture periods per week for 6 weeks

Student Assessment Strategies
4. Students will be assessed through continuous assessments activities
5. The final mark will be made of 100% Continuous Assessment
6. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments, Project and Presentation: 60%
   ii) Tests (at least 2 tests):40%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultation with students.
2. Offer extra reading materials where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
   [2] Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002

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Next Revision: September 2028

Module Title:	DIGITAL LITERACY
Module Code	U3583DD
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial/ week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) Prerequisite	None
Semester Offered	Core
Module coordinator and Contact Details	Mr Erkkie Haipinge, ehaipinge@unam.na, Tel: +264 612064906

Module Purpose

The purpose of this module is to equip students with competencies to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment and entrepreneurship.

Overarching Learning Outcome

Apply digital literacy skills for effective learning across the curriculum and for successful attainment of their personal and professional goals.

Specific Learning Outcomes

On completing the module students should be able to:

1. Use ICT-based devices, basic productivity software, a web browser and search engines, email and other digital communication services
2. Carry out digital productivity activities such as download and upload materials to the internet or cloud or institutional shared spaces, and use digital tools to fit learning
3. Discover, organise and manage relevant digital information using relevant search engines, indexes or tag clouds, and evaluate digital information trustworthiness and relevance
4. Access and make sense of messages in a range of digital media, and appreciate how digital messages are designed
5. Design new digital materials, make decisions and solve problems and adopt new digital tools for learning
6. Participate in a range of digital communication media, work in digital teams and projects, and participate in a range of online networks
7. Identify, choose and participate in digital learning opportunities
8. Manage and maintain digital profiles suitable for different networks that consider digital reputation

Module Content

Digital Proficiency: ICT-based devices (laptops, tablets, smartphones, desktop computers, digital instruments and equipment); a mouse, keyboard, touch screen, voice control and other forms of input; screens, audio headsets and other forms of output; digital capture devices; University digital learning systems and a range of personal digital services such as social media, cloud storage services, sharing sites **Digital Productivity:** Basic productivity software (text editing, presentation, spreadsheets, image editing); email and other digital communication services; Internet or cloud or institutional shared spaces for organising, managing and backing up digital files; software/apps and services suitable for learning-related tasks; digital tools fit learning and managing learning time. **Information Literacy:** search engines, indexes or tag clouds; wikis, blog posts, scholarly journals, e-books and the open web; file spaces and folders, bookmarks, reference management software and tagging; copyright, and digital citizenship issues. **Data and Media Literacy:** Digital data using spreadsheets and other media; data security and privacy; digital media messages – text, graphics, video, animation, audio and multimedia. **Digital Creation and Innovation:** digital materials (video, audio, stories, presentations, infographics); new digital tools for learning in digital settings. **Digital Communication, Collaboration and Participation**: digital communication; differences between media, norms of communicating in different spaces; false or damaging digital communications; collaborative tools and online environments; online networks. **Digital Learning and Development:** digital learning opportunities; digital learning resources; digital tools/materials for organising, planning and reflecting on learning (mind-mapping, note-taking, e-portfolio/ learning journal/ blog). **Digital Identity and Wellbeing:** online profiles for different networks (personal, professional, academic); digital reputation; managing personal data and privacy; digital CV or portfolio of work; digital technologies for personal development; online etiquette; wellbeing and safety online; internet addiction; cyberbullying and other damaging online behaviour.

Contribution to Exit Level Outcome:

- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4 and 6)

Learning and Teaching Strategies/Activities

- **Lectures**: presentation on concepts and other theoretical foundations of Digital Literacy
- **Discussion forums:** reflecting on own contexts and sharing perspectives
- **Collaborative learning:** group learning and activities carried as part of projects
- **Inquiry:** carrying out of research to explore and understand scenarios and problems
- **Projects:** carry out projects on digital literacy
- **Presentations and demonstrations:** presentation of outcomes of projects (products, processes, impact)
- **Portfolio writing:** writing reflective learning journals related to digital literacy

Student Assessment Strategies

- **Collaborative assessment tasks**
  - Digital productivity: *cloud based collaborative digital media creation using cloud platforms*
  - Project: Digital communication, collaboration and participation/ Digital Wellbeing
- **Individual assessment tasks**
  - Assignment: information literacy assignment
  - Test x 2
- **Practical**
  - Digital proficiency
  - Data and Media literacy
- **No written examination**

Learning and Teaching Enhancement Strategies

- **Student feedback:** feedback from students using focused feedback instruments
- **Peer feedback:** student feedback on peer evaluation of each other's collaboration, participation and contribution
- **Self-evaluation:** quizzes and students' reflective journal/ portfolio on their own learning
- **Learning analytics:** use of learning management tools on student participation and online learning activities, and analyse assessment performance

Prescribed Learning Resources
Textbook

[1] Schwartz, M., Bali, M., Blocksidge, K., Brown, C., Caines, A., Dermody, K., and Peters, J. (2020). *Digital Citizenship Toolkit*. Retrieved from https://pressbooks.library.ryerson.ca/digcit/ (online version); https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/3/Digital-Citizenship-Toolkit-1598899274.pdf (PDF version) https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/2/Digital-Citizenship-Toolkit-1598899308.epub (eBook)

Digital Resources

[1] JISC. (2019). Jisc digital capabilities framework: The six elements defined. Retrieved from https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf
[2] JISC. (2017). Digital capabilities framework. Retrieved from https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF
[3] Joint Research Centre (European Commission). (2019). *The Digital Competence Framework 2.0*. Retrieved from https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework
[4] Carretero, S., Vuorikari, R., and Punie, Y. (2017). The digital competence framework for citizens. *Publications Office of the European Union*. Retrieved from http://svwo.be/sites/default/files/DigComp%202.1.pdf

Course resources (videos and SCORM package)

[1] Microsoft. (2021). *Microsoft digital literacy courses and resources (videos and SCORM packages)*. Available at https://www.microsoft.com/en-us/digital-literacy
[2] Microsoft. (2021). *Microsoft digital literacy: Teaching guides*. Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWBupo
[3] OER Commons. (2021). *Digital Literacy (learning objects)*. Retrieved https://www.oercommons.org/curated-collections/347

Issue Date:	September 2023
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Module Title:	**NATIONAL AND GLOBAL CITIZENSHIP**
Module Code	U3420CN
NQF Level	4
Notional Hours	20
Contact hours	Up to 1 contact lecture period per week for 6 Weeks
Mode of Delivery	Blended: Face to face and Online
Additional learning requirements	Each student will be required to work on a personal project which will include a site visit
NQF Credits	2
Semester Offered	Core
Module coordinator and Contact Details	Dr Romanus Shivoro, rshivoro@unam.na ; Ext. 3378

Module Purpose
The purpose of this module is to equip UNAM students with knowledge to understand the interconnectedness of local and global issues. Students will become acquainted with perspectives on, global citizenship, globalization and civic engagement. The module will enable students to reflect on issues affecting their communities and the world by providing a platform where students can meet and learn from one another and from external sources of information. It will guide students to determine how they can contribute to bring positive changes in their communities in relation to the Sustainable Development Goals. Furthermore, it will provide knowledge and understanding of cultural diversity and intercultural communication to enable students to become thoughtful stewards in a globalized world.

Overarching Learning Outcome
Demonstrate understanding of global citizenship and initiate action towards the betterment of local, national and global conditions, as informed and responsible citizens with a civic duty in their personal and professional lives.

Specific Learning Outcomes
On completing the module students should be able to:
1. Explain the importance of the National Constitution;
2. Express understanding of National and Global Citizenship;
3. Participate in community engagement activities as part of community upliftment;
4. Express understanding of globalization;
5. Apply intercultural communication skills; and
6. Interpret SDGs to initiate personal action towards contribution of their achievement.

Module Content

UNIT 1: Constitution and its Importance
What is a constitution; Functions of a constitution; What it contains; Constitution and democracy

UNIT 2: Global Citizenship
The meaning of global citizenship; Importance of global awareness; World issues of concern to global citizens.

UNIT 3: Civic Engagement
What do we mean by civic engagement; Dimensions of civic engagement; Indicators of civic engagement; Promoting civic engagement.

UNIT 4: Globalization
Understanding globalization; Cultural construction of neoliberal globalization; Major players; Major domains; Major Issues; Futures of Globalization

UNIT 5: Intercultural Communication
Dealing with difference; Levels of culture; Stereotypes and generalizations; Intercultural communication Processes

UNIT 6: Sustainable Development Goals and individual action
Introduction to SDGs; Contributing to achievement of SDGs through action.

Learning and Teaching Strategies/Activities
Student learning in this module will be supported by provision of subject knowledge; engaging students in class discussions, and individual awareness and action portfolios. It will expose students to real life situation through formal lectures, guest lectures, experiential activities such as engaging local civic organizations; Students will engage in active and participatory learning in which they generate ideas and share their knowledge on a topic. Material will include journal articles, videos, PowerPoint presentations, as well as handouts for students' reflection.

Student Assessment Strategies
Continuous assessment of 100% - Assessment will be done by completing online pop-up quizzes; and developing their online portfolios of personal action as response to tasks assigned in class.

Learning and Teaching Enhancement Strategies:
Strategies will include: Continuous Module Review, and Lecturer/student evaluations.
Student progress will be monitored by observing class participation during live lectures, and submission of feedback material. Including online portfolios.

Recommended Learning Resources

- Adler, R.P and Goggin, J. (2005). What do we mean by Civic Engagement? A Journal of Transformative Education. 3 (3) 236 – 253
- Bennett, M.J (1998). Intercultural Communication: A current Perspective. In Milton J. Bennett (Ed.) Basic Concepts of Intercultural Communication: Selected Readings. Yarmouth: ME Intercultural Press
- Green, M. (2012). Global Citizenship: What are we talking about and why does it matter. NAFSA Association of International Education
- International IDEA (2014). What is a Constitution? Principles and Concepts. Constitution-building Primers.
- Perception Change Project. 170 Daily Actions to Transform our World. United Nations Office in Geneva
- Ritzer, G. (Ed.) (2007). The Blackwell Companion to Globalization. Blackwell Publishing: USA
- United Nations. Transforming our World: the 2030 Agenda for Sustainable Development. UNDP

Issue Date:	September 2023
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11.5.1.2 YEAR 1 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS I
Module Code	I3511IM
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome
Apply broad basic mathematical skills to solve engineering problems.

Specific Learning Outcomes
On completing the module students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices.
2. Calculate eigenvalues and eigenvectors and relate them to engineering solutions
3. Perform functions transformations (Cartesian/polar), sketch and name some polar graphs.
4. Use various mathematical functions and apply them to engineering.
5. Apply trigonometry in solving mathematical and engineering problems.
6. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
7. Manipulate sequence and series of numbers
8. Define, interpret complex numbers and to perform elementary complex numbers algebra.

Module Content
Lines and Planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersection of lines and planes. **Matrix Algebra:** Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. Eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Sequences and series of numbers:** Introduction to sequences and series. Absolutely convergent series, tests for convergence. Power series. Radius of convergence and interval of convergence. **Functions:** Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions. **Polar coordinates/Graphs:** Definition of polar coordinates, relate Cartesian and polar coordinates, sketch, and name different types of polar graphs. **Differentiation:** Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, the chain rule, differentiation of algebraic functions. **Integration:** Anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, basic integration techniques, integration of trigonometric functions. **Introduction to complex numbers:** Definition of complex numbers and the complex plane, complex number representation on argand diagrams, complex number algebra. Demoivre's theorem.

Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,3,5,6,7)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5,6,7)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
   [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
   [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
   [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

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Module Title:	**ENGINEERING MATHEMATICS SUPPORT I**
Module Code	I3401MS
NQF level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Prerequisite	None
Semester Offered:	1

Module Purpose
The purpose of this module is to consolidate school curriculum computation skills whilst creating a wider context in which students can contextualise mathematical knowledge.

Overarching Learning Outcome
Consolidate numeracy and problem solution skills in a wide range of mathematics fundamentals.
Specific Learning Outcomes
Upon completion of this module, a student should be able to
1. Explain and conduct deductive arguments involving sets and relations.
2. Identify and correlate intervals.
3. Solve systems of linear equations methodically.
4. Handle matrix calculus.
5. Identify types of real valued functions.
6. Compute the domain and range of a real valued function.
7. Assess properties of real-valued functions.

Module Content:
Number system: Natural, integers, rational, irrational, real and complex numbers. Sets: cardinal number, operations on a set (equality, intersection, union, relative compliment, de Morgan's law, power set, application of cardinality (inclusion-exclusion formula), Cartesian products, ordered pairs and relations), intervals and inequalities. Solving equation and inequalities: linear and quadratic equation, inequalities involving two variables. System of linear equations: Matrices and matrices operations (addition, subtraction, multiplication, associativity, distrutivity, determinant, invertible, Gaussian row and column operations, rank, solution to system of linear equations). Real-valued function: definition, relation, domain and range, injective, bijective, inverse, odd and even, piecewise defined, graphs. Coordinates system: polar, polar graph, cylindrical, cylindrical graph.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

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Module Title:	**ENGINEERING DRAWING**
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	(None)
NQF Credits	16
(Co-requisites) / Prerequisite	None
Semester Offered	1

Module Purpose

The purpose of this module is to teach students how to visualize, create and interpret engineering drawing principles in two and three dimensions by applying of geometrical and engineering methods, and introduce students to computer aided drawing, with a focus on AutoCAD software,

Overarching Learning Outcome

Create and interpret basic drawings and communicate technically, as well as to use AutoCAD software to create two - and three - dimensional technical engineering drawings

Specific Learning Outcomes

On completing the module students should be able to:

- Use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts and assembly drawings of various engineering components
- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD
- Create three - dimensional objects

Module Content

Foundations of Representing Technical Bodies: drawing equipment, drawing formats, types of lines, construction geometry, simplified representations, scales, lettering, tittle block, elaboration of part drawings, Principle of orthographic projection, sectioning, dimensioning. **Isometric and oblique representations**. **Sections, Interpenetrations and developments**: cones, cylinders, pyramids. **Free hand**

techniques: Introduction to free-hand sketching of machine parts. **Assembly Drawing**. **Introduction to AutoCAD:** Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; **Working in two - dimensional space:** Creating objects; Drawing with precision; Controlling the drawing display; Editing methods; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; Managing content with AutoCAD design Centre; Creating a layout to plot; Plotting (model and paper spaces). **Working in three - dimensional space**: Creating three-dimensional objects using solid primitives, and from 2D profiles; editing of 3D objects. **Practical Exercises.**

Contribution to Exit Level Outcome:

- 3 Engineering Design (Course Outcomes 4 and 5)
- 5 Engineering methods, skills, Tools and including technology (course outcome 1 and 3)
- 6 Professional and Technical Communication (Course Outcomes 2, 3, 4 and 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical exercises
- Face to face consultations

Student Assessment Strategies

- Students will be assessed through Continuous Assessments activities
- The final mark will be made of 100% Continuous Assessment.
- The Continuous Assessment will be made up of the following assessment activities:
    8 Assignments (At least 4 assignments): 40%
    9 Mini project: 20%
    10 Tests (At least 3 tests): 40%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the module
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books
    [1] Parker M. A., and Pickup F., 1992. Engineering drawing with worked examples, vol. 1, 3rd Edition
    [2] David A. Madsen, Engineering drawing and design, 5th Edition
    [3] Colin H. Simmons, Neil Phelps, Manual of Engineering Drawing 3rd Edition
    [4] Terry Wohlers., Applying AutoCAD, 2010
2. Design Software: AutoCAD
3. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS I**
Module Code	I3581NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of physics as they relate to engineering.
Overarching Learning Outcome
Prepare students to apply fundamental physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:
1. Do unit conversions
2. Solve problems regarding one- and two-dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gases.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.
10. Demonstrate abilities to communicate ideas and facts using equations, graphs and principles.

Module Content
Measurements and Units: Instruments and Uncertainty, Standards and Units. **Kinematics:** One Dimensional Motion, Vectors, Projectile Motion, Circular Motion, Relative Motion. **Dynamics:** Newton's Laws of Motion, Newton's Law of Gravitation, Free-Body Diagrams, Friction. Work, Energy and Power. **Momentum:** Collisions, Impulse, Centre of Mass. **Rotational Dynamics:** Rolling Motion, Torque, Rotational Inertia and Energy, Angular Momentum. **Planetary Motion:** Kepler's Laws of Planetary Motion. Elasticity: Hooke's Law. **Fluids:** Pressure, Buoyancy, Fluid Dynamics: Flow Rates, Equation of Continuity and Bernoulli's Equation. **Heat and Thermodynamics:** Thermal Expansion, Ideal Gas, Specific Heat, Heat Capacity, Latent Heat, Calorimetry, Heat Transfer: Laws of Thermodynamics, Entropy, Enthalpy, Gibbs Free Energy.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Practical exercises
4. Face to face consultations

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   - Assignments (tutorials, quizzes): 40%
   - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books

[1] Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson - ISBN-13: 978-1-292-31473-0, e-Textbook ISBN-13: 978-1-292-31481-5
[2] Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
[3] Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	PHYSICS FOR ENGINEERS SUPPORT I
Module Code	I3421PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	Entry requirements
Semester Offered	1

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course.

Overarching Learning Outcome
Solve problems, in single-particle mechanics, Newtonian gravity, fluids, and heat.

Specific Learning outcomes
On completing the module students should be able to:
1. Employ units, do unit conversions, express uncertainties use significant figures, use vectors in 2 dimensions.
2. Solve basic problems regarding one and two-dimensional kinematics.
3. Apply Newton's laws of motion and energy principles to a variety of basic problems in dynamics.
4. Discuss and solve simple problems in rotational kinematics and dynamics.
5. Discuss the principles of waves and sound.
6. Solve basic problems in statics, Newtonian gravitation, fluids, heat, and gasses.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Measurement and estimation; Kinematics in 1D; Kinematics in 2D; Vectors; Dynamics/Newton's Laws; Circular motion; Gravitation; Work and Energy; Linear Momentum; Rotational Motion; Static Equilibrium; Fluids; Oscillation and Waves; Sound; Temperature and Kinetic Theory; Heat; The Laws of Thermodynamics.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks.
2. One tutorial session per week for 14 weeks.
3. Weekly consultation sessions.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	COMPUTING FUNDAMENTALS
Module Code	I3581CC
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Prerequisite	(None)
Semester Offered	1

Module Purpose:
This course aims to introduce students to general computer literacy, the basic principles of problem-solving using computers, advanced Microsoft Excel skills for data analysis, computer programme planning, basic data communication and computer networks and the basic skills on modern web development tools. It also introduces students to the basic tools and environments needed for machine learning programme ing.

Overarching Learning Outcome
Demonstrate understanding of the windows and Unix based computer working environment; skills on how to develop a computer-based problem-solving plan; basic knowledge of modern web development tools; application of advanced spreadsheets and related tools to engineering related problems.

Specific Learning Outcomes

On completing the module students should be able to:

- Relate with computers under the Windows and Linux operating environment for information processing and presentation.
- Recall basic features of common computer hardware architectures.
- List the basic communication architecture of a computer.
- Show algorithms for solving basic problems using flowcharts and pseudocode.
- Recall advanced spreadsheet tools and functions.
- Match basic web applications using modern web development tools and frameworks to simple real-life problems.
- Define basic concepts of networking.

Module Content:
Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored programme concept. Von-Neumann architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. **Computer Arithmetic**: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). **Introduction to CISC and RISC architecture**: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types). **Introduction of computer operating environment** Windows and UNIX based systems. **Computer Architecture:** The design and structure of a computer. **Information Processing and Data Analysis tools**: Equations and Formulas Creation, Diagram Creation and Editing, PowerPoint Presentations Creation Advanced Spreadsheets Skills. **Computer Programme Planning**. Flowcharts and Pseudocode **Introduction to Computer Networking**: Basics of Communication Systems and Computer Networks. **Web Developments:** Front-End Web Development, Web Page Styling and Website logic development with scripting languages such as JavaScript. **Overview of memory system**, memory chip organization and error correction, cache memory, memory storage devices. **Introduction to Data Science Tools:** Installation and basic use of Anaconda and Jupyter Notebooks.

Contribution to Exit Level Outcome:
1 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 5, 6)
2 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 5, 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
    i) Assignments (tutorials, quizzes, reports, practical assignments): 20%
    ii) Tests (At least 2 tests): 50%
    iii) Semester Mini project (prototype oral presentation and development report): 30%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student's evaluation
3. Regular review of the course content
4. Face-to-face consultations
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

[1] F. Wempen. Computing Fundamentals: Introduction to Computers First Edition Wiley, 2015
[2] W. Palm. MATLAB for Engineering Applications 4th Edition, Mc-GrawHill, 2019
[3] J. L. Hennessy. Computer Architecture, Fifth Edition, Morgan Kaufmann, 2012.

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Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS**
Module Code	I3511NC
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1T or 1PS /Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	**None**
Semester Offered	1

Module Purpose

The purpose of this module is to enable students to understand the basic concepts of chemistry as they relate to engineering.

Overarching Learning Outcome

Equip students with firm grasp of fundamental chemistry principles which are applicable in engineering industries.

Specific Learning Outcomes

On completing the module students should be able to:
- Describe the fundamental techniques used for chemical analysis in industrial processes.
- Explain the basic concept of batteries and fuel cells and their applications.
- Describe the processing of high polymers and their applications.
- Explain different methods for water analysis and purification.
- Describe different ways of dealing with pollution and managing solid waste.

Module Content
Spectroscopic techniques and Applications: Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet and Visible and Raman spectroscopy. **Electrochemistry:** Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system. **Battery Technology;** Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life. Basic requirements for commercial batteries. Construction, working and applications of: Zn-Ag_2O, Ni-Cd, Zn-air and Lithium-ion battery. Fuel Cells- Differences between battery and a fuel cell, Classification of fuel

cells - based on type of fuel, electrolyte and temperature. Construction, working and applications of solid oxide fuel cell. **Water Analysis;** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method), Alkalinity - determination, Determination of dissolved oxygen, Determination of chemical oxygen demand, Boiler scales-formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis. **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methods). Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapor deposition. **Polymers;** Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (BunaS, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. **Environmental Chemistry**; Air Pollution, Water Pollution, Radioactive Pollution, Solid Waste Management, Green Chemistry.

Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning and teaching activities:

- Four lecture periods per week for 14 weeks (face to face or blended)
- One practical session per week for 14 weeks relating the theory to practice
- One tutorial period per week for 14 weeks
- Face-to-face and/or online consultation

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes, lab and field reports): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
   [1] Mukhopadhyay, Raghupati, and Sriparna Datta. Engineering chemistry. New Age International Pvt. Limited, Publishers, 2008.
   [2] Garwal, Shikha. Engineering chemistry: Fundamentals and applications. Cambridge University Press, 2019

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS SUPPORT**
Module Code	I3441CS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	None
Semester Offered	1

Module Purpose
To introduce the student to general chemistry, lay the foundation of basic facts necessary for further studies in Chemistry and acquaint students with safety rules and regulations in a chemical laboratory.

Overarching Learning Outcome
Apply and interpret knowledge on basic facts in Chemistry for further studies.

Specific Learning outcomes
On completing the module students should be able to:
1. Use scientific notation and significant figures when doing all calculations
2. Define and explain the mass number (A), atomic number (Z) and isotope and also state the symbol for an isotope given its mass number and atomic number
3. Define the terms molar mass, relative molecular mass (Mr) and relative atomic mass (Ar) and carry out calculations involving these
4. Define and explain the terms empirical formula and molecular formula and also to determine the empirical and molecular formulae of a given compound
5. Use balanced chemical equations to obtain information about the amounts of reactants and products
6. Prepare dilute solutions from concentrated stock solutions and solve solution stoichiometry problems
7. Describe and explain data from experiments to distinguish between strong and weak acids and bases
8. Differentiate between oxidation and reduction reactions and balance redox reactions by the half-reaction method (acid and basic medium)
9. Apply quantum theory to predict the electron configuration of elements and explain the variation of properties across the periodic table
10. Explain the structure and bonding in molecules and ions and draw their Lewis structures
11. Apply Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) to describe molecular geometry as well as physical and chemical properties of some compounds

Module Content
Introduction: Matter, Measurement and Molecules; Stoichiometry: Calculations with Chemical Formulae and Equations; Aqueous Reactions and Solutions Stoichiometry; Electronic Structure of Atoms; Periodic Properties of the Elements and Relationships Among Elements; Basic Concepts of Chemical Bonding; Intermolecular Forces; Basic Molecular Geometry and Bonding Theories; Gases.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks.
2. One tutorial session per week for 14 weeks.
3. Weekly consultation sessions.

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Brown T. L., LeMay H.E, Bursten B.E., Murphy C., Woodward P., Langford S., Sagatys D. and George A. (2014). Chemistry: The Central Science. (3rd Ed.). Pearson Australia. Australia.
2. Chang, R. (2010). Chemistry. (10th Ed.) McGraw Hill Higher Education. New York. ISBN:978-0-07

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Next Revision: September 2028

11.5.1.3 YEAR 1 SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS II
Module Code	I3582IM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Mathematics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome
Apply broad mathematical skills to solve engineering problems.

Specific Learning Outcomes
On completing the module students should be able to:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique.
- Apply calculus to trigonometric functions to solve mathematical and engineering problems.
- Solve engineering problems using 1st order and 2nd order differential equations
- Define and analyse Fourier series of real-valued functions.
- Use Laplace and Fourier transforms in solving differential equations.

Module Content
Further Matrix Algebra: eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Further Integration:** Integration by parts technique. Integration by substitution. Integration of trigonometric functions. Integration of powers of trigonometric functions. Integration of trigonometric functions by substitution. Reduction formula. **Applications of integration:** areas, volumes of revolution, etc. **Differential Equations:** Meaning and solutions of differential equations. First order ordinary differential equations (separable, homogenous, Exact and linear types) and their applications. Solutions of second order linear ordinary differential equations with constant coefficients; initial or boundary value problems using the methods of undetermined coefficients and variation of parameters. **Integral Transforms:** Laplace Transforms (LT), Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st and 2nd ordinary differential equations. **Fourier Series and Transforms:** Fourier series. Fourier sine and cosine series. Introduction to Fourier transforms and its applications in solving boundary value problems.

Contribution to Exit Level Outcome:

- 1 Problem solving (Course Outcomes 1,2,4,5)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
- 5 Eng Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

1. Three lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (tutorials, quizzes): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
   [2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
   [3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
   [4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

Issue Date: September 2023
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Module Title:	**ENGINEERING MATHEMATICS SUPPORT II**
Module Code	I3402MS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(**Co-requisites) /Prerequisite**	None
Semester Offered:	2

Module Purpose
The purpose of this module is to equip students with an intuitive grasp of the behaviour of a real-valued function as well as the analytical techniques to test their intuition.

Overarching Learning Outcome
Gather sufficient information about the behaviour of a real valued function to sketch its graph with accuracy.

Specific Learning Outcomes
Upon completion of this module, a student should be able to
1. Employ the exact definitions of limit and continuity.
2. Use various differentiation techniques and assess differentiability.
3. Apply those tools to study local extrema, end behaviour, and asymptotic behaviour of function graphs.
4. Use integration to compute the area below a curve.
5. Handle complex numbers.

Module Content:
Solving equation: Exponentials and logarithms. Graph of a function: polynomial, rational, exponential, logarithmic, trigonometric functions. Limit of a function: definition, continuity, differentiation, sum, product, quotient, chain rules, examples from the engineering sciences. Integration: Definition and basic properties of the Riemann integral, the Fundamental Theorem of calculus, integrals of simple function, substitution rule and integration by parts; applications to the computation of areas and (rotational) volumes.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. B. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

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Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS II**
Module Code	I3582NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3521NP Physics for Engineers II)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of physics as they relate to engineering.
Overarching Learning Outcome
Prepare students to apply fundamental physics principles in engineering industries.

Specific Learning Outcomes
On completing the module students should be able to:
- Solve problems on electric and magnetic fields
- Sketch electric circuits and solve problems on capacitors and resistors
- Discuss and solve problems in geometrical optics, radioactivity and sound.
- Prepare and perform experiments related to the contents of the module.
- Demonstrate entry-level general laboratory skills including elementary data analysis.
- Demonstrate abilities to communicate ideas and facts using equations, graphs and principles

Module Content
Electrostatics: Electric charge, Current and Current Density, Electric field, Electric Potential, Resistance and Resistivity, Capacitance and Dielectrics**. Magnetostatics:** Biot-Savart law, Magnetic field, Magnetic materials, Motion of a Charged Particle in a Magnetic Field, Magnetic force, Ampere's Law; Torque and Magnetic Moments; **Electromagnetic Induction:** Electromagnetic Force (EMF), Faraday's Law of Electromagnetic Induction, Lenz's Law, Fleming's Right-Hand Rule, Inductance and Mutual Inductance. **Vibrations and Waves:** Simple harmonic motion, Oscillations, Wave Motion, Types of Waves, Standing Waves and Resonance. **Sound:** intensity of Sound, interference of Sound Waves, Doppler's Effect. **Light and Optics:** Reflection, Refraction and Diffraction, Snell's Law, Lenses, Lens Equation. **Radioactivity:** types of radioactivity.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes): 40%
   ii. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books

[1] Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson, ISBN-13: 978-1-292-31473-0, eTextbook ISBN-13: 978-1-292-31481-5

[2] Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.

[3] Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	PHYSICS FOR ENGINEERS SUPPORT II
Module Code	I3422PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Pre-requisites	Entry requirements
Semester Offered	2

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course. This course focuses on Electricity and Magnetism, Optics and Radioactivity

Overarching Learning Outcome
Solve problems in electricity and magnetism, optics, and radioactivity.

Specific Learning outcomes
On completing the module students should be able to:
1. Discuss and solve basic problems on electric field and magnetic field.
2. Find currents and resistances in simple electric circuits.
3. Analyse DC and AC circuits involving capacitors, resistors, and inductors.
4. Resolve problems involving electromagnetic induction.
5. Solve simple problems in geometrical optics and nuclear physics.
6. Explain concepts pertaining to radioactivity and the effects of radiation.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Electric charge and electric field; Electric Potential; Electric Currents; DC Circuits; Magnetism; Electromagnetic induction; Electromagnetic waves; Geometric optics; Light; Radioactivity; Effects and Use of Radiation.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
4. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
5. Tests (at least 2 tests): 60%

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Module Code	I3522EE
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The module aims to equip students majoring in all branches of engineering, with the understanding of basic principles of electric circuits and networks. A further purpose is to introduce common technical vocabulary.

Overarching Learning Outcome
Demonstrate ability to analyse basic electric circuits using laws and theorems.

Specific Learning Outcomes
On completing the module students should be able to:

- Distinguish between real and ideal voltage and current sources
- State and apply the laws and rules of electric circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving of DC circuits
- Apply the principles of circuit analysis to series and parallel R, L, C circuits
- Perform a range of measurements in an electrical laboratory environment and be able to interpret the measured data to derive supplementary information
- Describe the principles of operation of a transformer and the basic AC generator and DC motors
- Conduct basic circuit analysis using appropriate CAD software (MATLAB, MultiSIM, etc.)

Module Content:
Introduction: SI Units and notations, Basic Electric Circuit (resistance, voltage and current). **Resistance:** Resistor coding, Series and parallel resistor networks, Y and delta resistor networks. **Sources:** Voltage and Current sources, dependent and independent sources, source transformations. **DC Circuit Analysis Techniques:** Ohm's law, Power and Energy, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, **DC Circuit Theorems:** Superposition Theorem, Thevenin's and Norton's Theorem, Maximum power transfer theorem. **Capacitors:** Capacitance, capacitors in series and parallel, Capacitor charging and time constant. **Inductors:** Inductance and mutual inductance. **AC Voltage:** AC voltage generation, AC Resistive circuit, AC capacitive circuit, AC inductive circuit. Electrical Machine Basics: Basics principles of transformers, AC generators, DC motors, three phase voltage generation and mathematical expression. Basics of circuit simulation using CAD software.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3. Engineering Design (Course Outcomes 4)
4. Investigations, Experiments and Data Analysis (Course Outcomes 4)
5. Engineering Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment.
- The Continuous Assessment will be made up of the following assessment activities:
  - At least 2 quizzes, and at least 2 lab reports: 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of assessment activities.
- Peer-review of course outlines and teaching.
- Students' lecturer evaluation
- Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources

1. Book

[1] Boylestad Robert. (2015), Introductory Circuit Analysis, 13th Edition, Pearson Education, USA
[2] Alexander K. Charles and Sadiku N.O. Mathews. (2013), Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, USA
[3] Hughes Edward. (2016), Electrical and Electronic Technology, 12th Edition, Pearson Education, USA

2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	MATERIALS SCIENCE
Module Code	I3592IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1Tutorials and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Prerequisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to enable the students to understand the relationship between the structure and properties of engineering materials and practical skills in metallography and materials testing.

Overarching Learning Outcome
Identify the right engineering material for a particular application based on materials' structure and properties.
Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the molecular and crystal structure of materials.
2. Perform calculations on elemental diffusion in metals.
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams.
4. Outline the various phase transformations in the Fe-Fe3C phase system and associated microstructures.
5. Explain how materials properties depend on structure and crystal defects.
6. Demonstrate practical basic skills in metallography and report writing.
7. Explain the relationship between Materials Science and the Fourth Industrial Revolution.

Module Content
Materials for Engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. **Structure of materials**: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Solidification, Crystalline Imperfections and Diffusion in solids**; Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; **Equilibrium phase diagrams:** unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **Properties of Materials:** review of Mechanical, Electrical, Optical and Thermal properties of materials. **Mechanical properties of materials**: Stress and Strain, Tensile testing, True stress and True strain, Deformation modes; Yield and Fracture, Hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. **Effects of environment on materials:** corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. **Real-world applications of Engineering materials:** Functional Materials and Devices; The Relationship between Materials Science and the Fourth Industrial Revolution. Basic criteria for the selection of materials for engineering applications.

Contribution to Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1,2, 3, 4)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
- 4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Practical sessions.
4. Face-to-face consultations wherever necessary.

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (tutorials, quizzes, lab and field reports): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement:

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books
   [1] Callister, W. D., Rethwisch, D. G., Materials Science and Engineering, An Introduction, 10^{th} Edition, Wiley and Sons, 2018
   [2] Donald R. Askeland, Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2^{nd} Edition, 2008
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MECHANICS I**
Module Code	I3582NM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3581NP Physics for Engineers I)
Prerequisite	**None**
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with the knowledge to analyse system of forces on engineering components and to develop an approach to solving engineering problems.
Overarching Learning Outcome
Analyse the effect of static forces and equilibrium on systems and structural bodie**s.**
Specific Learning Outcomes
On completing the module students should be able to:

- Express force operations and force systems using vectors
- Apply the laws of static equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Determine the centroid and moment of inertia for plane and composite cross-sectional areas.

Module Content
System of forces and moment forces: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Equilibrium in three dimensions**. **Forces in submerged surfaces**. **Distributed Forces: Centroid and Centre of Gravity, Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams. **Analysis of forces in a truss:** Method of joints, method of sections.
Contribution to Exit Level Outcome:

- 1 Problem Solving (Course Outcomes 1-6)
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 3-7)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following learning activities:

- Three lecture periods per week for 14 weeks
- One tutorial or practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (At least 4 assignments): 20%
    - Tests (At least 2 tests): 60%
    - Practical and Report: 20%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. Books
   [1] Robert W. Soutas-Little and Daniel J. Inmand, Engineering Mechanics Statics, copyright 1999 by Prentice-Hall, Inc.
   [2] R. C. Hibbeler, Engineering Mechanics Statics, Ninth Edition, copyright 2001, 1998, 1995, 1992, 1989, 1986, 1983, 1978, and 1974 by R. C. Hibbeler.
   [3] Irving H. Shames, Engineering Mechanics Statics, Second, Volume 1, copyright 1958, 1959, 1966.
   [4] J. L. Meriam and L. G Kraige, Engineering Mechanics Statics, Fifth Edition, copyright 2003, John Wiley and sons.
2. Lecture Notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	STATISTICS FOR ENGINEERS
Module Code	I3582IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the concept of probability theory, statistical modelling and inference in Engineering.

Overarching Learning Outcome
Conduct statistical data analysis, modelling and apply decision-making skills in engineering.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe the theory of probability.
2. Analyse data using probability distribution and densities.
3. Use principles of sampling distribution and densities.
4. Apply linear regression and correlation to a set of data.
5. Apply analysis of variance to solve engineering problems.
6. Analyse data using the statistical software

Module Content
Probability: Theory (Random experiments, Random events), conditional probability and Bayes theorem, mathematical expectation and decision making. **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, uniform, Gamma, Beta and Weibull. **Sampling Distributions:** Mean, variance, inferences concerning mean and proportions: point and interval estimations, parametric tests, nonparametric tests. **Regression and Correlation:** Simple and multiple linear regressions, correlation. The logistic regression model. **Analysis of Variance:** Completely randomized and randomized block designs, multiple comparisons**. Introduction to Data Analysis with R:** Lab 1: Measures of Central Tendency: Mean, median and other quantiles, mode. Saving and Using Graphics etc. Lab 2: Measuring Variability: variance and standard deviation, median, Interquartile Range, coefficient of variation, covariance and correlation of variables. Lab 3: Measuring Symmetry: skewness, kurtosis, etc. Frequency distributions: histograms, bar charts, pie charts, box plots, line graphs, scatterplots.

Contribution to Exit Level Outcome:
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2,3,4,5)
- 4 Investigation, Experiments and Data Analysis (Course Outcomes 4,5,6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Three lecture periods per week for 14 weeks
- One tutorial or practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i) Assignments (Lab assessment): 40%
   ii) Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
   [1] William Navidi., Statistics for Engineers and Scientists, 2nd Edition, 2008.
   [2] Jay L. Devote., Probability and Statistics for Engineering and the Sciences, 7th Edition, 2008
   [3] Samprit Chatterjee and Ali S. Hadi., Regression Analysis by Example, 4th Edition, 2006
2. Lecture notes
3. Software: R-Studio

Issue Date: September 2023
Next Revision: September 2028

12. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) - EXTENDED

YEAR 1 OF (32BHMX) BACHELOR OF SCIENCE IN MINING ENGINEERING HONOURS – EXTENDED 132 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Mining Engineering	I3500MI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Mining Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Mathematics support I	I3401MS	4	0	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Physics for Engineers Support I	I3421PS	4	0	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Chemistry for Engineers Support	I3441CS	4	0	None
Total credits 1st Semester BSc Mining Engineering				**44**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Engineering Mathematics support II	I3402MS	4	0	(None)/**None**
2	Physics for Engineers II	I3582NP	5	12	I3581NP
2	Physics for Engineers Support II	I3422PS	4	0	None
Total credits 2nd Semester BSc Mining Engineering			**28**		

YEAR 2 OF (32BHMX) BACHELOR OF SCIENCE IN MINING ENGINEERING HONOURS – EXTENDED 136 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	**U3583AL**
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Mining Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Drawing	I3530ID	5	16	None
1	Engineering Economics	I3661IE	6	8	None
1	Computing Fundamentals	I3581CC	5	12	None
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) **I3511IM**
Total credits 1st Semester BSc Mining Engineering				**52**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
2	Materials Science	I3592IS	5	12	None
2	Engineering Mathematics IV	I3612IM	6	16	**I3512IM,** I3611IM
2	Fundamentals of Electrical Engineering	I3522EE	5	8	I3511IM
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	I3511IM
Total credits 2nd Semester BSc Mining Engineering				**60**	

12.1 CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.2 DEGREE NAME: BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) (19BMNE AND 32BHMI)

12.3 AIM

The curriculum for the degree of Bachelor of Science in Mining Engineering (Honours) aims at producing Graduate Engineers with knowledge, skills and abilities in mining Engineering design, surface and underground working of mineral deposits, drilling and blasting technology, as well as effective safety, health and environmental management techniques in mining operations.

12.4 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Mining Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study (semester **I** and **II**) is common to all Engineering disciplines. In Years 2 to 4 (semesters **III** to **VIII**), students take discipline-specific modules and a few common modules. There are no taught modules in Semester VIII since this semester is fully dedicated to Research and Design Projects.

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Session. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some assignments and Lab reports, where applicable.

YEAR 1 OF (32BHMI) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)– 164 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Skills Portfolio	U3403FS	5	0	None
Core	Academic Literacy I	U3583AL	5	8	None
Core	Introduction to Mining Engineering	I3500MI	5	6	None
Core	Digital Literacy	U3583DD	5	8	None
Core	National and Global Citizenship	U3420CN	5	2	None
Total credits Core Semester BSc Mining Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics I	I3511IM	5	16	None
1	Engineering Drawing	I3530ID	5	16	None
1	Physics for Engineers I	I3581NP	5	12	None
1	Chemistry for Engineers	I3511NC	5	16	None
1	Computing Fundamentals	I3581CC	5	12	None
Total credits 1st Semester BSc Mining Engineering				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Engineering Mathematics II	I3582IM	5	12	(I3511IM)
2	Physics for Engineers II	I3582NP	5	12	(I3521NP)
2	Materials Science	I3592IS	5	12	None
2	Fundamentals of Electrical Engineering	I3522EE	5	8	(I3511IM)
2	Engineering Mechanics I	I3582NM	5	12	(I3581NP)
2	Statistics for Engineers	I3582IS	5	12	(I3511IM)
Total credits 2nd Semester BSc Mining Engineering				**68**	

YEAR 2 OF (32BHMI) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) – 164 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
Core	Academic Literacy II	U3683AL	6	8	U3583AL
Core	Engineering Entrepreneurship	I3620IE	6	8	None
Core	Workshop Practice	I3640IW	6	8	None
Total credits Core Semester BSc Mining Engineering				**24**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
1	Engineering Mathematics III	I3611IM	6	16	(I3512IM) I3511IM
1	Engineering Economics	I3661IE	6	8	None
1	Computer Programming I	I3691CP	6	12	(I3551CC)
1	Engineering and Structural Geology	I3611MG	6	16	None
1	Introduction to Mining Methods	I3691MM	6	12	None
1	Strength of Materials	I3681VM	6	12	(I3532NM)
Total credits 1st Semester BSc Mining Engineering				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**

2	Engineering Mathematics IV	I3612IM	6	16	(I3611IM) **I3512IM**
2	Surveying for Engineers	I3692VS	6	8	**I3511IM**
2	Fluid Mechanics I	I3692NF	6	12	**I3582NM**
2	Drilling and Blasting Technology	I3672MB	6	16	(I3691MM)
2	Soil and Rock Mechanics	I3682MS	6	12	**I3582NM**
Total credits 2nd Semester BSc MINING **Engineering**				**64**	

YEAR 3 OF (32BHVI) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) – 124 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE and CO-REQUISITE
1	Mine Survey and Geospatial Technologies	I3781MG	7	12	(I3692VS)
1	Mine Equipment and Automation	I3791ME	7	12	(I3691MM)
1	Hydrogeology	I3721MH	7	8	(I3611MG)
1	Surface Mining	I3711MS	7	16	(I3682MS) **I3691MM)**
1	Rock Engineering	I3781MR	7	12	(I3682MS)
Total credits 1st Semester BSc Mining Engineering				**60**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE and CO-REQUISITE**
2	Technical Writing	I3762VW	7	8	U3683AL
2	Mineral Processing	I3742MP	7	8	(U3683AL)
2	Oil and Gas Engineering	I3762MO	7	8	(I3691MM)
2	Mineral Resource Estimation	I3742MM	7	8	(I3682MS) (I3691MM)
2	Underground Mining	I3732MU	7	16	(I3691MM) **I3582IS**
2	Mine Ventilation and Climate Control	I3752MV	7	16	(I3682MS) **I3691MM**
Total credits 2nd Semester BSc Mining Engineering				**64**	

YEAR 4 OF (19BMNE) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) – 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	**PRE** and CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3742
1	Project Management	TEGM3881	8	12	TEGT3761
1	Mine Safety, Health and Environment	TMNU3831	8	16	**TMNU3741** TMNS3762
1	Underground Mining	TMNU3811	8	16	TMNE3711
1	Rock Engineering	TMNS3861	8	8	TMNU3791
1	Mine Management Principles and Financial Valuation	TMNS3831	8	16	TMNU3742
Total credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	
2	Research Project	TMNR3892	8	30	All 3rd Year Modules
2	Mining Design Project	TMND3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total credits Semester VIII				**64**	

TOTAL CREDITS FOR BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) 592

12.5 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.5.1 YEAR 1 OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.5.1.1 YEAR 1 CORE SEMESTER

Module Title:	**SKILLS PORTFOLIO**
Module Code	U3403FS
NQF Level	5
Notional Hours	N/A
Contact hours	N/A
Additional learning requirements	None
NQF Credits	0
Prerequisite	None
Semester Offered	Core
Module Coordinator and Contact Details	-

Module Purpose

The purpose of this module is to determine, develop and maintain individual students' academic motivation, needs and strengths for effective learning ensuring academic success.

Overarching Learning Outcome

Apply skills relevant to their academic journey at the University in terms of successful attainment of professional and personal goals.

Specific Learning Outcomes

On completing the module students should be able to:

- Apply motivational theories to demonstrate positive attitudes in their professional and academic life.
- Identify and manage needs and factors that may negatively impact their academic work including the design of action plans to motivate and guide them.
- Identify and make use of the different learning styles to promote learning in a more efficient manner using various study methods and skills.
- Manage time effectively
- Design and make use of various test taking and examination preparation strategies.
- Identify and use tools to improve and maintain Mental Health and wellbeing.
- Apply the dynamics of interpersonal communication.
- Manage their finances.
- Identify violence as a social problem in the Namibian context to manage and prevent the occurrence thereof in their life.
- Recognize the importance of skills training and upgrading in career planning and development to improve their classroom experiences.
- Create a career plan, set clear, realistic and attainable career goals and engage in activities to enhance their CVs.

Module Content

UNIT 1: Academic Planning and Goal Setting

Individual Needs and Values; Steps in Reaching a Personal Vision; Proactive Approach Towards Learning; Self-Regulated Learning; Personal and Academic Goal Setting; Receptiveness to Learning; Exploring Self-Development and Self- Awareness.

UNIT 2: Attitude and Motivation

Understanding Motivation; Personal Attitudes, Behaviours and Interests; Self-Reflective Process; Approaches to Dealing with Negative Factors; Class Attendance and Participation; Procrastination; Self-Reliance; Discipline; Accountability; Healthy Habits.

UNIT 3: Learning styles

Understanding Personal Approaches to Learning; Dynamics of the Learning Process; Learning Styles and Strategies.

UNIT 4: Study Methods and Skills

Study Habits and Strategies; Learning Styles and Techniques; Effective Study Methods and Skills; Note Taking; Memory and Reading Skills; Critical Thinking.

UNIT 5: Time Management

Effective Time Management; Planning; Decision-making; Prioritization; Setting Boundaries; Time for Self – care; Procrastination.

UNIT 6: Assessment Preparation

In class exercise; Test and Examination preparation; Organizing academic workload; Setting daily study goals; Staying physically active; Study groups.

UNIT 7: Mental well-being

Understanding mental health; Signs and indicators of poor mental health; commonly experienced mental health challenges; psychosocial stressors; Seeking professional help; Coping strategies.

UNIT 8: Interpersonal Communication

Effective Communication Skills; Verbal and Non-Verbal Communication; Listening Skills; Problem Solving; Assertiveness; Negotiation Skills; Practicing Empathy in Communication; Self-Confidence; Receptiveness to Feedback; Building Trust; Teamwork; Leadership; Public Speaking Skills.

UNIT 9: Financial matters and management

Financial Literacy; Budgeting; Available Finance Options and Assistance; Managing Financial Resources.
UNIT 10: Student Violence
Types of Violence; Individual Roles in Violence; Myths, Forms; Consequences of Violence; Prevention Measures; Seeking for Help.
UNIT 11: Career Planning and Development
Defining and Selecting Career Goals; Career Exploring Different Strategies; Soft Skills Training.

Learning and Teaching Strategies/Activities

The course will be facilitated through, but not limited to, the following learning activities:

- Online teaching: Self-study on theoretical foundations and concepts of the Skills Portfolio module
- Discussion forums (peer review): reflecting on own contexts, experiences and sharing perspectives
- Inquiry: carrying out research to explore and understand scenarios and problems relating to self
- Portfolio writing: writing reflective learning journals related to the Skills Portfolio module

Student Assessment Strategies

- 100% continuous assessment
- Reflective journal on each unit (portfolio)

Learning and Teaching Enhancement Strategies

- Student – lecturer evaluations, conducted twice a year
- Moderation of assessment tools

Learning Resources

[1] Feldman, R. S. and Chick, S. (2005) Power learning: Strategies for Success in Higher Education and Life. Toronto: Mc Graw-Hill Ryerson Limited.
[2] Light, R. J. (2001). Making the most out of College: Students Speak their Minds. Cambridge, Mass: Harvard University Press.
[3] Tracy, E. (2002). The student's guide to exam success. Philadelphia: Open University Press
[4] Toft, D. (2005). Mastering Student Guide to Academic Success. Boston: Houghton Mifflin Company.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ACADEMIC LITERACY I**
Module Code	U3583AL
NQF Level	5
Notional Hours	80
NQF Credits	8
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial per week
Semester Offered	0

Module Purpose

The purpose of Academic Literacy is to introduce students to sources of information required to contribute to academic discourse to enhance their receptive and productive language skills through exposure to different academic genres.

Overarching Learning Outcome

Students should be able to apply information searching techniques with academic skills necessary to fulfil tasks and cope with academic reading, listening, speaking and writing demands at university level.

Specific Learning Outcomes

On completing the Module students should be able to:

1. Identify potential sources of information
2. Articulate the need of information and behavioural approaches.
3. Identify required skillset to solve academic tasks or work.
4. Develop concept mapping and task-based learning themes.
5. Integrate summaries, paraphrases and quotations to avoid plagiarism.
6. Apply features of academic writing and other academic conventions in own writing.
7. Apply patterns of text organization to academic writing.
8. Summarise main ideas or relevant parts of texts.
9. Apply appropriate reading comprehension strategies.
10. Illustrate the correct use of vocabulary and grammar in speaking and writing.

Module Content

The module will cover study skills, reading (including extensive reading), listening, speaking, writing, referencing, and language usage and text organisation.

Learning and teaching strategies

The course will be facilitated through, but not limited to, the following learning activities:

1. Blended instruction: Face-to-face and online
2. Tests and assignments
3. Tutorials/ Academic support
4. Presentations

Student assessment strategies
Assessment will be based on Continuous Assessment.
Learning and teaching enhancement strategies
1. Students shall be exposed to library user-based services and training.
2. Students that might experience performance difficulty in the module will be identified and the necessary support and guidance as an intervention strategy will be provided by the teaching staff.
3. Statistics of the module pass and failure rate will be continuously monitored.
4. Student-lecturer evaluation
5. Lecturer-peer evaluation
6. Curriculum review
7. Moderation of assessment tools

Prescribed Learning Resources
- Academic Literacy IA Study Guide.
- Literature texts (still to be decided)

Recommended Learning Resources
- Bailey, S. (2015). Academic writing: A handbook for international students (4th ed.). NY: Routledge.
- Beekman, L., Dube, C., Potgieter, H. and Underhill, J. (2016). Academic literacy (2nd ed.). Cape Town: Juta and Company (Pty) Ltd.
- Gaetz, S and Phadke, S. (2018). Academic English: Reading and writing across the disciplines (3rd ed.). London.UK: Pearson.
- Machet, M. (2013). Mastering Information Skills for the 21st Century. 2nd Edition, UNISA Press, South Africa.
- Piscitelli, S. (2009). Study skills: do I really need this stuff? (2nd ed). N.J. Pearson Prentice Hall,
- UNAM Library Subject Specific Guides https://unam-na.libguides.com/?b=gandd=a

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**INTRODUCTION TO MINING ENGINEERING**
Module Code	I3500MI
NQF Level	5
Notional Hours	60
NQF Credits	6
Prerequisite	None
Contact Hours	2 Lectures + 1 Tutorial per week
Additional learning requirements	Group work and Project
Semester Offered	0

Module Purpose
The purpose of this module is to enable the student to understand the relevance of mineral industry and career paths for mining engineers.

Overarching Learning Outcome
Students should be able to describe the mining engineering field and its braches

Specific Learning Outcomes
On completing the Module students should be able to:
Describe the field of mining engineering
Explain the historical context and importance of mining engineering
Identify braches of mining engineering
Distinguish the different types of mining methods
Describe the impact of technology advancement on mining engineering

Module Content
Introduction: **Mining in Namibia**: Overview of mining and history in Namibia, Minerals and rocks in Namibia and SADC. **Significance of mineral industry to the world**. **Mining methods**: Surface mining methods and underground mining, rock breaking, rock loading and transport. **Mine ventilation, safety, health and environment**. **Explanation of underground and surface mining terms, basic mine layouts. Roles of Mining Engineers. Engineering services for mining and mine technical skills.**

Contribution to Exit Level Outcome:
Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
Engineering Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities
Two lecture periods per week for 6 weeks

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments, Project and Presentation: 60%
    b. Tests (at least 2 tests):40%

Criteria for qualifying for the Examination:
No Examination
Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources
1. Books
   [1]. Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
   [2]. Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

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Next Revision: September 2028

Module Title:	**DIGITAL LITERACY**
Module Code	U3583DD
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial/ week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) Prerequisite	None
Semester Offered	Core
Module coordinator and Contact Details	Mr Erkkie Haipinge, ehaipinge@unam.na, Tel: +264 612064906

Module Purpose

The purpose of this module is to equip students with competencies to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment and entrepreneurship.

Overarching Learning Outcome
Apply digital literacy skills for effective learning across the curriculum and for successful attainment of their personal and professional goals.

Specific Learning Outcomes
On completing the module students should be able to:

9. Use ICT-based devices, basic productivity software, a web browser and search engines, email and other digital communication services
10. Carry out digital productivity activities such as download and upload materials to the internet or cloud or institutional shared spaces, and use digital tools to fit learning
11. Discover, organise and manage relevant digital information using relevant search engines, indexes or tag clouds, and evaluate digital information trustworthiness and relevance
12. Access and make sense of messages in a range of digital media, and appreciate how digital messages are designed
13. Design new digital materials, make decisions and solve problems and adopt new digital tools for learning
14. Participate in a range of digital communication media, work in digital teams and projects, and participate in a range of online networks
15. Identify, choose and participate in digital learning opportunities
16. Manage and maintain digital profiles suitable for different networks that consider digital reputation

Module Content
Digital Proficiency: ICT-based devices (laptops, tablets, smartphones, desktop computers, digital instruments and equipment); a mouse, keyboard, touch screen, voice control and other forms of input; screens, audio headsets and other forms of output; digital capture devices; University digital learning systems and a range of personal digital services such as social media, cloud storage services, sharing sites **Digital Productivity:** Basic productivity software (text editing, presentation, spreadsheets, image editing); email and other digital communication services; Internet or cloud or institutional shared spaces for organising, managing and backing up digital files; software/apps and services suitable for learning-related tasks; digital tools fit learning and managing learning time. **Information Literacy:** search engines,

indexes or tag clouds; wikis, blog posts, scholarly journals, e-books and the open web; file spaces and folders, bookmarks, reference management software and tagging; copyright, and digital citizenship issues. **Data and Media Literacy:** Digital data using spreadsheets and other media; data security and privacy; digital media messages – text, graphics, video, animation, audio and multimedia. **Digital Creation and Innovation:** digital materials (video, audio, stories, presentations, infographics); new digital tools for learning in digital settings. **Digital Communication, Collaboration and Participation**: digital communication; differences between media, norms of communicating in different spaces; false or damaging digital communications; collaborative tools and online environments; online networks. **Digital Learning and Development:** digital learning opportunities; digital learning resources; digital tools/materials for organising, planning and reflecting on learning (mind-mapping, note-taking, e-portfolio/ learning journal/ blog). **Digital Identity and Wellbeing:** online profiles for different networks (personal, professional, academic); digital reputation; managing personal data and privacy; digital CV or portfolio of work; digital technologies for personal development; online etiquette; wellbeing and safety online; internet addiction; cyberbullying and other damaging online behaviour.

Contribution to Exit Level Outcome:

- 5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4 and 6)

Learning and Teaching Strategies/Activities

- **Lectures**: presentation on concepts and other theoretical foundations of Digital Literacy
- **Discussion forums:** reflecting on own contexts and sharing perspectives
- **Collaborative learning:** group learning and activities carried as part of projects
- **Inquiry:** carrying out of research to explore and understand scenarios and problems
- **Projects:** carry out projects on digital literacy
- **Presentations and demonstrations:** presentation of outcomes of projects (products, processes, impact)
- **Portfolio writing:** writing reflective learning journals related to digital literacy

Student Assessment Strategies

- **Collaborative assessment tasks**
  - Digital productivity: *cloud based collaborative digital media creation using cloud platforms*
  - Project: Digital communication, collaboration and participation/ Digital Wellbeing
- **Individual assessment tasks**
  - Assignment: information literacy assignment
  - Test x 2
- **Practical**
  - Digital proficiency
  - Data and Media literacy
- **No written examination**

Learning and Teaching Enhancement Strategies

- **Student feedback:** feedback from students using focused feedback instruments
- **Peer feedback:** student feedback on peer evaluation of each other's collaboration, participation and contribution
- **Self-evaluation:** quizzes and students' reflective journal/ portfolio on their own learning
- **Learning analytics:** use of learning management tools on student participation and online learning activities, and analyse assessment performance

Prescribed Learning Resources

Textbook

[1] Schwartz, M., Bali, M., Blocksidge, K., Brown, C., Caines, A., Dermody, K., and Peters, J. (2020). *Digital Citizenship Toolkit*. Retrieved from https://pressbooks.library.ryerson.ca/digcit/ (online version); https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/3/Digital-Citizenship-Toolkit-1598899274.pdf (PDF version) https://openlibrary-repo.ecampusontario.ca/jspui/bitstream/123456789/856/2/Digital-Citizenship-Toolkit-1598899308.epub (eBook)

Digital Resources

[1] JISC. (2019). Jisc digital capabilities framework: The six elements defined.
Retrieved from https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf
[2] JISC. (2017). Digital capabilities framework.
Retrieved from https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF
[3] Joint Research Centre (European Commission). (2019). *The Digital Competence Framework 2.0*.
Retrieved from https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework
[4] Carretero, S., Vuorikari, R., and Punie, Y. (2017). The digital competence framework for citizens.
Publications Office of the European Union. Retrieved from http://svwo.be/sites/default/files/DigComp%202.1.pdf

Course resources (videos and SCORM package)

[1] Microsoft. (2021). *Microsoft digital literacy courses and resources (videos and SCORM packages)*.
Available at https://www.microsoft.com/en-us/digital-literacy
[2] Microsoft. (2021). *Microsoft digital literacy: Teaching guides*.
Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWBupo
[3] OER Commons. (2021). *Digital Literacy (learning objects)*. Retrieved https://www.oercommons.org/curated-collections/347

Issue Date: September 2023
Next Revision: September 2028

Module Title:	NATIONAL AND GLOBAL CITIZENSHIP
Module Code	U3420CN
NQF Level	5
Notional Hours	20
Contact hours	Up to 1 contact lecture period per week for 6 Weeks
Mode of Delivery	Blended: Face to face and Online
Additional learning requirements	Each student will be required to work on a personal project which will include a site visit
NQF Credits	2
(Co-requisites) Prerequisite	None (University Core Module)
Semester Offered	Core Semester
Module coordinator and Contact Details	*Dr Romanus Shivoro, rshivoro@unam.na ; Ext. 3378*

Module Purpose
The purpose of this Module is to equip UNAM students with knowledge to understand the interconnectedness of local and global issues. Students will become acquainted with perspectives on, global citizenship, globalization and civic engagement. The module will enable students to reflect on issues affecting their communities and the world by providing a platform where students can meet and learn from one another and from external sources of information. It will guide students to determine how they can contribute to bring positive changes in their communities in relation to the Sustainable Development Goals. Furthermore, it will provide knowledge and understanding of cultural diversity and intercultural communication to enable students to become thoughtful stewards in a globalized world.

Overarching Learning Outcome
Students demonstrate understanding of global citizenship and initiate action towards the betterment of local, national and global conditions, as informed and responsible citizens with a civic duty in their personal and professional lives.

Specific Learning Outcomes
On completing the module students should be able to:
1. Explain the importance of the National Constitution;
2. Express understanding of National and Global Citizenship;
3. Participate in community engagement activities as part of community upliftment;
4. Express understanding of globalization;
5. Apply intercultural communication skills; and
6. Interpret SDGs to initiate personal action towards contribution of their achievement.

Module Content
UNIT 1: Constitution and its Importance
What is a constitution; Functions of a constitution; What it contains; Constitution and democracy
UNIT 2: Global Citizenship
The meaning of global citizenship; Importance of global awareness; World issues of concern to global citizens.
UNIT 3: Civic Engagement
What do we mean by civic engagement; Dimensions of civic engagement; Indicators of civic engagement; Promoting civic engagement.
UNIT 4: Globalization
Understanding globalization; Cultural construction of neoliberal globalization; Major players; Major domains; Major Issues; Futures of Globalization
UNIT 5: Intercultural Communication
Dealing with difference; Levels of culture; Stereotypes and generalizations; Intercultural communication Processes
UNIT 6: Sustainable Development Goals and individual action
Introduction to SDGs; Contributing to achievement of SDGs through action

Learning and Teaching Strategies/Activities
Student learning in this module will be supported by provision of subject knowledge; engaging students in class discussions, and individual awareness and action portfolios. It will expose students to real life situation through formal lectures, guest lectures, experiential activities such as engaging local civic organizations; Students will engage in active and participatory learning in which they generate ideas and share their knowledge on a topic. Material will include journal articles, videos, PowerPoint presentations, as well as handouts for students' reflection.

Student Assessment Strategies
- Continuous assessment of 100% - Assessment will be done by completing online pop-up quizzes; and developing their online portfolios of personal action as response to tasks assigned in class.

Learning and Teaching Enhancement Strategies
- Strategies will include: Continuous Module Review, and Lecturer/student evaluations.
- Student progress will be monitored by observing class participation during live lectures, and submission of feedback material. Including online portfolios.

Recommended Learning Resources

- Adler, R.P and Goggin, J. (2005). What do we mean by Civic Engagement? *A Journal of Transformative Education*. 3 (3) 236 – 253
- Bennett, M.J (1998). *Intercultural Communication: A current Perspective*. In Milton J. Bennett (Ed.) Basic Concepts of Intercultural Communication: Selected Readings. Yarmouth: ME Intercultural Press
- Green, M. (2012). *Global Citizenship: What are we talking about and why does it matter.* NAFSA Association of International Education
- International IDEA (2014). *What is a Constitution? Principles and Concepts*. Constitution-building Primers.
- Perception Change Project. *170 Daily Actions to Transform our World*. United Nations Office in Geneva
- Ritzer, G. (Ed.) (2007). *The Blackwell Companion to Globalization*. Blackwell Publishing: USA
- United Nations. *Transforming our World: the 2030 Agenda for Sustainable Development*. UNDP

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Next Revision: September 2028

12.5.1.2 YEAR 1 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS I
Module Code	I3511IM
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(None)
Prerequisite	None
Semester Offered	1

Module Purpose

The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Apply broad basic mathematical skills to solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices.
2. Calculate eigenvalues and eigenvectors and relate them to engineering solutions
3. Perform functions transformations (Cartesian/polar), sketch and name some polar graphs.
4. Use various mathematical functions and apply them to engineering.
5. Apply trigonometry in solving mathematical and engineering problems.
6. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
7. Manipulate sequence and series of numbers
8. Define, interpret complex numbers and to perform elementary complex numbers algebra.

Module Content

Lines and Planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersection of lines and planes. **Matrix Algebra:** Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. Eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Sequences and series of numbers:** Introduction to sequences and series. Absolutely convergent series, tests for convergence. Power series. Radius of convergence and interval of convergence. **Functions:** Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions. **Polar coordinates/Graphs:** Definition of polar coordinates, relate Cartesian and polar coordinates, sketch and name different types of polar graphs. **Differentiation:** Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, the chain rule, differentiation of algebraic functions. **Integration:** Anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, basic integration techniques, integration of trigonometric functions. **Introduction to complex numbers:** Definition of complex numbers and the complex plane, complex number representation on argand diagrams, complex number algebra. Demoivre's theorem.

Contribution to Exit Level Outcome:

1. Problem solving (Course Outcomes 1, 2, 3, 5, 6, 7)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5)
3. Engineering Methods, Skills and Tools, including IT (Course Outcomes1, 2, 3, 4, 5, 6, 7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Four lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (tutorials, quizzes): 40%
    b. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.

2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT I**
Module Code	I3401MS
NQF level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Prerequisite	None
Semester Offered:	1

Module Purpose

The purpose of this module is to consolidate school curriculum computation skills whilst creating a wider context in which students can contextualise mathematical knowledge.

Overarching Learning Outcome

Consolidate numeracy and problem solution skills in a wide range of mathematics fundamentals.

Specific Learning Outcomes

Upon completion of this module, a student should be able to

1. Explain and conduct deductive arguments involving sets and relations.
2. Identify and correlate intervals.
3. Solve systems of linear equations methodically.
4. Handle matrix calculus.
5. Identify types of real valued functions.
6. Compute the domain and range of a real valued function.
7. Assess properties of real-valued functions.

Module Content:

Number system: Natural, integers, rational, irrational, real and complex numbers. Sets: cardinal number, operations on a set (equality, intersection, union, relative compliment, de Morgan's law, power set, application of cardinality (inclusion-exclusion formula), Cartesian products, ordered pairs and relations), intervals and inequalities. Solving equation and inequalities: linear and quadratic equation, inequalities involving two variables. System of linear equations: Matrices and matrices operations (addition, subtraction, multiplication, associativity, distrutivity, determinant, invertible, Gaussian row and column operations, rank, solution to system of linear equations). Real-valued function: definition, relation, domain and range, injective, bijective, inverse, odd and even, piecewise defined, graphs. Coordinates system: polar, polar graph, cylindrical, cylindrical graph.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

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Next Revision: September 2028

Module Title:	**ENGINEERING DRAWING**
Module Code	I3530ID
NQF Level	5
Notional Hours	160
Contact hours	4 Lectures +1 Tutorial and/or 1 Practical /Week
Additional learning requirements	(None)
NQF Credits	16
(Co-requisites) Prerequisite	**None**
Semester Offered	1

Module Purpose

The purpose of this module is to teach students how to visualize, create and interpret engineering drawing principles in two and three dimensions by applying of geometrical and engineering methods, and introduce students to computer aided drawing, with a focus on AutoCAD software,

Overarching Learning Outcome

Create and interpret basic drawings and communicate technically, as well as to use AutoCAD software to create two - and three - dimensional technical engineering drawings

Specific Learning Outcomes

On completing the module students should be able to:

- Use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts and assembly drawings of various engineering components
- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD
- Create three - dimensional objects

Module Content

Foundations of Representing Technical Bodies: drawing equipment, drawing formats, types of lines, construction geometry, simplified representations, scales, lettering, tittle block, elaboration of part drawings, Principle of orthographic projection, sectioning, dimensioning. **Isometric and oblique representations**. **Sections, Interpenetrations and developments**: cones, cylinders, pyramids. **Free hand techniques**: Introduction to free-hand sketching of machine parts. **Assembly Drawing**. **Introduction to AutoCAD:** Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; **Working in two - dimensional space:** Creating objects; Drawing with precision; Controlling the drawing display; Editing methods; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; Managing content with AutoCAD design Centre; Creating a layout to plot; Plotting (model and paper spaces). **Working in three - dimensional space**: Creating three-dimensional objects using solid primitives, and from 2D profiles; editing of 3D objects. **Practical Exercises.**

Contribution to Exit Level Outcome:

1. Engineering Design (Course Outcomes 4 and 5)
2. Engineering methods, skills, Tools and including IT (course outcome 1 and 3)
3. Professional and Technical Communication (Course Outcomes 2, 3, 4 and 5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

1. Four lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Practical exercises
4. Face to face consultations

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (At least 4 assignments): 40%
    b. Mini project: 20%
    c. Tests (At least 3 tests): 40%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the module
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Peer-review of course outlines and teaching.
2. Student evaluations.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

Books

[1] Parker M. A., and Pickup F., 1992. Engineering drawing with worked examples, vol1, 3rd Edition
[2] David A. Madsen, Engineering drawing and design, 5th Edition
[3] Colin H. Simmons, Neil Phelps, Manual of Engineering Drawing 3rd Edition
[4] Terry Wohlers., Applying AutoCAD, 2010

Design Software: AutoCAD
Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS A FOR ENGINEERS I**
Module Code	I3581NP
NQF Level	*5*
Notional Hours	*120*
Contact hours	3 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	12
(Co-requisites) / rerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of Physics as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to prepare students to apply fundamental Physics principles in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:

- Do unit conversions
- Solve problems regarding one and two dimensional kinematics.
- Solve problems regarding the dynamics of linear motion via Newton's laws.
- Solve problems regarding the dynamics of linear motion using energy methods.
- Solve simple problems in rotational kinematics and dynamics.
- Solve basic problems in statics and Newtonian gravitation.
- Solve problems using the principles of fluids.
- Solve basic problems regarding heat and gasses.
- Demonstrate entry-level general laboratory skills including elementary data analysis.
- Demonstrate abilities to communicate ideas and facts using equations, graphs and principles.

Module content
Measurements and Units: Instruments and Uncertainty, Standards and Units. **Kinematics**: One Dimensional Motion, Vectors, Projectile Motion, Circular Motion, Relative Motion. **Dynamics**: Newton's Laws of Motion, Newton's Law of Gravitation, Free-Body Diagrams, Friction. **Work, Energy and Power**. **Momentum**: Collisions, Impulse, Centre of Mass. **Rotational Dynamics**: Rolling Motion, Torque, Rotational Inertia and Energy, Angular Momentum. **Planetary Motion**: Kepler's Laws of Planetary Motion. **Elasticity**: Hooke's Law. **Fluids**: Pressure, Buoyancy, Fluid Dynamics: Flow Rates, Equation of Continuity and Bernoulli's Equation. **Heat and Thermodynamics**: Thermal Expansion, Ideal Gas, Specific Heat, Heat Capacity, Latent Heat, Calorimetry, Heat Transfer: Laws of Thermodynamics, Entropy, Enthalpy, Gibbs Free Energy.
Contribution to Exit Level Outcome:
Problem Solving (Course Outcomes 1,2, 3, 4)
Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
Investigations, Experiments and Data Analysis (Course Outcomes 6)
Learning and Teaching methods
The course will be facilitated through the following teaching learning activities:
1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment
1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (tutorials, quizzes, lab and field reports): 20%
    b. Tests (At least 2 tests): 30%
3. The final examination (1 x 3-hour paper): 50%

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources
1. Young, H. D. and Freedman, R. A. (2020) University Physics with Modern Physics in SI Units, Pearson Education Limited, Harlow, United Kingdom.
2. Singh J. (2004) Modern Physics for Engineers, WILEY-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
3. Giancoli, D. C. (2016) Physics Principles with Applications, Pearson Education Limited, Harlow, United Kingdom.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT I**
Module Code	I3421PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	Entry requirements
Semester Offered	1

Module Purpose
To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course.
Overarching Learning Outcome
Solve problems, in single-particle mechanics, Newtonian gravity, fluids, and heat.

Specific Learning outcomes
On completing the module students should be able to:
1. Employ units, do unit conversions, express uncertainties use significant figures, use vectors in 2 dimensions.
2. Solve basic problems regarding one and two-dimensional kinematics.
3. Apply Newton's laws of motion and energy principles to a variety of basic problems in dynamics.
4. Discuss and solve simple problems in rotational kinematics and dynamics.

5. Discuss the principles of waves and sound.
6. Solve basic problems in statics, Newtonian gravitation, fluids, heat, and gasses.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content
Measurement and estimation; Kinematics in 1D; Kinematics in 2D; Vectors; Dynamics/Newton's Laws; Circular motion; Gravitation; Work and Energy; Linear Momentum; Rotational Motion; Static Equilibrium; Fluids; Oscillation and Waves; Sound; Temperature and Kinetic Theory; Heat; The Laws of Thermodynamics.

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching and learning activities:
1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
    b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

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Next Revision: September 2028

Module Title:	COMPUTING FUNDAMENTALS
Module Code	I3581CC
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial or 1 Practical session /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites) / Prerequisite	None
Semester Offered	1

Module Purpose

This course introduces students the principles and techniques behind hardware and software systems. This includes the technical skills required to model and develop working software solutions and identify related ethical issues. It also introduces students to the basic tools and environments needed for machine learning programming.

Overarching Learning Outcome

Understand the principles and techniques behind hardware and software systems and, apply the technical skills required to model and develop working software solutions and identify related ethical issues.

Specific Learning Outcomes

On completing the module students should be able to:

- Relate with computers under the Windows and Linux operating environment for information processing and presentation.
- Recall basic features of common computer hardware architectures.
- List the basic communication architecture of a computer.
- Show algorithms for solving basic problems using flowcharts and pseudocode.
- Recall advanced spreadsheet tools and functions.
- Match basic web applications using modern web development tools and frameworks to simple real-life problems.
- Define basic concepts of networking.

Module Content:

Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored programme concept. Von-Neumann architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. **Computer Arithmetic**: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). **Introduction to CISC and RISC architecture**: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types). **Introduction of computer operating environment** Windows and UNIX based systems. **Computer Architecture:** The design and structure of a computer. **Information Processing and Data Analysis tools**: Equations and Formulas Creation, Diagram Creation and Editing, PowerPoint Presentations Creation Advanced Spreadsheets Skills. **Computer Programme Planning**. Flowcharts and Pseudocode **Introduction to Computer Networking**: Basics of Communication Systems and Computer Networks. **Web Developments:** Front-End Web Development, Web Page Styling and Website logic development with scripting languages such as JavaScript. **Overview of memory system**, memory chip organization and error correction, cache memory, memory storage devices. **Introduction to Data Science Tools:** Installation and basic use of Anaconda and Jupyter Notebooks.

Contribution to Exit Level Outcome:

1 Application of Scientific and Engineering Knowledge (Course Outcomes 1,2, 3,5,6)
2 Engineering Methods, Skills, and Tools including IT (Course Outcomes 1,2, 3, 4, 5,6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The final mark will be made of 100% Continuous Assessment
- The Continuous Assessment will be made up of the following assessment activities:
    - Assignments (tutorials, quizzes, reports, practical assignments): 20%
    - Tests (At least 2 tests): 50%
    - Semester Mini project (prototype oral presentation and development report): 30%

Criteria for qualifying for the Examination:

No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation
- Regular review of the course content
- Face-to-face consultations
- Effective and efficient supervision and monitoring of assignments, tests and projects.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. Invite students for one-one consultation to find the root cause of the problem
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

1. F. Wempen: Computing Fundamentals: Introduction to Computers First Edition Wiley, 2015
2. W. Palm: MATLAB for Engineering Applications 4th Edition, Mc-GrawHill, 2019
3. J. L. Hennessy; Computer Architecture, Fifth Edition, Morgan Kaufmann, 2012

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS**
Module Code	I3511NC
NQF Level	*5*
Notional Hours	*160*
Contact hours	4 Lectures + 1 Tutorials or 1 Practical session / Week
NQF Credits	16
(Co-requisites)	
Prerequisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to enable students to understand the basic concepts of chemistry as they relate to engineering.
Overarching Learning Outcome
The overarching outcome of this module is to equip students with firm grasp of fundamental chemistry principles which are applicable in engineering industries.
Specific Learning Outcomes
On completing the module students should be able to:

1. Describe the fundamental techniques used for chemical analysis in industrial processes.
2. Explain the basic concept of batteries and fuel cells and their applications.
3. Describe the processing of high polymers and their applications.
4. Explain different methods for water analysis and purification.
5. Describe different ways of dealing with pollution and managing solid waste.

Module content
Spectroscopic techniques and Applications: Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet and Visible and Raman spectroscopy. **Electrochemistry:** Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system. **Battery Technology;** Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life. Basic requirements for commercial batteries. Construction, working and applications of: Zn-Ag_2O, Ni-Cd, Zn-air and Lithium-ion battery. Fuel Cells- Differences between battery and a fuel cell, Classification of fuel cells - based on type of fuel, electrolyte and temperature. Construction, working and applications of solid oxide fuel cell. **Water Analysis;** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method), Alkalinity - determination, Determination of dissolved oxygen, Determination of chemical oxygen demand, Boiler scales-formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis. **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulong's methods). Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapour deposition. **Polymers;** Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (BunaS, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications. **Environmental Chemistry**; Air Pollution, Water Pollution, Radioactive Pollution, Solid Waste Management, Green Chemistry.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching methods

The course will be facilitated through the following teaching learning activities:

1. Three lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions.

Student Assessment

1. Students will be assessed through continuous assessments activities and a final examination
2. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (tutorials, quizzes, lab and field reports): 20%
    b. Tests (At least 2 tests): 30%
3. The final examination (1 x 3-hour paper) 50%

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Quality Assurance Arrangements

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests and examination.
5. Regular review of course content.

Learning Resources

1. Mukhopadhyay, Raghupati, and Sriparna Datta. Engineering chemistry. New Age International Pvt Limited, Publishers, 2008.
2. Agarwal, Shikha. Engineering chemistry: Fundamentals and applications. Cambridge University Press, 2019.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**CHEMISTRY FOR ENGINEERS SUPPORT**
Module Code	I3441CS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites)/ Pre-requisites	None
Semester Offered	1

Module Purpose

To introduce the student to general chemistry, lay the foundation of basic facts necessary for further studies in Chemistry and acquaint students with safety rules and regulations in a chemical laboratory.

Overarching Learning Outcome

Apply and interpret knowledge on basic facts in Chemistry for further studies.

Specific Learning outcomes

On completing the module students should be able to:

1. Use scientific notation and significant figures when doing all calculations
2. Define and explain the mass number (A), atomic number (Z) and isotope and also state the symbol for an isotope given its mass number and atomic number
3. Define the terms molar mass, relative molecular mass (Mr) and relative atomic mass (Ar) and carry out calculations involving these
4. Define and explain the terms empirical formula and molecular formula and also to determine the empirical and molecular formulae of a given compound
5. Use balanced chemical equations to obtain information about the amounts of reactants and products
6. Prepare dilute solutions from concentrated stock solutions and solve solution stoichiometry problems
7. Describe and explain data from experiments to distinguish between strong and weak acids and bases
8. Differentiate between oxidation and reduction reactions and balance redox reactions by the half-reaction method (acid and basic medium)
9. Apply quantum theory to predict the electron configuration of elements and explain the variation of properties across the periodic table
10. Explain the structure and bonding in molecules and ions and draw their Lewis structures
11. Apply Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) to describe molecular geometry as well as physical and chemical properties of some compounds

Module Content

Introduction: Matter, Measurement and Molecules; Stoichiometry: Calculations with Chemical Formulae and Equations; Aqueous Reactions and Solutions Stoichiometry; Electronic Structure of Atoms; Periodic Properties of the Elements and Relationships Among Elements; Basic Concepts of Chemical Bonding; Intermolecular Forces; Basic Molecular Geometry and Bonding Theories; Gases.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Brown T. L., LeMay H.E, Bursten B.E., Murphy C., Woodward P., Langford S., Sagatys D. and George A. (2014). Chemistry: The Central Science. (3rd Ed.). Pearson Australia. Australia
2. Chang, R. (2010). Chemistry. (10th Ed.) McGraw Hill Higher Education. New York. ISBN:978-0-07

Issue Date: September 2023
Next Revision: September 2028

12.5.1.3 YEAR 1 SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS II
Module Code	I3582IM
NQF Level	5
Notional Hours	120
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Mathematics I)
Prerequisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the fundamentals of engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Apply broad mathematical skills to solve engineering problems.
Specific Learning Outcomes
On completing the module students should be able to:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique.
- Apply calculus to trigonometric functions to solve mathematical and engineering problems.
- Solve engineering problems using 1st order and 2nd order differential equations
- Define and analyse Fourier series of real-valued functions.
- Use Laplace and Fourier transforms in solving differential equations.

Module Content
Further Matrix Algebra: eigenvalue-eigenvector problems. Hermitian and unitary matrices. Quadratic forms. **Further Integration:** Integration by parts technique. Integration by substitution. Integration of trigonometric functions. Integration of powers of trigonometric functions. Integration of trigonometric functions by substitution. Reduction formula. **Applications of integration:** areas, volumes of revolution, etc. **Differential Equations:** Meaning and solutions of differential equations. First order ordinary differential equations (separable, homogenous, Exact and linear types) and their applications. Solutions of second order linear ordinary differential equations with constant coefficients; initial or boundary value problems using the methods of undetermined coefficients and variation of parameters. **Integral Transforms:** Laplace Transforms (LT), Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st and 2nd ordinary differential equations. **Fourier Series and Transforms:** Fourier series. Fourier sine and cosine series. Introduction to Fourier transforms and its applications in solving boundary value problems.
Contribution to Exit Level Outcome:

1. Problem solving (Course Outcomes 1,2,4,5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2,3,5)
3. Engineering Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

1. Four lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   a. Assignments (tutorials, quizzes): 40%
   b. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
    1. Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
    2. Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
    3. Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
    4. Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
2. Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MATHEMATICS SUPPORT II**
Module Code	I3402MS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Prerequisite	None
Semester Offered:	2

Module Purpose

The purpose of this module is to equip students with an intuitive grasp of the behaviour of a real-valued function as well as the analytical techniques to test their intuition.

Overarching Learning Outcome

Gather sufficient information about the behaviour of a real valued function to sketch its graph with accuracy.

Specific Learning Outcomes

Upon completion of this module, a student should be able to

1. Employ the exact definitions of limit and continuity.
2. Use various differentiation techniques and assess differentiability.
3. Apply those tools to study local extrema, end behaviour, and asymptotic behaviour of function graphs.
4. Use integration to compute the area below a curve.
5. Handle complex numbers.

Module Content:

Solving equation: Exponentials and logarithms. Graph of a function: polynomial, rational, exponential, logarithmic, trigonometric functions. Limit of a function: definition, continuity, differentiation, sum, product, quotient, chain rules, examples from the engineering sciences. Integration: Definition and basic properties of the Riemann integral, the Fundamental Theorem of calculus, integrals of simple function, substitution rule and integration by parts; applications to the computation of areas and (rotational) volumes.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:

a. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
b. Tests (at least 2 tests): 60%

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. B. Huntley and A. Love. Elementary Tertiary Mathematics with Geometry. Addison Wesley, (2009).
2. R. Larson. College Algebra: Real Mathematics, Real People. Brookes/ Cole International Edition (6th Ed. - 2012).
3. J. Stewart, L. Redlin and S. Watson. Precalculus, Mathematics for Calculus. Cengage Learning, Higher Education (7th Ed. – 2016).

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Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS II**
Module Code	I3582NP
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Practical Session /Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3581NP Physics for Engineers I)
Prerequisite	None
Semester Offered	2

Module Purpose
To provide a fully-fledged, calculus-based university physics course, designed to conform to the international standard for a first university level course, that aims to introduce the candidate to university level Physics. To understand this course, one must realize that it and its preceding course (PZX3511) form a unit that was by necessity packaged in two parts. Together, these two courses form the foundation for all subsequent courses in Physics. This course focusses on electromagnetism, optics radioactivity and sound.

Overarching Learning Outcome
Students should be able to solve problems, using calculus, in electromagnetism, electricity, optics, radioactivity, sound and basic modern physics.

Specific Learning Outcomes
On completing the module students should be able to:

- Discuss and solve problems on electric field and magnetic field.
- Find currents and resistances in electric circuits.
- Analyse DC and AC circuits involving capacitors, resistors, and inductors.
- Resolve problems involving electromagnetic induction and apply Maxwell's laws.
- Solve problems in geometrical optics and nuclear physics.
- Explain concepts pertaining to modern physics.
- Conduct experiments, estimate, and propagate errors, tabulate and graph data with error bars, and write practical reports including the interpretation of errors.

Module Content
Electromagnetism: Electric Charge and Electric Field; Gauss's Law; Electric Potential; Capacitance and Dielectrics; Current, Resistance, and Electromotive Force; Direct-Current Circuits; Magnetic Field and Magnetic Forces; Sources of Magnetic Field; Electromagnetic Induction; Inductance; Alternating Current; Electromagnetic Waves. Optics: The Nature and Propagation of Light; Geometric Optics; Interference; Diffraction. Modern Physics: Relativity; Photons: Light Waves Behaving as Particles; Particles Behaving as Waves; Quantum Mechanics I: Wave Functions; Quantum Mechanics II: Atomic Structure; Molecules and Condensed Matter; Nuclear Physics; Particle Physics and Cosmology.
Contribution to Exit Level Outcome:

1. Application of Scientific and Engineering Knowledge (Course Outcomes 3 and 4).
2. Investigations, Experiments and Data Analysis (Course Outcomes 2 and 6)

Learning and Teaching Strategies/Activities

- Face-to-face lectures and/or online lectures/activities (pre-recorded or real-time)
- Face-to-face or online tutorials.
- Physical and/or virtual practical sessions
- Self-study tasks and assignments

Student Assessment Strategies

- Continuous assessment (50% of the final mark) consisting of a combination (or subset) of the following written and/or online assessments:
  - Test(s) and quiz(es) – at least a minimum of 3 hours in total
  - Assignments – at least a minimum of 3 notional hours in total
  - Practical reports and tutorial tests – at least 10 notional hours in total
- One examination with minimum duration of 3-hours (50% of the final mark).

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module

- A subminimum of 40% in the examination is required to pass, irrespective of the final mark.
- A final mark of 50% is required to pass this course.

Learning and Teaching Enhancement Strategies

- The module shall be continuously reviewed as per NQA schedule, or when the need arises.
- The examination shall be both internally and externally moderated by senior academics.
- The students shall have the opportunity to submit an evaluation of the module.
- Student progress shall be monitored by timely assessment and feedback.

Prescribed Learning Resources

Books

1. Young, H.D. and Freedman, R.A. (2020), University Physics with Modern Physics (15th ed.), Pearson, ISBN-13: 978-1-292-31473-0, eTextbook ISBN-13: 978-1-292-31481-5

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**PHYSICS FOR ENGINEERS SUPPORT II**
Module Code	I3422PS
NQF Level	4
Notional Hours	0
Contact Hours	2 Lectures + 1 Tutorials or 1 Practical session / Week
Additional learning requirements	None
NQF Credits	0
(Co-requisites) /Pre-requisites	Entry requirements
Semester Offered	2

Module Purpose

To provide an algebra-based college physics course, designed to provide essential knowledge in Physics for either life sciences or function as a precursor to a full-fledged university physics course. This course focuses on Electricity and Magnetism, Optics and Radioactivity

Overarching Learning Outcome

Solve problems in electricity and magnetism, optics, and radioactivity.

Specific Learning outcomes

On completing the module students should be able to:

1. Discuss and solve basic problems on electric field and magnetic field.
2. Find currents and resistances in simple electric circuits.
3. Analyse DC and AC circuits involving capacitors, resistors, and inductors.
4. Resolve problems involving electromagnetic induction.
5. Solve simple problems in geometrical optics and nuclear physics.
6. Explain concepts pertaining to radioactivity and the effects of radiation.
7. Conduct simple experiments, tabulate and graph data and write practical reports.

Module Content

Electric charge and electric field; Electric Potential; Electric Currents; DC Circuits; Magnetism; Electromagnetic induction; Electromagnetic waves; Geometric optics; Light; Radioactivity; Effects and Use of Radiation.

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching and learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through Continuous Assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
4. Assignments/ quizzes (at least 2 assignments/ quizzes): 40%
5. Tests (at least 2 tests): 60%

Prescribed Learning Resources

1. Giancoli, D.C. (2015), Physics: Principles with Applications, Global Edition (7th ed.), Pearson ISBN-13: 978-1292057125 (soft cover), eBook ISBN-13: 978-1292066851

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**MATERIALS SCIENCE**
Module Code	I3592IS
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1Tutorials and 1 Practical Session / Week
Additional learning requirements	None.
NQF Credits	12
(Co-requisites) / Prerequisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to enable the students to understand the relationship between the structure and properties of engineering materials and practical skills in metallography and materials testing.

Overarching Learning Outcome

Identify the right engineering material for a particular application based on materials' structure and properties.

Specific Learning Outcomes

On completing the module students should be able to:

- Describe the molecular and crystal structure of materials.
- Perform calculations on elemental diffusion in metals.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Outline the various phase transformations in the Fe-Fe3C phase system and associated microstructures.
- Explain how materials properties depend on structure and crystal defects.
- Demonstrate practical basic skills in metallography and report writing.
- Explain the relationship between Materials Science and the Fourth Industrial Revolution.

Module Content

Materials for Engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; Solidification, Crystalline Imperfections and Diffusion in solids; Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. Properties of Materials: review of Mechanical, Electrical, Optical and Thermal properties of materials. Mechanical properties of materials: Stress and Strain, Tensile testing, True stress and True strain, Deformation modes; Yield and Fracture, Hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. Real-world applications of Engineering materials: Functional Materials and Devices; The Relationship between Materials Science and the Fourth Industrial Revolution. Basic criteria for the selection of materials for engineering applications.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 6)

Learning and Teaching Strategies/Activities

- Four lecture periods per week for 14 weeks
- One tutorial or one practical session per week for 14 weeks
- Practical sessions.
- Face-to-face consultations wherever necessary.

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - o Assignments (tutorials, quizzes, lab and field reports): 40%
  - o Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

Books:

[1] Callister, W. D., Rethwisch, D. G., Materials Science and Engineering, An Introduction, 10th Edition, Wiley and Sons, 2018
[2] Donald R. Askeland, Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2nd Edition, 2008
Lecture notes

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Module Code	I3522EE
NQF Level	5
Notional Hours	80
Contact hours	2 Lectures + 1Tutorial and or 1 Practical Session /Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	
Semester Offered	2

Module Purpose:

The module aims to equip students majoring in all branches of engineering, with the understanding of basic principles of electric circuits and networks. A further purpose is to introduce common technical vocabulary.

Overarching Learning Outcome

Demonstrate ability to analyse basic electric circuits using laws and theorems.

Specific Learning Outcomes

On completing the module students should be able to:

- Distinguish between real and ideal voltage and current sources
- State and apply the laws and rules of electric circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving of DC circuits
- Apply the principles of circuit analysis to series and parallel R, L, C circuits
- Perform a range of measurements in an electrical laboratory environment and be able to interpret the measured data to derive supplementary information
- Describe the principles of operation of a transformer and the basic AC generator and DC motors
- Conduct basic circuit analysis using appropriate CAD software (MATLAB, MultiSIM, etc.)

Module Content:

Introduction: SI Units and notations, Basic Electric Circuit (resistance, voltage and current). **Resistance:** Resistor coding, Series and parallel resistor networks, Y and delta resistor networks. **Sources:** Voltage and Current sources, dependent and independent sources, source transformations. **DC Circuit Analysis Techniques:** Ohm's law, Power and Energy, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, **DC Circuit Theorems:** Superposition Theorem, Thevenin's and Norton's Theorem, Maximum power transfer theorem. **Capacitors:** Capacitance, capacitors in series and parallel, Capacitor charging and time constant. **Inductors:** Inductance and mutual inductance. **AC Voltage:** AC voltage generation, AC Resistive circuit, AC capacitive circuit, AC inductive circuit. Electrical Machine Basics: Basics principles of transformers, AC generators, DC motors, three phase voltage generation and mathematical expression. Basics of circuit simulation using CAD software).

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1,2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3. Engineering Design (Course Outcomes 4)
4. Investigations, Experiments and Data Analysis (Course Outcomes 4)
5. Engineering Methods, Skills, and Tools including IT (Course Outcomes 5)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Two lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities
2. The final mark will be made of 100% Continuous Assessment.
3. The Continuous Assessment will be made up of the following assessment activities:
    a. At least 2 quizzes, and at least 2 lab reports: 40%
    b. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of assessment activities.
2. Peer-review of course outlines and teaching.
3. Students' lecturer evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and quizzes.

Prescribed Learning Resources
Book

1. Boylestad Robert. (2015), Introductory Circuit Analysis, 13th Edition, Pearson Education, USA
2. Alexander K. Charles and Sadiku N.O. Mathews. (2013), Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, USA
3. Hughes Edward. (2016), Electrical and Electronic Technology, 12th Edition, Pearson Education, USA

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING MECHANICS I**
Module Code	I3582NM
NQF Level	5
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3581NP Physics for Engineers I)
Prerequisite	None
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with the knowledge to analyse system of forces on engineering components and to develop an approach to solving engineering problems.
Overarching Learning Outcome
Analyse the effect of static forces and equilibrium on systems and structural bodies.
Specific Learning Outcomes
On completing the module students should be able to:

- Express force operations and force systems using vectors
- Apply the laws of static equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Determine the centroid and moment of inertia for plane and composite cross-sectional areas.

Module Content
System of forces and moment forces: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Equilibrium in three dimensions**. **Forces in submerged surfaces**. **Distributed Forces: Centroid and Centre of Gravity, Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams. **Analysis of forces in a truss:** Method of joints, method of sections.
Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1-6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3-7)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

1. Four lecture periods per week for 14 weeks
2. One tutorial or practical session per week for 14 weeks
3. Face to face consultations
4. Laboratory activities

Student Assessment Strategies

1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
    a. Assignments (At least 4 assignments): 20%
    b. Tests (At least 2 tests): 60%
    c. Practical and Report: 20%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultation with students
2. Offer extra reading materials were applicable
3. Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

Books

1. Robert W. Soutas-Little and Daniel J. Inmand, Engineering Mechanics Statics, copyright 1999 by Prentice-Hall, Inc.
2. R. C. Hibbeler, Engineering Mechanics Statics, Ninth Edition, copyright 2001, 1998, 1995, 1992, 1989, 1986, 1983, 1978, and 1974 by R. C. Hibbeler.
3. Irving H. Shames, Engineering Mechanics Statics, Second, Volume 1, copyright 1958, 1959, 1966.
4. J. L. Meriam and L. G Kraige, Engineering Mechanics Statics, Fifth Edition, copyright 2003, John Wiley and sons.

Lecture Notes:

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**STATISTICS FOR ENGINEERS**
Module Code	I3582IS
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to the concept of probability theory, statistical modelling and inference in Engineering.

Overarching Learning Outcome
Conduct statistical data analysis, modelling and apply decision-making skills in engineering.

Specific Learning Outcomes
On completing the module students should be able to:

- Describe the theory of probability.
- Analyse data using probability distribution and densities.
- Use principles of sampling distribution and densities.
- Apply linear regression and correlation to a set of data.
- Apply analysis of variance to solve engineering problems.
- Analyse data using the statistical software

Module Content
Probability: Theory (Random experiments, Random events), conditional probability and Bayes theorem, mathematical expectation and decision making. **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, uniform, Gamma, Beta and Weibull. **Sampling Distributions:** Mean, variance, inferences concerning mean and proportions: point and interval estimations, parametric tests, nonparametric tests. **Regression and Correlation:** Simple and multiple linear regressions, correlation. The logistic regression model. **Analysis of Variance:** Completely randomized and randomized block designs, multiple comparisons**. Introduction to Data Analysis with R:** Lab 1: Measures of Central Tendency: mean, median, and other quantiles, mode. Saving and Using Graphics etc. Lab 2: Measuring Variability: variance and standard deviation, median, Interquartile Range, coefficient of variation, covariance and correlation of variables. Lab 3: Measuring Symmetry: skewness, kurtosis, etc. Frequency distributions: histograms, bar charts, pie charts, box plots, line graphs, scatterplots.

Contribution to Exit Level Outcome:

1. Application of Scientific and Engineering Knowledge (Course Outcomes 1,2,3,4,5)
2. Investigation, Experiments and Data Analysis (Course Outcomes 4,5,6)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 14 weeks
- One tutorial or practical session per week for 14 weeks
- Face to face consultations
- Laboratory activities

Student Assessment Strategies

- Students will be assessed through continuous assessments activities and a final examination
- The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments (Lab assessment): 40%
  - Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

- Internal and external moderation of examination papers and scripts.
- Peer-review of course outlines and teaching.
- Student evaluations.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultations with students during consultation hours.
- Allocation of extra reading material where applicable.
- Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books:
   [1] William Navidi., Statistics for Engineers and Scientists, 2nd Edition, 2008.
   [2] Jay L. Devote., Probability and Statistics for Engineering and the Sciences, 7th Edition, 2008
   [3] Samprit Chatterjee and Ali S. Hadi., Regression Analysis by Example, 4th Edition, 2006
2. Lecture notes
3. Software: R-Studio

Issue Date: September 2023
Next Revision: September 2028

12.5.2 YEAR 2 OF (32BHMI) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.5.2 .1 YEAR 2 CORE SEMESTER

Module Title:	**ACADEMIC LITERACY II**
Module Code	U3683AL
NQF Level	6
Notional Hours	80
NQF Credits	8
Contact Hours	Semester 0: 4 hours/week Semester 2: 2 hours/week
Prerequisite	**U3583AL**
Semester Offered	Core Semester,1and2

Module Purpose
The purpose of Academic Literacy II is to enhance students' reading, research, presentation and writing skills as demanded by different university disciplines. The course also aims to develop students' critical and analytical thinking skills.
Overarching Learning Outcome
Students will be able to effectively communicate in academic discourse to meet the requirements in their respective academic disciplines.
Specific Learning Outcomes
On completing the module students should be able to:

- Apply appropriate receptive and productive skills in various academic discursive modes and situations
- Read and interpret specific texts
- Critique various types of academic texts for a specific purpose
- Synthesise information from different texts into a coherent essay
- Summarise and paraphrase texts for academic purposes
- Edit and proofread written work using technology
- Write for specific purposes
- Substantiate arguments
- Participate in academic presentations.

Module content
The module is designed for students enrolled in a bachelor's degree, which requires them to do basic research, read and listen to specific academic material, produce specific written texts and give academic presentations. The module thus, focuses on enhancing academic reading, academic vocabulary, writing, listening and speaking.
Learning and teaching strategies/activities
The course will be facilitated through, but not limited to, the following learning activities:

- Blended instruction: Face-to-face and online
- Integrated and/or collaborative instruction
- Tests and assignments, tutorials and presentations

Student assessment strategies

- The module will be continuous assessment based.
- Assessment will include written tests, individual and group assignments, portfolio assessments and oral presentations.

Learning and teaching enhancement strategies

- Weekly task completion monitoring
- Student-lecturer evaluation
- Lecturer peer-review
- Moderation of assessment tools
- Curriculum review

Prescribed learning resources

- Academic Literacy II Study Guide.
- Beekman, L., Dube, C., Potgieter, H., and Underhill, J. (2019). *Academic Literacy* (3rd.). Cape Town: Juta and Company.

Recommended learning resources
http://www.uefap.com/

Issue Date: September 2023
Next Revision: September 2028

Module Title:	ENGINEERING ENTREPRENEURSHIP
Module Code	I3620IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	None
Semester Offered	2

Module Purpose

The purpose of this module is to enable the students to understand the concept of entrepreneurship and innovation in the engineering field and the different aspects that makes an entrepreneur.

Overarching Learning Outcome

Apply entrepreneurship skills to innovate and manage entrepreneurial ventures.

Specific Learning Outcomes

On completing the module students should be able to:

- Discuss the concept of entrepreneurship
- Describe key attributes of entrepreneur
- Carry out a feasibility study and draw up a business development plan
- Discuss the process of innovation (transformative and incremental) and product development
- Relate economic challenges and business creation
- Describe the procedures followed in starting a new business venture including some regulations guiding the process
- Explain the risk management process
- Discuss the theory of motivation
- Discuss the roles of strategic business and marketing management
- Explain the importance of change management theory in entrepreneurship.

Module content

Entrepreneurship: - concept of entrepreneurship, characteristics of an entrepreneur, examples of good local and international entrepreneurial ventures, feasibility studies and business plan development and its components, government policies and regulations for starting new business ventures. **Entrepreneurship opportunities in Engineering:** innovative ideas and process of innovation, transformative and incremental innovations, innovation and business development, product development process and market research. **Risk management:** types of risk, risk management process, risk control and mitigation, risk response. **Change management:** Importance of change management, group dynamics and communication. **Strategic business management:** Management functions, strategic planning and management, resource management plan. **Strategic marketing management:** Marketing functions, marketing mix, innovative marketing, competitor analysis

Contribution to Exit Level Outcome:

1. Sustainability and Impact of Engineering Activity (Course Outcomes 3)
2. Engineering Management (Course Outcomes 4 and 6)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:

- Two lecture periods per week for 14 weeks
- One tutorial session per week for 14 weeks
- Face to face consultations

Student Assessment Strategies

- Students will be assessed through continuous assessments activities
- The Continuous Assessment will be made up of the following assessment activities:
  - Assignments: 20%
  - Tests (At least 3 tests): 50%
  - Written reports: 30%
- No Examination
- To pass this course a student should obtain a minimum final mark of 50%.
- The final mark will be made of 100% Continuous Assessment

Learning and Teaching Enhancement Strategies

- Peer-review of course outlines and teaching.
- Student's evaluation.
- Regular review of course content.
- Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

- One-on-one consultation with students
- Offer extra reading materials were applicable
- Implement a bi-semester course evaluation to be administered through a Google Survey

Prescribed Learning Resources

Books:

1. Nieuwenhuizen, C. and Nieman, G. (2018). Entrepreneurship: A South African Perspective 4th ed. Van Schaik Publishers
2. Sibanda, M. (2021). Nuts and Bolts, Strengthening Africa's Innovation and Entrepreneurship Ecosystems. Tracey McDonald Publishers

Other Resources

1. Botha, T. (2019). Entrepreneurship and how to establish your own business. 6th ed. Juta Legal and Academic Publishers

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**WORKSHOP PRACTICE**
Module Code	I3640IW
NQF Level	6
Notional Hours	80
Contact hours	3 Practical Sessions /Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(None)
Prerequisite	None
Semester Offered	Core

Module Purpose

The purpose of this module is to enable the students to understand engineering workshop practices.

Overarching Learning Outcome

Carry out basic fabrications in an engineering workshop in a professional manner.

Specific Learning Outcomes

On completing the module students should be able to:

1. Work collaboratively in a team setting and use modern engineering tools and practices.
2. Discuss general safety procedures applicable to engineering workshops.
3. Describe specific hand tools used in engineering workshops.
4. Construct basic wall structures using brickwork, cement and mortar.
5. Differentiate between a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Fabricate a prescribed wooden component using the principles of carpentry.
11. Perform simple plumbing and pipe fitting exercises.
12. Describe the general operation of air-conditioning and refrigeration systems.

Module Content

Safety procedures applicable to engineering workshops: Safety equipment; Protective clothing; Signage. **Use of workshop hand tools. Principles and practices of**: Masonry and brickwork; Machining Operations (cutting, drilling, turning, milling, shaping); Sheet metal and fitting; Welding fabrication; Auto mechanics; Electrical wiring and installation; Soldering and de-soldering of electronic components; Carpentry and woodwork; Plumbing and pipe fitting; Refrigeration and air-conditioning systems and their installation.

Contribution to Exit Level Outcome:

1. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 5 and 10)
2. Engineering Methods, Skills, and Tools including Technology (Course Outcomes 2, 4, 6, 9)

Learning and Teaching Strategies/Activities

Three practical sessions per week for 6 weeks
Practical demonstrations
Supervised practical, use of hand tools and machine tools
Fabrication of simple components using various workshops and tools

Student Assessment Strategies
Students will be assessed through continuous assessments activities
The final mark will be made of 100% Continuous Assessment
The Continuous Assessment will be made up of the following assessment activities:
1. At least 5 practical reports: 40%
2. Fabricated Components: 60%

Criteria for qualifying for the Examination:
No Examination

Criteria for passing the course:
To pass this course a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student's evaluation.
3. Regular review of course content.
4. Effective and efficient supervision and monitoring of assignments and tests.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultation with students.
2. Offer extra reading materials where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
Books:
1. Saeed Moaveni, Engineering Fundamentals: An Introduction to Engineering, Cengage Learning, fourth edition, 2007.
2. Mark Holtzapple, W. Reece, Foundations of Engineering, McGraw Hill Education, 2nd edition, 2002.

Issue Date: September 2023
Next Revision: September 2028

12.5.2 .2 YEAR 2 SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Module Code	I3611IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3582IM Engineering Mathematics II)
Prerequisite	**I3511IM Engineering Mathematics I**
Semester Offered	1

Module Purpose
The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.
Overarching Learning Outcome
Apply broad and advanced mathematical skills to solve engineering problems.
Specific Learning Outcomes
On completing the module students should be able to:
Apply differential vector calculus to solve mathematical and engineering problems.
Apply functions of several variables in solving engineering problems.
Approximate solutions to 2nd order differential equations using power series.
Describe the basis for complex analysis in engineering problem solving.
Apply the residual theorem to engineering problems.

Module Content
Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binomial, torsion, curvature. **Functions of several variables:** limits, continuity, derivatives, differentials, the Jacobian, matrix and determinants, composite functions, higher order derivatives. Applications: optimization on surfaces, constrained optimization. The gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. **Power Series and their applications:** Power series. Radius of convergence and interval of convergence. Power series representation of functions, Taylor and Maclaurin series, the Binomial theorem. Power series solutions to ODEs with variables coefficients. **Analytic Functions:** Complex functions, derivatives, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem and evaluation of complex integrals.

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes1,2,3)
3. Engineering Methods, Skills and Tools, including IT (Course Outcomes1,2,3,4,5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 14 weeks
2. One tutorial session per week for 14 weeks
3. Weekly consultation sessions

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes): 40%
   ii. Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:
To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.
Criteria for passing the module
To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

Books:

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING ECONOMICS**
Module Code	I3661IE
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites) / Pre-requisite	(None)
Semester Offered	1

Module Purpose

The purpose of this module is to introduce the students to key economic concepts and how they are applied in the different sectors of the economy and specifically in engineering.

Overarching Learning Outcome

Students should be able to apply the concepts and theories of micro- and macro- economics to analyse capital projects and calculate the depreciation of assets.

Specific Learning Outcomes

On completing the module students should be able to:

1. Discuss the fundamentals of microeconomics.
2. Apply the concept of time value of money.
3. Apply investment analysis techniques for projects (NPV, ROR, IRR, CBA, Payback Period, etc.).
4. Apply depreciation methods on assets for valuation.
5. Discuss the fundamentals of macroeconomics.
6. Apply financial accounting principles in engineering projects.
7. Discuss the principles of marketing engineering products.

Module Content

Microeconomics: economic concepts, economic problems, demand and supply, consumer choice and demand theory, production functions, production costs, profit maximisation. Time value of money: time value of money, investment analysis (NPV, ROR, IRR, ROI, CBA, etc.), depreciation methods (straight line, reducing balance, sum of digits). Macroeconomics: inflation and deflation, business cycle, monetary and fiscal policies, unemployment, international trade. Financial accounting: product costing, cost accounting, financial statements, and budgeting. Introduction to marketing: marketing principles.

Contribution to Exit Level Outcome

Engineering Management (Course Outcomes 3, 6 and 7).

Learning and Teaching Strategies/Activities

The module will be facilitated through the following teaching and learning activities:

1. Lectures.
2. Tutorials.
3. Face-to-face consultations.

Student Assessment Strategies

Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination as follows:

1. The Continuous Assessment will be made up of the following assessment activities:
   a. Tests (at least 2 tests): 30%.
   b. Assignments: 20%.
2. End-of-semester examination (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination

To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module

1. To pass this module a student should obtain a minimum final mark of 50%.
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests, and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact, and effect improvement:

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

1. Goodwin, N., Harris, J., Nelson, J.A., Roach, B. and Torras, M. (2020). Principles of Economics in Context. 2nd Edition, Routledge.
2. Mohr, P. (2015). Economics for South African Students. 5th Edition, Van Schaik Publishers.

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Next Revision: September 2028

Module Title:	**COMPUTING FUNDAMENTALS I**
Module Code	I3691CP
NQF Level	6
Notional Hours	150
Contact hours	4L + 1T or 1PS /Week
Additional learning requirements	NONE
NQF Credits	12
(Co-requisites)	None
Prerequisite	I3551CC Computing Fundamentals
Semester Offered	1

Module Purpose:
The course aims to equip students with general principles of programming, skills, theories, and techniques for computer programmes design and solutions.

Overarching Learning Outcome
Design and analyse computer programme.

Specific Learning Outcomes
On completing the module students should be able to:

8. Design algorithms and data structures for solving mathematical and engineering problems using pseudo code, flowcharts, and related tools.
9. Differentiate different programming paradigms (structural, functional and object-oriented).
10. Discuss the concept of compiled and interpreted languages.
11. Use different data types in the design of programmes.
12. Apply arithmetic, logical and bitwise operations on different data types in programming.
13. Compile computer programmes in different integrated development environments.
14. Apply and test the three basic programming structures (Sequential, Decision and Looping) using specific programming languages (e.g., MATLAB, Python, C, etc.)

Module Content:
Programme design: programming problem definition, programme requirements elicitation and analysis, specification development, design methods, design tool (pseudo code, flow charts etc.).
Programming Paradigms: Structural, functional and object-oriented programming concepts.
Introduction to programme compilation and interpretation: Definition and differences between compiled and interpreted languages, Compilation process, Execution of compiled code, Interpretation process, Examples of compiled and interpreted language, Advantages and disadvantages of each type of languages.
Introduction to programming: variables, operators, data types, iteration, branching
Data Structures: Arrays, lists, stack and queues, structures and enumeration/hash maps.
Fundamental concepts of programming: Data types, variables, programme flow control (decisions and loops), string manipulation, functions, data structures and their operations

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 5)
5 Engineering Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 5)

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
- Four lecture periods per week for 12 weeks
- One tutorial or one practical session per week for 12 weeks
- Weekly consultation sessions
- A group mini project at the end of the module.
- A special hands-on demonstration that may involve an invitation of an expert from outside.
- Special soft skills lecture that may be done on-site or via video demos.

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and there will be no examination at the end of the semester.
2. The Continuous Assessment will be made up of the following assessment activities:
a) Assignments (tutorials, quizzes, reports, practical assignments): 20%
b) Tests (At least 3 tests): 50%
c) Semester Mini project (prototype, oral presentation and development report): 30%

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 100% Continuous Assessment

Learning and Teaching Enhancement Strategies
1. Peer-review of course outlines and teaching.
2. Student's evaluation
3. Regular review of the course content
4. Face-to-face consultations
5. Effective and efficient supervision and monitoring of assignments, tests and projects.

Prescribed Learning Resources
[1] Cay Horstmann, Rance Necaise; Python for Everyone, Second Edition, Wiley, 2016.
[2] William J. Palm III; Introduction to MATLAB for Engineers, Third Edition, Mc Graw Hill, 2011.
[3] Gregg Perry and Dean Miller; C Programming Absolute Beginner's Guide, Third Edition, Pearson, 2014.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**ENGINEERING AND STRUCTURAL GEOLOGY**
Module Code	I3611MG
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Mine visit
NQF Credits	16
(Co-requisites)	
Pre-requisite	None
Semester Offered	1

Module Purpose:
This Module aims to enable students to understand internal structure of the earth crust and rock/mineral formations; it also aims to provide the necessary and fundamental knowledge of ore deposit formation and structural settings for the application in mining.

Overarching Learning Outcome
Students will be able to identify most common rocks, minerals and mineral groups.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe composition and properties of common minerals and rocks.
2. Analyse the nature of the interior of the earth and the plate tectonic theory.
3. Describe weathering processes and soil formation processes.
4. Interpret geological maps.
5. Describe processes leading to the formation of folds and faults.
6. Comprehend ore forming processes and the classification of ore deposits.
7. Discuss African geology on a broader context.
8. Apply basic geological knowledge to solve engineering geology problems.
9. Estimate the economic value of a mineral deposit.
10. Analyse morphologies specific to different types of deposits.

Module Content:

Mineralogy: Properties and composition of rock forming and economic minerals; **Petrology**: Composition and identification of common igneous; sedimentary and metamorphic rocks. Practical work involves the identification of common minerals and rocks. **Internal processes:** The nature of the interior of the earth; plate tectonic theory. **Surface processes:** rock weathering and soil formation; erosion and denudation; sediment transport and deposition; the rock cycle in the context of plate tectonic theory. **Introduction to Hydrogeology**: Introduction to the water cycle; climate change, geohydrology; aquifers; Darcy's law; pumping tests and their purposes. **Practical work on geological map interpretation**: Horizontal strata and how it affects engineering structures; dipping strata and how it affects engineering projects such as road cuts; foundations; underground and surface mining; 3-Point problems; Geological map interpretation. **Structural geology:** brittle and ductile deformation and formation of folds and faults; solution of structural problems involving folded and fractured rocks. Application of stereonets. **Economic geology:** Ore and mineral exploration methods and Prospecting Techniques; ore forming processes and the classification of ore deposits; the geology of the world's major ore deposits. **African geology**: the geological evolution of Africa, with particular reference to its ore deposits. Practical work involves the interpretation of geological maps and the solution of structural problems in a mining context.

Contribution to Exit Level Outcome:

1. Problem solving (Course Outcomes 1, 2, 3, 4).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 7).
3. Engineering design (Course Outcomes 4).
4. Investigations, experiments and data analysis (Course Outcomes 3, 4, 6, 7).
5. Individual, team and multidisciplinary working (Course Outcomes 2, 7).

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Four lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks
3. Weekly consultation sessions
4. Practical sessions.

Student Assessment Strategies

Students will be assessed through continuous assessments activities and a final examination

1. The Continuous Assessment will be made up of the following assessment activities:
    i. Assignments (tutorials, quizzes, practical sessions and field reports): 20%
    ii. Tests (At least 3 tests): 30%
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 50% in the design project.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours.

Prescribed Learning Resources

1. David, G.P. (2009) Engineering Geology-Principles and Practice. Springer-Verlag Berlin. ISBN 978-3-540-29249-4.
2. Barnes, J. Lisle. R.J. (2004) Basic Geological Mapping. John Wiley and Sons, Chichester, England. ISBN: 0-470-84986-X.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	INTRODUCTION TO MINING METHODS
Module Code	I3691MM
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial Session/ Week
Additional learning requirements	Nil
NQF Credits	12
(Co-requisites) / Pre-requisite	None
Semester Offered	2

Module Purpose:
The purpose of this module is to enable the student to understand the whole mining operation from the development, production and lastly the closure of the mine.
Overarching Learning Outcome
Students will be able to identify, analyse and evaluate various methods of extracting minerals.

Specific Learning Outcomes
1. On completing the module students should be able to:
2. Define the basic mining terminologies.
3. Comprehend the structure of the Namibian mining industry and mineral deposits.
4. Describe the stages of mining operation.
5. Analyse drilling and blasting design techniques.
6. Describe the various mining methods.
7. Explain the various mine transportation methods.
8. Compare the various mining methods and mining equipment.
9. Identify the environmental concerns as applied to mines and the mining industry.

Module Content:
Introduction to mining: Significance of the mining Industry; history of mining, role of mining in human civilization and socio-economic impacts of mining. Mineral resources in Namibia and their locations. The economic significance of the Namibian Mining Industry. Minerals and ores. Rock: formation; types; characteristics and rock cycle. Stages in the life of a mine. Basis concepts of mining and mining technology: Development procedures; distinctive features; major technological processes for surface and underground mines; classification of mining methods; mining terminologies applied in surface and underground mining and mineral processing. Mining methods for ore deposits: Elementary ideas about Surface and Underground Mining methods; Comparison of underground and surface mining. Unit Operations-Drilling and rock penetration: drills and types of drilling methods; explosives (Classification and properties of explosives) and blasting; loading and transportation. Different methods of entering into a deposit to be worked out by underground mining: adit; shaft; incline shaft; incline and decline. Diamond and gold mining technologies and methods. Introduction to mine health, safety and mine ventilation. Students are expected to create physical models (mining equipment, pit shells etc.).

Contribution to Exit Level Outcome:
1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4).
2. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
3. Sustainability and impact of engineering activity (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
4. Engineering management (Course Outcomes 8).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial session per week for 12 weeks.
3. Weekly consultation sessions.
4. A group physical models/design project at the end of the module.
5. At least one field trip/mine visit.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination
1. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (tutorials and quizzes): 10%
ii) Tests (At least 2 tests): 30%
iii) Physical models/design project (team project report): 10%
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 50%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Prescribed Learning Resources
1. Hartman, H.L. (2002) Introductory Mining Engineering, Wiley, New York, 2nd edition.
2. Kennedy, B.A. (1990) Surface Mining, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 2nd edition.

Issue Date: September 2023
Next Revision: September 2028

Module Title:	**STRENGTH OF MATERIALS**
Module Code	I3681VM
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(I3582NM Engineering Mechanics I)
Pre-requisite	None
Semester Offered	1

Module Purpose
The purpose of this module is to introduce the fundamental concepts of stress and strain and the geometrical properties of plane sections. This foundational module equips the student with fundamental knowledge of structural analysis and design.
Overarching Learning Outcome
Students will be able to analysis stresses and strains in 1-, 2- and 3-dimensional planes and determine the geometrical properties of plane sections and common material failure theories and mechanisms.
Specific Learning Outcomes
On completing the module students should be able to:
1. Analyse the state of stress and strain in one-, two-and three-dimensional planes.
2. Execute the transformation of stresses in two- and three- dimensional planes.
3. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
4. Analyse the geometrical properties of plane sections.
5. Solve problems involving shear stresses and shear flow in beams and thin-walled open sections.
6. Analyse stresses and strains due to bending, torsion and thermal effects.
7. Describe the failure theories of materials and use them in the prediction of failure.
8. Analyse the buckling loads of struts subjected to various end conditions.
9. Relate stresses in thin cylinders and spheres subjected to internal pressure.
10. Test the mechanical properties and sectional properties of materials.

Module Content
Stresses and strains in one-dimension: introduction to stresses and strains; direct tensile test; Hooke's law and Modulus of Elasticity; ductility; Normal stress and strain; Poisson's ratio; Thermal stresses and strains; Axially-loaded bars, composite bars, axially-loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars; Shear stresses and strains; Modulus of rigidity. **Stresses and strains in two and three dimensions:** analysis of two- and three-dimensional state of stress; transformation of stresses and strains; principal stresses and maximum shear stresses; analysis of two and three-dimensional state of strain; Mohr's circle of stress and strain; Volumetric strain; Bulk modulus. **Geometrical characteristics of plane sections:** centroids of simple and complex areas; second moment of area; polar moment of area; section modulus; parallel axes theorem; perpendicular axes theorem. **Bending and shear stresses in beams:** theory of beam bending; composite beams; shear stress distribution due to bending. **Combined bending and direct stresses in structural members**. **Unsymmetrical bending**. **Shear stress in thin-walled open sections**. **Shear centre**. **Material failure:** failure theories of materials; Creep; Fatigue; Fracture; Stress concentration. **Elastic instability:** buckling of struts. **Simple torsion:** pure torsion of circular bars; shear stress and shear strain in shafts; torsional rigidity; torsion of hollow shafts. **Stresses in thin cylinders and spheres:** thin cylindrical and spherical shells subjected to internal pressure; hoop stress; longitudinal stress. **Laboratory demonstrations:** direct tensile test; elastic modulus/ductility; torsion; fracture; stress concentration; buckling of struts.

Contribution to Exit Level Outcome
Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6 and 8).
Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).
Investigations, experiments and data analysis (Course Outcome 10).
Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:

1. Four lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Face-to-face consultations wherever necessary.
4. Laboratory demonstrations.

Student Assessment Strategies

1. Students will be assessed through Continuous Assessment (CA) and an end-of-semester examination
2. The final mark will be made up of 50% Continuous Assessment (CA) and 50% end-of-semester examination (1 x 2-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Laboratory reports: 20% of CA.
   ii. Assignments: 20% of CA.
   iii. Tests: 60% of CA.
4. End-of-semester examination: (1 x 2-hour paper): 50%.

Criteria for qualifying for the Examination
To qualify for the end-of-semester examination, a student must obtain a minimum Continuous Assessment (CA) mark of 40%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

1. Books

[1] Khurmi, R.S., and Khurmi, N. (2019). A Textbook of Strength of Materials. S Chand Publishing.
[2] Stephens, R.C. (2013). Strength of Materials: Theory and examples. Elsevier.
[3] Timoshenko, S. (2004). Strength of Materials, Part 1: Elementary Theory and Problems, 3rd Edition. CBS Publishers.
[4] Case, J., Chilver, A.H., and Ross, C.T.F. (1999). Strength of Materials and Structures, 4th Edition, Butterworth-Heinemann.

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12.5.2 .3 YEAR 2 SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Module Code	I3612IM
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial / Week
Additional learning requirements	None
NQF Credits	16
(Co-requisites)	(I3511IM Engineering Mathematics I)
Prerequisite	**I3582IM Engineering Mathematics II**
Semester Offered	2

Module Purpose

The purpose of this module is to introduce students to advanced engineering mathematics and its applications to science and engineering.

Overarching Learning Outcome

Equip students with broad and advanced mathematical skills that will help them solve engineering problems.

Specific Learning Outcomes

On completing the module students should be able to:

1. Solve systems of first order linear differential equations using the LT and the matrix approach.
2. Define, classify and solve partial differential equations analytically.
3. Apply integral calculus to functions of several variables and describe Green's theorem.
4. Describe the principal of numerical methods and computational linear algebra.

Module Content

Systems of Linear Differential Equations: Homogeneous and nonhomogeneous systems and their methods of solutions: The Laplace Transform method and the matrix methods (eigenvalue-eigenvector approach). **Partial Differential Equations:** Partial differential equations classification; elliptic, parabolic and hyperbolic. Neumann, Dirichrit boundary conditions of PDEs. Method of separation of variables to the heat and wave equations; vibrations of a stretched elastic string fixed at both ends. **Integral Calculus of Functions of Several Variables**: Double and triple integrals, Double, triple and iterated integrals, Line integrals in the plane, Green's Theorem, Independence of path, Surface integral, Divergence theorem, Stoke's theorem, Irrotational and solenoidal fields, Physical and engineering applications. **Numerical Methods:** Zeros of functions, Polynomial interpolation and least squares approximation, numerical differentiation and integration. Numerical solution of first order ordinary differential equations and boundary value problems.

Contribution to Exit Level Outcome:

1. Problem solving (Course Outcomes 1, 2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3. Engineering Methods, Skills and Tools, including IT (Course Outcomes 1, 2, 3, 4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

Four lecture periods per week for 14 weeks
One tutorial session per week for 14 weeks
Weekly consultation sessions

Student Assessment Strategies

Students will be assessed through continuous assessments activities and a final examination
The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
The Continuous Assessment will be made up of the following assessment activities:

Assignments (tutorials, quizzes): 40%
Tests (At least 2 tests): 60%

Criteria for qualifying for the Examination:

To qualify for the exam, a student must obtain a minimum of 40% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement

1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources

Books:

[1] Stroud, K. A., and Booth, D. J., Engineering mathematics 5th Edition. Macmillan International Higher Education, 2013.
[2] Bird, J. Engineering Mathematics 5th Edition, 7th edition. Routledge, 2014.
[3] Stewart, J., Clegg, D. K., and Watson, S. Calculus: early transcendentals, 6th Edition. Cengage Learning, 2020.
[4] Stewart, J., Redlin, L., and Watson, S. Precalculus: Mathematics for calculus 7th Edition. Cengage Learning, 2015.
Lecture notes.

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Next Revision: September 2028

Module Title:	**SURVEYING FOR ENGINEERS**
Module Code	I3692VS
NQF Level	6
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	None
Pre-requisite	**I3511IM Engineering Mathematics I**
Semester Offered	2

Module Purpose:
The purpose of this module is equipping students with background knowledge and skills in engineering surveying concepts to perform engineering surveys.

Overarching Learning Outcome
Students will be able to map out an area using different surveying tools and software packages.
Specific Learning Outcomes
On completing the module students should be able to:
1. Demonstrate knowledge of the overview of surveying and its applications to engineering.
2. Describe the various techniques and tools used in practical surveying.
3. Demonstrate knowledge of surveying calculations.
4. Use contour and surface modelling software in surveying exercises.
5. Explain the principles of surveying as applied to mines.
6. Apply the knowledge of producing and analysing plans, maps and photographs of mines.
7. Interpret map projections, geometrical constructions and diagonal scales.
8. Evaluate rectangular and polar coordinates for contours and cartographic sections.
9. Relate practical knowledge of surveying in the field.
10. Analyse map projections and interpret mine surveying data.
11. Explain the GPS survey systems and its application in mining.

Module Content
Introduction to surveying: Types of surveys; surveying instrumentation; observation and reduction of observations. **Surveying tools: Plans, maps, photographs**, sections and profiles. Comparison of the engineering and cartographic approach to producing the graphic document, **Scales**. Simple map projections, developable surfaces and distortions, Geometrical construction of a grid, scale bars and diagonal scales. **Levelling**, levelling equipment, taping and electronic distance measurement; setting out; Sources of error; longitudinal and cross sections; cut and fill and mass haul diagrams; areas and volumes; coordinate system use of hand-held and GPS survey systems. **Surveying calculations:** joints, polars; intersections; traverse; resections; triangulation; tri-lateration; tri-highting; direction sheet; contouring and surface modelling software. **Rectangular and polar coordinates**: Contours and their interpolation, Cartographic conventions, layout, marginal information. Superimposition of design contours and cut/fill lines, longitudinal profiles and cross-sections. **GPS:** instruments and observations and their application in mining. **Practical:** distance measurement, measuring errors; levelling traversing (with tapes and total stations); vertical surveys; care of surveying equipment; using a gyro-theodolite to determine azimuth.
Contribution to Exit Level Outcome:

1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10).

2. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 11).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks.
3. Weekly consultation sessions.
4. A group/individual practical.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination
1. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (tutorials and quizzes): 10%
ii) Tests (At least 2 tests): 30%
iii) Group/individual practical: 10%
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 40%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Landman K., Hunter T., and Jackson J. (2013) An Introduction to Engineering Surveying, Juta and Company Ltd., Cape Town, South Africa.
2. Uren J., and Price W. (2006) Surveying for Engineers, 4th Edition, Palgrave Macmillan, New York, USA.
3. Bannister A., Raymond S. and Baker R. (1998) Surveying; 7th Edition, Pearson Education Limited, Edinburg Gate, England 502p.
4. McCormac J., Sarasua W., and Davis W. (2013) Surveying, John Wiley and Sons Inc, 6th Edition, New York, USA.
5. Schofield W. And Breach M. (2011) Engineering Surveying. 6th Edition, Spon Press, Milton Park, Abingdon, Oxon, 622p.
6. Walker, John, Awange, Joseph L. (2020) Surveying for Civil and Mine Engineers, Springer Nature, Chan, Switzerland 130p.

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Module Title:	**FLUID MECHANICS I**
Module Code	I3692NF
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session/Week
Additional learning requirements	None
NQF Credits	12
(Co-requisites)	(None)
Prerequisite	**I3582NM Engineering Mechanics I**
Semester Offered	2

Module Purpose
The purpose of this module is to introduce students to the fluid mechanics sciences, and to enable students to understand of the mechanisms of fluid flow.
Overarching Learning Outcome
Understand fluid mechanics principles and apply the governing equations to solve fluid flow problems.

Specific Learning Outcomes
On completing the module students should be able to:
1. Describe properties of fluids and conditions for relative equilibrium in fluids.
2. Categorize one-dimensional mass and momentum conservation and applications of the continuity equation and the Bernoulli's equation.
3. Demonstrate skills for flow measurements in laboratory demonstrations.
4. Solve general hydraulic systems problems with respect to energy changes (pressure, velocity), pipe friction, and local hydraulic losses.

Module Content

Introduction to fluid mechanics; properties of fluids (density, viscosity, vapour pressure); fluid equilibrium; units. **Fluid Statics**: The governing differential equations; pressure distributions, manometric pressure measurement; fluids in relative equilibrium; forces on submerged surfaces; buoyancy. **One-dimensional flows with inertia**: 1-D mass conservation (Continuity equation); 1-D momentum conservation (Bernoulli equation); total head diagrams; flow measurement; **Flow states:** laminar vs turbulent, steady vs unsteady, uniform vs non-uniform, continuous vs discontinuous, sub-critical vs super-critical. **Hydraulic systems**: Energy changes in systems; pipe friction (continuous hydraulic energy losses: laminar and turbulent friction factors, Moody diagram); local hydraulic energy losses: loss coefficients and applications. **Lab practical:** 1. Hydrostatics, 2. Fluid dynamics: Discharge determination, 3. Fluid dynamics: Energy shares in a pressurised system (pressure and velocity dependencies), and 4. Fluid dynamics: Determination of continuous and local hydraulic losses.

Contribution to Exit Level Outcome

1. Application of Scientific and Engineering Knowledge (Course Outcomes 2 and 4)

Learning and Teaching Strategies/Activities

The course will be facilitated through the following learning activities:
1. Four lecture periods per week for 14 weeks
2. One tutorial or one practical session per week for 14 weeks
3. Face to face consultations
4. Laboratory demonstrations and experiment documentation

Student Assessment Strategies
1. Students will be assessed through continuous assessments activities and a final examination
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).
3. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (At least 3 assignments): 20%
   ii. Practical reports: 40%
   iii. Tests (At least 2 tests): 40%

Criteria for qualifying for the Examination

To qualify for the exam, a student must obtain a minimum of 50% in the Continuous Assessment.

Criteria for passing the module

To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
1. Books:
   [1] Yunus A. Cengel and John M. Cimbala, Fluid Mechanics, Fundamentals and Applications, 3rd edition, 2014
   [2] R. K Bansal, Fluid Mechanics and Hydraulic Machines, 9th edition, 2010.
   [3] Marcel Dekker, Turbomachinery Design and Theory, 2003.
2. Lecture notes

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Module Title:	DRILLING AND BLASTING TECHNOLOGY
Module Code	I3672MB
NQF Level	6
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial Session / Week
Additional learning requirements	Mine visit
NQF Credits	16
(Co-requisites)	(I3691MM Introduction to Mining Methods)
Prerequisite	**None**
Semester Offered	1

Module Purpose
The aim of the module is to provide students with the fundamental and scientific advanced knowledge of various excavation methods used in mining operations i.e. mechanical excavation, drilling and blasting, and skills to design various excavation methods i.e. drilling and blasting patterns for surface and underground mining operations.
Overarching Learning Outcome
Students should be able to apply, analyse and design various excavation techniques for surface and underground mining operations.
Specific Learning Outcomes
On completing the module students should be able to:
1. Select the most suitable powering systems for a mining operation
2. Appraise various techniques of mechanical excavation of rock and earth matter.
3. Apply scientific theories of rock cutting to select and design the most suitable rock cutting tools for a particular excavation method.
4. Apply the scientific theories of machine design and rock drilling to select and design the most optimum method of excavation.
5. Apply scientific theories of explosives and rock breaking to design the most optimum blasting design for a particular mining operation.
6. Appraise various rock breaking and blasting techniques.
7. Appraise blasting techniques for underground and surface mining.
8. Design drilling and blasting for surface and underground mining operations.
9. Utilise software to design drilling and blasting for surface and underground mining operations.
10. Evaluate drilling and blasting results for surface and underground mining operations.

Module Content
Powering Systems: Fundamentals of powering systems for machines: electrical, pneumatic, hydropower, Fluid and hydraulic (mineral oil and emulsion systems) Mechanical excavation: Mechanics of cutting with picks, discs, toothed roller cutters, button cutters. Application in terms of machine design and operation to: Coal cutters, continuous miners, longwall and short-wall, drum shearers, tunnel and shaft borers, drilling rigs. Mechanics of impact breaking: Application in terms of machine design, operation and impact breaking machines for hard rock tabular mining. Rock drilling and explosives: Factors affecting rock penetration, principles of rock drilling, percussive drilling, rotary drilling, drilling machines and consumables, cost. History, classification and composition of explosives, transportation and storage of explosive, chemical and physical characteristics, disposal of expired and deteriorated explosives, Fundamental chemical calculations, mechanics of detonation, Hydrodynamic theory of detonation, Ideal and non-ideal detonation, Theory of initiation. Rock Breaking and blasting applications: Mechanism of rock breaking: propagation of shock waves in solid medium, interaction of compressive waves from free face, mechanics of breaking rock, crack propagation, interaction of cracks, current research. Blasting design: factor affecting rock blasting design, System Approach, Idealized fragmentation curves, preliminary guidelines for blast layout, Ratios for initial design, effects to pattern design in changing explosive and changing rock properties, geological impacts on blast design. Underground blasting: Stopping practice, drilling pattern in underground mining, sequential firing, ring blasting, development and shaft sinking, Surface mining blasting: Practical applications: Bench blasting, Drilling patterns, charge calculation, Blasting methods (non-electrical blasting, safety fuse and detonating cord electrical), Electrical circuits (series, parallel, series-parallel), test circuit, Initiation patterns, misfire, ground vibrations, air blast and fly rocks. Controlled blasting line: drilling, pre-splitting, smoothwall blasting, trim blasting, blasting ornamental rock, underwater rock excavation, controlled blasting rules of thumb Evaluation of blast results; Fragmentation and swelling of the muckpile, Geometry of muckpile, its height and displacement, condition of the remaining mass, analysis of the bench floor, boulders, vibrations and airblast, blast evaluation in underground mining. New technologies in blasting such as green explosives etc. Application of the following software to drilling and blasting design: SURPAC, Sherpa for surface and underground mines etc. Mine visit.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 5 and 8)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9).
3. Engineering Design (Course Outcomes 3, 4, 5, 8, 9).
4. Investigations, Experiments and Data Analysis (Course Outcomes 10).
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 8, 9, 10).

Learning and Teaching Strategies/Activities
1. Four lecture periods per week for 12 weeks
2. One tutorial per week for 12 weeks.
3. Weekly consultations sessions.
4. A group design project.
5. Field Trip to surface and or underground mines.
6. Guest Lecture

Student Assessment Strategies

Students will be assessed through continuous assessments activities and a final examination.

1. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (at least 2): 10%.
   ii. Quizzes
   iii. Field trip reports : 5 %
   iv. Tests (At least 2 tests): 20%.
   v. Mini design project (oral presentation and design report): 15%.
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of CA of 40%.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.

Student's evaluation

1. Regular review of course content.
2. Effective and efficient supervision and monitoring of assignments, tests and examination.
3. Weekly consultation hours.

Prescribed Learning Resources

- Lecture Notes
- Books
  1. Duncan C. Wyllie, C. M., 2004. Rock Slope Engineering: Fourth ed. London and New York: CRC Press.
  2. Howard L. Hartman, S. f. M. M. a. E. (., 1992. SME Mining Engineering Handbook, Volume 2. 2nd ed. s.l.: Society for Mining, Metallurgy, and Exploration.
  3. Mutmansky, H. L. H. and. J. M. .., 2002. Introductory Mining Engineering. 2nd ed. New Jersey: John Wiley and Sons.
  4. Tatiya, R. R., 2005. Surface and Underground Excavation. 1st ed. Great Britain: Taylor and Francis Group plc, London, UK.
  5. William A. Hustrulid, M. K. R. K. M., 2013. Open Pit Mine Planning and Design, Two Volume Set and CD-ROM Pack. 3rd ed. London and New York: CRC Press.

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Module Title:	**SOIL AND ROCK MECHANICS**
Module Code	I3682MS
NQF Level	6
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or Practical Session / Week
Additional learning requirements	Mine visit
NQF Credits	12
(Co-requisites)	(None)
Pre-requisite	**I3582NM Engineering Mechanics I**
Semester Offered	2

Module Purpose
This course aims to provide an understanding of applied science in strength of material to evaluate the engineering properties of the ground before, during and after the mining excavation operations. A thorough understanding of soils and rock physical and mechanical properties, stress analysis, lateral earth pressure, seepage etc. will be discussed.

Overarching Learning Outcome
Students will be able to identify the geotechnical properties of soils and rocks for the design of a mine.

Specific Learning Outcomes
On completing the module students should be able to:
1. Perform two-dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity.
2. Display knowledge of the strength and deformation characteristics of rock masses.
3. Discuss useful mechanical properties of rock masses.
4. Analyse failure criteria for rocks and rock masses.
5. Analyse and monitor slope stability of mine faces.
6. Discuss the characteristics and the mechanical properties (strength and failure criteria) of rock mass, rock matrix and discontinuities.
7. Explain methods for in situ investigation and laboratory testing of rock matrix and discontinuities.
8. Conduct rock slope stability analyses.
9. Analyse the stress distribution (isotropic, anisotropic) in situ and around an opening in rock (competent rock, jointed rock mass, blocky rock).
10. Propose designs of excavation supports and solve practical problems related to rock excavations.
11. Describe the theory, analysis, and control of rock and soil slope stability and rockfall hazards. Calculate the Factor of Safety of rock slopes and underground excavations.

Module Content
Simple soil properties, classification of soils and rocks, Soil profiles, site exploration, drilling and sampling. Compaction of soils, shear strength, settlement, bearing capacity, slope stability and monitoring of slopes with available instrument, earth pressure. Problems of equilibrium and deformation, Effective and total stresses, Consolidation and settlements of soils Theory of shear strength in soils. **Mechanics of solids**: Two-dimensional analysis of stress and strain; linear elasticity; stresses and displacements around mining excavations; three-dimensional elasticity. Strength and deformation characteristics of rock: Intact rock properties; shear strength of discontinuities; mechanical properties of rock masses; **Mohr-Coulomb and Hoek-Brown failure criteria**. Mine Tour: a series of visits to mines and mining-related institutions as arranged by the Department at appropriate times.
Rock coring and logging. Physico-mechanical properties – **Physical Properties**: Density, unit weight and specific gravity, Moisture content, degree of saturation, Porosity, Void ratio, Permeability, Velocity of elastic waves, Electrical resistivity, Thermal properties, Durability, - Mechanical Properties: Uniaxial compressive strength, Tensile strength, Point load strength, Triaxial strength, Direct shear strength, Rock strength and failure mod, **Intact rock properties**: shear strength of discontinuities; mechanical properties of rock masses; *Mohr-Coulomb and Hoek-Brown failure criteria*. Rock slope instabilities: types, design and mitigation measures. Stress distribution (isotropic, anisotropic) in situ and around an opening in rock (competent rock, jointed rock mass, blocky rock), design of excavation supports for underground and surface mining. **Slope stability** and underground rock excavation methods in a given stress environment. **Discontinuities:** deformability, strength and failure Criteria. Strength and deformation characteristics of rock: **Rock mass classification** (RMR, Q, GSI) and rock mass behaviour (including influence of discontinuities on strength, stress distribution and water flow). In situ investigation and laboratory testing for the measurement of strength and deformation behaviour of intact rocks and their interpretation to determine the strength and deformation parameters under *uniaxial compression, triaxial* compression and uniaxial tension.

Contribution to Exit Level Outcome:
- Problem solving (Course Outcomes 1, 2, 4, 5, 7, 8, 9, 10).
- Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4 5, 7, 8, 9, 10, 11)
- Engineering design (Course Outcomes 8, 10).
- Individual, team and multidisciplinary working (Course Outcomes 1, 4, 5, 7, 8, 9, 10).
- Engineering management (Course Outcomes 10, 11).
- Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11).

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

- Four lecture periods per week for 12 weeks
- One tutorial or practical session per week for 12 weeks
- Weekly consultation sessions
- Laboratory practicals
- At least one field trip/mine visit.

Student Assessment Strategies

Students will be assessed through continuous assessments activities and a final examination

1. The Continuous Assessment will be made up of the following assessment activities:

    Assignments (tutorials, quizzes and field practicals): 20%

    Tests (At least 3 tests): 30%

2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 50% in Continuous Assessment.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students' evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours.

Prescribed Learning Resources

1. S, Bhawani and R. K. Goel (2011) Engineering Rock Mass Classification: Tunnelling, Foundations and Landslides, Elsevier
2. G. H. G. Brady and E. T. Brown (2014) Rock Mechanics for Underground mining: Third Edition, Kluwer Academic Publisher
3. John A Hudson and John P Harrison (2016) Engineering rock mechanics volume 3, university of London, UK.
4. Craig's Soil Mechanics (SEVEN EDITION), R. F. Craig, University of Dundee, UK
5. Soil Mechanics, Arnold Verruijt, Delft University of Technology

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15.5.3 YEAR 3 OF (32BHMI) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.5.3 .1 YEAR 2 SEMESTER 1

Module Title:	**MINE SURVEYING AND GEOSPATIAL TECHNOLOGIES**
Module Code	I3781MG
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Nil
NQF Credits	12
(Co-requisites)	(I3692VS Surveying for Engineers)
Pre-requisite	
Semester Offered	1

Module Purpose:
The purpose of this module is to apply the knowledge from engineering surveying in surface and underground mines and exposes students to current and emerging geospatial techniques used in mining.
Overarching Learning Outcome
Students will be able to conduct and interpret mine surveys, and use information from geospatial technologies to make decision.
Specific Learning Outcomes
On completing the module students should be able to:
1. Design and select appropriate mine transport systems for loading and hauling.
2. Illustrate major mining methods and related equipment and support infrastructure.
3. Manage, select, and maintain equipment, materials, and consumables.
4. Demonstrate awareness of major technological trends.
5. Analyse processes in accessing, recovering, transporting, and processing ore.
6. Demonstrate the fundamental tools and techniques of automation and robotics as applied to modern mining practice.
7. Recommend equipment for production requirements.
8. Conduct routine maintenance on equipment.
9. Apply suitable equipment for a specific mining method.
10. Perform haul-road maintenance.

Module Content:
Mine surveying: introduction to the importance of mine surveying in the efficient and safe running of a mine; principles of surveying and mine surveying; surveying equipment; principles of reserve estimation of mineral deposits The plane-meter and areas Interpretation of maps and plan:. Understanding map projections, developable surfaces and distortions; Underground Surveying: transfer of surface surveys to the underground environment; underground mine surveying methods, application to mine planning, design and safety; surveying legal requirements and their application to the mining industry; mathematical and surveying principles for solving three dimensional mine design problems; interpretation of mine surveying results for improved decision making. Geospatial techniques: earth geographic information using Geographical Information System (GIS), Remote Sensing (RS) and other ground information from various devices and instruments and their application to mining Practical: underground traversing (with tapes and total stations); using a gyro-theodolite; GPS instruments; observations and producing mine surveying records in terms of the mining laws.
Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 2, 3, 4, 5, 6, 7).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3. Individual, team and multidisciplinary working (Course Outcomes 6).
4. Engineering methods, skills and tools, including information technology (Course Outcomes 2, 3, 4, 5, 6, 7).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks
3. Weekly consultation sessions
4. A group/individual practical.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination
1. The Continuous Assessment will be made up of the following assessment activities:
iii) Assignments (tutorials and quizzes): 10%
iv) Tests (At least 3 tests): 30%
v) A group/individual practical: 10%
2. End-of-semester examination (50%).
Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 40%.
Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Prescribed Learning Resources

1. Landman K., Hunter T., and Jackson J. (2013) An Introduction to Engineering Surveying, Juta and Company Ltd., Cape Town, South Africa.
2. Uren J., and Price W. (2006) Surveying for Engineers, Fourth edition, Palgrave Macmillan, New York, USA.
3. Surveying for Mine Surveyors (2004) The Institute of Mine Surveyors of South Africa, Updated Edition, 493p.
4. Bannister A., Raymond S. and Baker R. (1998) Surveying; Seventh Edition, Pearson Education Limited, Edinburg Gate, England 502p.
5. McCormac J., Sarasua W., and Davis W., (2013) Surveying, John Wiley and Sons Inc, Sixth Edition, New York, USA.
6. Schofield W. And Breach M. (2011) Engineering Surveying. Sixth Edition, Spon Press, Milton Park, Abingdon, Oxon, 622p.
7. Walker, John, Awange, Joseph L. (2020) Surveying for Civil and Mine Engineers, Springer Nature, Chan, Switzerland 130p

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Module Title:	**MINE EQUIPMENT AND AUTOMATION**
Module Code	I3791ME
NQF Level	7
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorial Session / Week
Additional learning requirements	Mine visit
NQF Credits	12
(Co-requisites)	(I3691MM Introduction to Mining Methods)
Semester Offered	1

Module Purpose:
The purpose of this module is to equip the students with knowledge and skills in the selection of appropriate machinery and equipment for different mining applications at different conditions.

Overarching Learning Outcome
Students will be able to analyse and select suitable mine transportation systems for different mining methods.

Specific Learning Outcomes
On completing the module students should be able to:
1. Design and select appropriate mine transport systems for loading and hauling.
2. Illustrate major mining methods and related equipment and support infrastructure.
3. Manage, select, and maintain equipment, materials, and consumables.
4. Demonstrate awareness of major technological trends.
5. Analyse processes in accessing, recovering, transporting, and processing ore.
6. Demonstrate the fundamental tools and techniques of automation and robotics as applied to modern mining practice.
7. Recommend equipment for production requirements.
8. Conduct routine maintenance on equipment.
9. Apply suitable equipment for a specific mining method.
10. Perform haul-road maintenance.

Module Content:
Underground man riding and material transportation systems: belt conveyors; underground loading and hauling systems; surface loading and hauling systems; automation and robotics equipment ownership and operating cost**. Underground scraper winch systems and loaders. Railway tramping systems for rock, men and material. Loading machines**: rope shovels; hydraulic mining shovels; bucket excavators and draglines; dredges; front end loaders; trackless load haul dump units. **Surface mine Machinery:** Power shovel; front-end-loaders; dragline; hydraulic excavators; bucket wheel excavators; bucket chain excavators; rippers; scrapers; bulldozers and dump trucks. **Underground mine machinery**: Loaders-gathering arm loaders; bucket type loaders; front-end-loaders and load-haul-dump. **Transport and Haulage**: Railways; shuttle cars; conveyor belts; rope way; rope haulage-direct and endless rope. **Maintenance of mine machinery**: routine; emergency; periodic overhaul and planned maintenance; reliability and availability of equipment. **Workshop and maintenance tools**. Dredges. **Pneumatic conveying of solids in pipelines:** hydraulic transportation; Types of pumps and their application. **Pump characteristics**: compressors-reciprocating; piston and rotary types; characteristics and choice of compressors. Surface Mining: Automated Haulage; Fleet Management. Robotic Digging: Robotic Dozing; Autonomous Blasthole Drilling and Telerobotic Rock Breaking. **Automated Loading Unit and Truck Interactions:** Dragline Automation; Machine Positioning and Terrain Mapping. **Underground Mining**: Telerobotic Operations; Autonomous Tramming; **Robotic Loading and Longwall Automation**. **Robotic Explosives Loading and Underground Mapping**: Surveying and Positioning**. Surface and underground mine automation**. Technical report writing and presentation. **Mine visit.**

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3. Engineering design (Course Outcomes 1, 7).
4. Individual, team and multidisciplinary working (Course Outcomes 2, 7).
5. Engineering management (Course Outcomes 8).
6. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks
3. Weekly consultation sessions
4. A group physical models/design project at the end of the module.
5. At least one field trip/mine visit.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination
1. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes and field reports): 20%
   ii. Tests (At least 3 tests): 30%
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 50% in the design project.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Prescribed Learning Resources
1. Hartman, H.L. (2002) Introductory Mining Engineering, 2nd edition. Wiley, New York.
2. Hustrulid, W. Kuchta, M. (2006) Open Pit Mine Planning and Design, Balkema, Rotterdam.

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Module Title:	**HYDROGEOLOGY**
Module Code	I3721MH
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Nil
NQF Credits	8
(Co-requisites)	
Pre-requisite	(I3611MG Engineering and Structural Geology)
Semester Offered	1

Module Purpose:
The aim of the module is to provide students with sound knowledge of geological description of existing soils and bedrock, depth of the water table and groundwater flow direction and hydraulic gradient vital in the design of a mine and skills to identify and understand various ways of water's appearance and flow.
Overarching Learning Outcome
Students will be able to analyse, identify and evaluate the geological description of existing soils and bedrock within the depth of the water table.
Specific Learning Outcomes
On completing the module students should be able to:
1. Analyse the mechanics of groundwater recharge and its analysis.
2. Apply the theory of aquifer hydraulics, model underground aquifers and evaluate them.

3. Appraise the reactions governing underground solutions
4. Develop the skills to identify and understand various ways of water's appearance and flow
5. Analyse pumping systems and sequences for underground mining purposes.
6. Develop methods of controlling and predicting contamination levels of underground water by minerals and other solutions.
7. Apply basic geological knowledge to solve engineering geology problems.
8. Develop techniques to control and predict contamination levels of underground water.
9. Design and select appropriate pumping systems for underground mining purposes.

Module Content:
Basic hydrogeology: Inventory of water resources on Earth; Elements of the hydrologic cycle. Groundwater flow equations and flow net analysis: piezometer, piezometer nests and potentiometric surface map; regional groundwater flow systems; ground recharge mechanisms and estimation techniques. Aquifer Hydraulics: Theis equation; computing drawdown; aquifer parameters from time-drawdown data; slug tests; intersecting pumping cones and well interference; effect of hydro geologic boundaries; aquifer test design; well loss; well efficiency; well specific capacity and optimum pumping rates. Solute transport in aquifers: diffusion; advection; dispersion; retardation; sorption reactions; redox reactions; cation exchange; carbonate dissolution and precipitation reactions. The advection-dispersion equation; mass transport with reaction; first order kinetic reactions; equilibrium sorption reactions.

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 1, 2, 3, 4).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 7).
3. Engineering design (Course Outcomes 1, 7).
4. Investigations, experiments and data analysis (Course Outcomes 3, 4, 6, 7).
5. Sustainability and impact of engineering activity (Course Outcomes 1, 2, 3, 4, 5, 6, 7).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks.
2. One tutorial or one practical session per week for 12 weeks.
3. Weekly consultation sessions.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination
1. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (tutorials, quizzes, practical sessions and field reports): 20%
ii) Tests (At least 3 tests): 30%
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 50%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours.

Prescribed Learning Resources
1. Hiscock, K. Bense, V. (2014) Hydrogeology, Principles and Practice. New York, NY: John Wiley and Sons Inc.
2. Brassington, R. (2017). Field hydrogeology. John Wiley and Sons. International Institute for Land Reclamation and Improvement.

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Module Title:	SURFACE MINING
Module Code	I3711MS
NQF Level	7
Notional Hours	160
Additional learning requirements	Mine visit
Contact hours	4 Lectures + 1 Tutorial and / or 1 Practical Session / Week
NQF Credits	16
(Co-requisites)	(I3682MS Soil and Rock Mechanics)
Prerequisite	I3691MM Introduction to Mining Methods
Semester Offered	2

Module Purpose
The aim of the module is to provide students with adequate scientific theories and knowledge of various surface mining methods and skills to design suitable surface mining methods for a particular deposit.

Overarching Learning Outcome
Students will be able to identify, select and design suitable surface mining methods, related equipment and support infrastructure to extract a particular mineral deposit.

Specific Learning Outcomes
On completing the module students should be able to:
1. Apply fundamental theories of various factors affecting in selecting of a particular surface mining method.
2. Apply fundamental theories to determine ore reserve; economic cut-offs; stripping ratios and breakeven ratios of a particular mineral deposit.
3. Determine layouts of various surface mining methods.
4. Apply scientific theories to the production of aggregates and dimension stones.
5. Apply the scientific and design concept to the design and operational parameters in various surface mining methods such as open pit, quarrying, open cast and marine mining.
6. Select the most suitable equipment's and machinery for a particular surface mining method project.
7. Perform mine planning and optimization of a particular surface mining extraction project.
8. Appraise mine rehabilitation and closure.
9. Design various extraction process/ surface mining techniques for mining of gold, uranium, copper, diamond, dimension stone etc. in Namibia, which safe, efficient, economic, environmentally and socially responsible operations

Module Contents
Surface mining methods: factor affecting the selection of a particular mining method; ore reserve estimation methods; economic cut-offs; pit optimization, mine development phases, stripping ratios and breakeven ratios. **Features and layouts of various surface mining** methods such as open pit, open cast/strip Mining, quarrying and marine mining, brine mining/ aqueous extraction, in situ mining. **Surface mine design**: Determination of design and operation parameters such as optimum depth of a pit, bench element: slopes, slope stability analysis, effects of water in a slope, monitoring of slopes, overall slope angle, width, height or working platform of a bench, haul roads, mine infrastructure and relevant transportation, equipment selection, cycle times, fleet optimization and material handling. **Mine planning**: Introduction to mine planning, short and long term planning, push back design. **Mine rehabilitation and closure**: integrated environmental management, environmental impact studies, water management and rehabilitation planning and waste dump. Application of the following software: SURPAC and Sherpa for Surface Mines etc. Mine visit.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 6, 7, 9).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 9).
3. Engineering Design (Course Outcomes 3, 5, 6, 7, 8, 9).
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5, 6, 7, 8, 9).
5. Individual, Team and Multidisciplinary Working (Course Outcomes 9).

Learning and Teaching Strategies/ Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks.
3. Weekly consultation sessions.
4. A group design project at the end of the module.
5. At least one field trip.
6. Guest Lecture

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination.
1. The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (at least 2): 10%.
   ii. Quizzes
   iii. Field trip reports : 5 %
   iv. Tests (At least 2 tests): 20%.
   v. Mini design project (oral presentation and design report): 15%.
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 40%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.
6. Weekly consultation hours

Prescribed Learning Resources
1. Duncan C. Wyllie, C. M., 2004. Rock Slope Engineering. Fourth ed. London and New York: CRC Press.
2. Howard L. Hartman, S. f. M. M. a. E. (1992. SME Mining Engineering Handbook, Volume 2. 2nd ed. Society for Mining, Metallurgy, and Exploration.
3. Mutmansky, H. L. H. and. J. M., 2002. Introductory Mining Engineering. 2nd ed. New Jersey: John Wiley and Sons,.
4. Tatiya, R. R., 2005. Surface and Underground Excavation. 1st ed. Great Britain: Taylor and Francis Group plc, London, UK.
5. William A. Hustrulid, M. K. R. K. M., 2013. Open Pit Mine Planning and Design, Two Volume Set and CD-ROM Pack. 3rd ed. London and New York: CRC Press.

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Module Title:	**ROCK ENGINEERING**
Module Code	I3781MR
NQF Level	8
Notional Hours	120
Contact hours	3 Lectures + 1 Tutorials and / or 1 Practical Session /Week
Additional learning requirements	Mine visit
NQF Credits	12
(Co-requisites)	
Pre-requisite	**(I3682MS Soil and Rock Mechanics)**
Semester Offered	1

Module Purpose:
The purpose of this module is to equip students with methods and principles in the design of structures built in rocks during surface and underground mine operations.

Overarching Learning Outcome
Students should be able to apply appropriate design methods in rock engineering on the basis of geologic environment, rock type, type of engineering structure, design loads that have to be considered, and end uses for which the engineering structure is intended.
Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss failure criteria for rocks and rock masses.
2. Apply rock engineering principles during the designs of mine openings.
3. Design the optimum sizes of the room and of pillars.
4. Design the necessary supports of mine openings.
5. Conduct engineering rock mass classification
6. Determine principal stresses around underground mine openings
7. Compute total average spacing between discontinuities intercepted by an orientation and a set of discontinuities.

Module Contents
Development of rock engineering, acceptable rock engineering design, rock mass classification, shear strength of discontinuities, structurally controlled instability in tunnels, slope stability, factor of safety and probability of failure, analysis of rockfall hazards, in situ and induced stresses, rock mass properties, tunnels in weak rock, large powerhouse caverns in weak rock, rock bolts and cables, shotcrete support, blasting damage in rock. Practical sessions on porosity, permeability, uniaxial compressive strength and tensile strength will be conducted.

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
2. Application of scientific and engineering knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
3. Engineering design (Course Outcomes 3, 4, 6).
4. Investigations, experiments and data analysis (Course Outcomes 1, 2, 3).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 2, 3).
6. Sustainability and impact of engineering activity (Course Outcomes 3, 4,).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Four lecture periods per week for 12 weeks.
2. One tutorial or practical session per week for 12 weeks.
3. Weekly consultation sessions

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination.
1. The Continuous Assessment will be made up of the following assessment activities:
i) Assignments (tutorials, case studies): 5%.
ii) Tests (At least 2 tests): 15%.
iii) Research project (oral presentation and design report): 30%.
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 50%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of projects, test question papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and presentations.
5. Weekly consultation hour.

Prescribed Learning Resources
1. Practical Rock Engineering, Evert Hoek 2006.
2. Rock Mechanics for Underground Mining, Third Edition, B.H.G. Brady and E.T. Brown, 2005.
3. Engineering Rock Mechanics Part 2, Illustrative worked examples, John A. Hudson and John P. Harrison, 2000.
4. Engineering Rock Mechanics Part 1. An Introduction to the principles, John A. Hudson and John P. Harrison, 1997.

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YEAR 3 OF (32BHMI) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.5.3 .3 YEAR 2 SEMESTER 2

Module Title:	**TECHNICAL WRITING**
Module Code	I3762VW
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial Session / Week
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(U3683AL Academic Literacy II)
Pre-requisite	
Semester Offered	2

Module Purpose
The purpose of this module is to equip students with skills based in theory relating to professional and technical writing.

Overarching Learning Outcome
Equip students with professional communication skills that will enable them to write good technical documents and to plan and present effective professional technical presentations individually and in teams.

Specific Learning Outcomes
On completing the module students should be able to:
1. Produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. Communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates and complying with constraints on document format.
3. Adapt content and rhetorical strategies according to audience and purpose for each document.
4. Select appropriate, credible sources to support the claims, findings or recommendations made in technical documents.
5. Incorporate ideas from source material, including images and figures.
6. Create and deliver technical briefings tailored to specific audiences, purposes and media.
7. Explain ethical considerations applicable to technical communication in engineering and computer sciences.

Module Content
Introduction: academic vs technical communication; introduction to a various technical and business writing theories and practices designed to be applicable to the production of business communication in the real world. Technical writing: fundamentals of good business/technical writing, including protocols for business letters, memoranda, electronic mail, good and bad messages; persuasive messages and formal reports and proposals. Technical reports: planning, structure, style and language for purpose and audience; effective graphical support. Professional Oral communication: structure, style and language; academic and professional discourse; group presentations to industry professionals. Posters and e-portfolios.

Contribution to Exit Level Outcome
Professional and technical communication (Course Outcomes 1, 2, 3, 4, 5, 6 and 7).

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Lectures.
2. Face-to-face consultations wherever necessary.
3. Case studies.

Student Assessment Strategies
Students will be assessed through Continuous Assessment (CA) activities as follows:
1. Assignments: 20%.
2. Group oral presentations: 10%.
3. Individual reports: 40%.
4. Tests (at least 2): 30%.

Criteria for passing the module
To pass this module a student should obtain a minimum final mark of 50%.

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of project reports and scripts.
2. Peer-review of course outlines and teaching.
3. Student evaluations.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.

Mechanisms that will be put in place to monitor student progress, evaluate course impact and effect improvement
1. One-on-one consultations with students during consultation hours.
2. Allocation of extra reading material where applicable.
3. Implement a bi-semester course evaluation to be administered through a Google Survey.

Prescribed Learning Resources
English, J. (2013). Professional Communication: Deliver effective written, spoken and visual messages, 3rd Edition, Juta Academic. ISBN 978-0702177927.

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Module Title:	MINERAL PROCESSING
Module Code	I3742MP
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Mine visit
NQF Credits	8
(Co-requisites)	(I3691MM Introduction to Mining Methods)
Pre-requisite	
Semester Offered	2

Module Purpose:
The purpose of this module is to equip the students with knowledge and skills in concepts of mineral concentration techniques, equipment and machinery, and Mining plant design.

Overarching Learning Outcome
Students should be able to design a mineral processing plant and select appropriate equipment for the plant.

Specific Learning Outcomes
On completing the module students should be able to:
1. Discuss the role of comminution in liberation of minerals
2. Discuss the processes involved in size reduction of minerals
3. Apply the principles of concentrating valuable minerals
4. Explain the principals involved in solid-liquid separation
5. Sketch simple flow sheets for mineral processing
6. Design and select an appropriate mine processing plant
7. Explain the basic methods of extracting metals from concentrated ores.

Module Content:
Comminution: role of comminution. Comminution laws, basic principles of crushing and crushing equipment; grinding and grinding equipment. **Classification**: screening and sieve analysis. **Concentration**: gravity concentration and equipment, magnetic and electrostatic separation and equipment, flotation principles. **Solid and liquid separation**: sedimentation, thickening and filtration, basic flowsheet design for selected minerals, coal preparation, heavy sands processing etc. **Basic Extractive Metallurgy**: pyrometallurgy, hydrometallurgy, electrometallurgy. Practical sessions will be carried on crushing, grinding and sieve analysis.

Contribution to Exit Level Outcome:
1. Problem solving (Course Outcomes 2, 3, 4, 5, 6, 7).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7)
3. Engineering design (Course Outcomes 5, 6).
4. Individual, team and multidisciplinary working (Course Outcomes 3, 6,).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7).

Learning and Teaching Strategies/Activities
The course will be facilitated through the following teaching learning activities:
1. Two lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks
3. Weekly consultation sessions
4. At least one field trip/mine visit.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination
1 The Continuous Assessment will be made up of the following assessment activities:
   i. Assignments (tutorials, quizzes, practical sessions and field reports): 20%
   ii. Tests (At least 3 tests): 30%
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of 50% in continuous assessments.
Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Prescribed Learning Resources
1. A. Gupta and D. S. Yan (2006) Mineral Processing Design and Operation: An Introduction book. ISBN: 978-0471033790
2. Barry A. Wills and Tim Napier-Munn, (2006) Mineral Processing Technology, 7th Edition. ISBN: 978-0-7506-4450-1

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Module Title:	**OIL AND GAS ENGINEERING**
Module Code	I3762MO
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial
Additional learning requirements	None
NQF Credits	8
(Co-requisites)	(I3682MS Soil and Rock Mechanics, I3691MM Introduction to Mining Methods)
Prerequisite	
Semester Offered	2

Module Purpose
The aim of the module is to provide students with fundamental knowledge of oil and gas engineering concepts such as oil and gas reservoirs, drilling, well completion, well logging and environment.
Overarching Learning Outcome
Students will be able to solve borehole and casing problems during drilling for oil and gas.

Specific Learning Outcomes
On completing the course students should be able to:
1. Apply scientific theories to identify and analyse hydrocarbon reservoirs.
2. Appraise the components of an oil and gas drilling rig.
3. Apply scientific theories to determine the pressure requirement at every stage of the drilling operation.
4. Design casing profile and establish a proper procedure for well control to ensure the safety of the personnel, and to protect the environment.
5. Perform readings of well logging data and evaluate well logs for formation evaluation.
6. Appraise the impact of oil and gas activities to environment.

Module Content
Oil and gas reservoir: Description of hydrocarbon reservoir. Origin, migration and accumulation of oil and gas. Composition of Oil and Gas, state of Oil and Gas. Types of traps. Gas-reservoirs, Gas-condensate reservoirs, unsaturated reservoirs, and oil reservoirs under various drive mechanisms. Fluid flow in reservoirs. Oil and Gas Economics, **Oil and gas drilling**: techniques for oil/gas well drilling. Drilling rigs: equipment, hoisting, drill string, casing, drill bits and drill string design. Circulating system-drilling fluids, drilling hydraulics. Functions of drilling mud, types and fundamental properties of drilling mud. Casing design, functions and types of casing, Strength consideration and loading. Cementing-functions, classes and types cement, properties of cement slurry, mechanics of cementing. Hole problems. Formation characteristics and associated drilling problems. Directional drilling and multi-zone completion. Well head equipment. **Well completions**: Skin, Production Casing and Liners, Perforating, Acidizing, Hydraulic Fracturing, Wellbore and Surface Hardware: Completion and Work over, Production and Christmas-tree, pressure, Reservoir Performance: Well flow measurement and monitoring, Monitoring and measuring devices. **Well logging**: logging environment, lithology logs, porosity logs, resistivity logs, and log calibration with formation samples. **Midstream and downstream operations**: The Midstream Sector, The Downstream Sector: Refineries. Oil and Gas and the Environment. Application of the following software: GMI- GeoMechanics International, Petrel.
Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 3).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 4).
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3,).
4. Sustainability and Impact of Engineering Activity (Course Outcomes 6).

Learning and Teaching Strategies/Activities
1. Two lecture periods per week for 12 weeks
2. One tutorial session per week for 12 weeks.
3. Weekly consultation sessions
4. A group design project at the end of the module.
5. At least one field trip.

Student Assessment Strategies
Students will be assessed through continuous assessments activities and a final examination.
1. The Continuous Assessment will be made up of the following assessment activities:
I. Assignments (at least 1): 15%.
II. Tests (At least 2 tests): 25%.
III. Quizzes (at least 4)
IV. Mini project (oral presentation and design report): 10%.
2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:
1. To qualify for the exam, a student must obtain a minimum of CA of 40%.

Criteria for passing the course:
1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 2-hour paper).

Learning and Teaching Enhancement Strategies
1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Student's evaluation.
4. Regular review of course content.
5. Effective and efficient supervision and monitoring of assignments, tests and examination.
6. Weekly consultation hours.

Prescribed Learning Resources
1. Lecture notes.
2. Books:
   i. Frach, J. R. and Christiansen, R. I., 2017. Introduction to Oil and Gas Engineering. 2nd ed.
   ii. Hyne Normal J, 2001. Oil and Gas Geology, Exploration, drilling and Production. 2nd ed. Penn Well Books.
   iii. John R. Fanchi, R. L. C., 2016. Introduction to Petroleum Engineering. New Jersey: John Wiley and Sons

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Module Title:	MINERAL RESOURCE ESTIMATION
Module Code	I3742MM
NQF Level	7
Notional Hours	80
Contact hours	2 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Nil
NQF Credits	8
(Co-requisites)	(I3691MM Introduction to Mining Methods)
Prerequisite	I3582IS Statistics for Engineers
Semester Offered	2

Module Purpose
This course aims to give students skill in the application of statistical technique to ore analysis and geo-statistical method to ore reserve estimation.

Overarching Learning Outcome
Students will be able to model an orebody using software packages.

Specific Learning Outcomes
On completing the module, students should be able to:
1. Review statistical valuation methods.
2. Analyse various geo-statistical models.
3. Apply geo-statistical methods in ore valuations.
4. Apply ore body modelling techniques to mine development.
5. Derive geological, geochemical and geotechnical characteristics of mineralisation using different sampling methods
6. Perform QA/QC on samples in the field and laboratory
7. Apply different coordinate systems to geological and resource modelling
8. Develop 3D geological block models using software packages

Module Content

Statistical valuation methods: Overview of descriptive statistics; inference from normal distributions, estimation of mean and standard deviation, confidence levels on parameters, hypothesis testing. Student's T and F-ratio's tests, correlation and regression methods, tests of significance, multivariate regression and trend surface analysis, inference from lognormal distributions, estimation of mean and confidence levels. Grade/tonnage curves. **Geo-statistical valuation methods**: inverse distance techniques, calculation and modelling of semi-variograms, estimation of unknown values, ordinary and universal rigging, volume/variance relationships. **Sampling**: sampling methods; sample preparation and assaying; sampling errors, sampling/drilling strategies. **Geo-statistical applications**: valuation and mine economics; mine process flow; mining factors; economic effects of dilution and recovery; SAMREC code; reporting of resources and reserves; paylimits; economic and planning cut-off grades; grade control. Principles of ore-forming processes and geological environments of ore formation; ore classification schemes; geometry of ore bodies; systematic review of major metallic and non-metallic ore types; ore samples and ore mineralogy; mapping techniques. **Geological and Resource Modelling**: 3D geological modelling; coordinate systems; data errors; data validation.

Contribution to Exit Level Outcome:

1 Problem solving (1, 3, 4, 5).
2 Application of Scientific and Engineering Knowledge (3, 5).
3 Investigations, Experiments and Data Analysis (1, 2).
5 Engineering Methods, Skills and Tools, Including Information Technology (1, 2, 3, 5).

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Two lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks.
3. Weekly face-to-face consultation sessions.
4. A group project at the end of the module.

Student Assessment Strategies

Students will be assessed through continuous assessments activities and a final examination.

1. The Continuous Assessment will be made up of the following assessment activities:

I. Assignments (technical report, tutorials, quizzes, lab): 10%.
II. Tests (At least 2 tests): 30%.
III. Group project (oral presentation and report): 10%.

2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of CA of 40%.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours.

Prescribed Learning Resources

1. Rossi, M., 2016. Mineral Resource Estimation. Springer.
2. Edwards, A., 2014. Mineral resource and ore reserve estimation. Carlton, Vic.: Australasian Institute of Mining and Metallurgy.
3. David, M., 2014. Geostatistical Ore Reserve Estimation. Amsterdam: Elsevier Science.
4. Journel, A. G, 2004. Evaluation of Mineral Reserves: A simulation Approach. Oxford University Press

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Module Title:	UNDERGROUND MINING
Module Code	I3732MU
NQF Level	8
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Mine Visit
NQF Credits	16
(Co-requisites)	(I3682MS Soil and Rock Mechanics)
Prerequisite	**(I3691MM) Introduction to Mining Methods**
Semester Offered	2

Module Purpose
The purpose of this module is to review underground mining methods and criteria for selection of each, understand criteria for underground mine planning optimization and estimation of production estimates and understand the principles for underground mine layout.
Overarching Learning Outcome
Students will be able to identify, select and design appropriate underground mining methods, related equipment and support infrastructure for a mineral deposit.

Specific Learning Outcomes
On completing the module students should be able to:
1. Evaluate underground mining systems with respect to safe, efficient, economic, and environmentally and socially responsible operations.
2. Identify and minimise core risks for an underground mining system.
3. Show an awareness of technological trends and options in underground mining systems.
4. Design and analyse different techniques and mechanical technologies used in massive deposits.
5. Discuss the mining systems and factors to be considered for safe working environment.
6. Demonstrate the application of automation in underground mining.
7. Develop the opening up of mineral deposits.
8. Design shafts and underground road ways.
9. Design ventilation systems underground.
10. Design transport systems underground.

Module Content
Scope and limitations of underground mining, opening up of underground deposits, choice of entry shaft and combination and their applicability, limitations**. Factors affecting selection of mode of entry and different types of mode entry**: incline, shaft, inclined shaft, adit/drift. Development planning and preparations for development and extraction, construction of development openings. **Underground mining systems**: unsupported and supported underground mining methods. Fundamentals of stope design/layout development, drilling and blasting, gravity flow analysis, and stope design. Mining of averagely thick and thick deposits. **Exploiting tabular ore deposits**. **Exploitation of massive ore bodies**: open stopping, room and pillar mining, cut and fill stopping, shrinkage mining, post pillar cut and fill mining, block caving, continuous block caving, cascade mining and vertical crater retreat, etc. **Factors influencing choice of coal mining methods and different coal mining methods. Bord and pillar mining**: applicability, limitations, advantages and disadvantages of bord and pillar mining method, development and depillaring sequence operations in bord and pillar mining, and its related calculations, dangers associated with bord and pillar method and precautions. **Longwall Mining:** Applicability, limitations, merits and demerits, different longwall mining methods, factors influencing selection of longwall method, method of development and depillaring and its related calculations. Thin seam and thick seam mining with longwall mining method. **Thick Seam and deep seam mining**: problems associated with thick and deep seam mining, selection of mining method, caving and stowing methods, limitations and applicability. **Working steep and moderately thick seams**: blasting gallery method, room and pillar method etc. **Stoping:** Classification of stoping methods, applicability, limitations, merits and demerits, Factors affecting choice of stopping methods like depth, dip, width grade / value of deposit, physio mechanical characteristics of the ore and wall rocks. Stoping methods: stoping without supports: open stopping, overhand, underhand, breast stoping. Stoping with Supports: shrinkage stopping cut and fill stopping, square set stopping. **Caving methods**: top slicing, sublevel caving and block caving. **Selection and operation of underground equipment**: conveyors, cable ropeways and rope haulage, track and trackless mining systems, hydraulic transport and pipeline systems. Technical report writing and presentation. **Mine visit**.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 3, 4).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4).
3. Engineering Design (Course Outcomes 4, 5, 7, 8, 9, 10).
4. Engineering Methods, Skills and Tools including Information Technology (Course Outcomes 4)

Learning and Teaching Strategies/Activities
The module will be facilitated through the following teaching and learning activities:
1. Four lecture periods per week for 12 weeks (including guest lectures).
2. One tutorials or practical session per week for 12 weeks.
3. Weekly consultation sessions.
4. Course group project at the end of the module.

Student Assessment Strategies

1. The Continuous Assessment will be made up of the following assessment activities:

i) Assignments (tutorials, demonstrations and technical reports): 15%.

ii) Main Tests (At least 3 tests): 30%.

iii) Course group project (oral presentation and report): 5%.

2. End-of-semester examination 50%.

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 40% for the Continuous Assessment.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum final mark of 50%.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation.
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours.

Prescribed Learning Resources

1. Hartman H. L., 2002. Introductory Mining Engineering, 2nd edition. Wiley, New York.
2. Hustrulid, W., Richard, L. Bullock, 2001. Underground Mining Methods: Engineering Fundamentals and International Case Studies.
3. Mining Explained: A Layman's Guide, 2004.
4. Szwilski, A.B., Richards, M. J., 1987. Underground Mining Methods and Technology Advances in Mining Science and Technology.
5. Singh, T. N., 1992. Underground Mining of Coal.

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Module Title:	**MINE VENTILATION AND CLIMATE CONTROL**
Module Code	I3752MV
NQF Level	7
Notional Hours	160
Contact hours	4 Lectures + 1 Tutorial and/or 1 Practical Session / Week
Additional learning requirements	Mine visit
NQF Credits	16
(Co-requisites)	(I3692NF Fluid Mechanics I)
Pre-requisite	**(I3691MM) Introduction to Mining Methods**
Semester Offered	2

Module Purpose:

The purpose of this module is to provide background knowledge of air flow through mine opening and it applications for the design of a ventilation system for an underground mine.

Overarching Learning Outcome

Students will be able to analyse, select and design an appropriate ventilation system for a mine.

Specific Learning Outcomes

On completing the module students should be able to:

1. Analyse the nature of the mine environment.
2. Analyse the common impurities and hazards in mine atmosphere.
3. Apply the principles of fluid flow to ventilation systems.
4. Develop skills to undertake mine ventilation calculations.
5. Design and select an appropriate ventilation system for a mine.
6. Analyse mine environmental hazards.
7. Analyse and recommend engineering control of mine dust.
8. Design the required head losses and fan power in mine airways.
9. Analyse the physiological effects of various mine impurities and possible remedies.
10. Perform control measures that detect, monitor, minimise and/or manage mine hazards.

Module Content

Ventilation: Fundamentals of mine ventilation; general air circulation; Natural and artificial ventilation of mines and enclosed areas. **Mine atmosphere**: Composition; impurities; mine gases; gases in sub surface openings; classification; mixtures; detection and monitoring. **Mine dust**: Hazardous nature of dust; classification; assessment of dust concentration; production and engineering control of mine dust. **Classification of gases emitted from diesel engines. Elementary mine ventilation planning, basic planning parameters and elementary mine ventilation economics and the impact of incorrect design and applications on safety and health. Mechanics of fluids:** Bernoulli equation; airflow in airways; Critical velocity; mine static head; mine velocity head and total mine head. **Determination of quantities of air required in the mines and respiratory requirements:** Oxygen depletion; gas laws and gas constant; general ideal gas equations; Graham's law of diffusion; layering and layering number. **Atkinson equation for friction loss:** selection of Friction factor; combine friction and shock loss and airpower. **Basic ventilation circuits:** ventilation networks; Kirchhoff's and its direct application. **Fans:** operation and installation of fans; types of fan, fan characteristics and performance. **Psychrometry. Physiological effects**: Thermal regulation of human body; physiological heat transfer; indices of heat stress; heat illness; cold environment; heat tolerance; acclimatization and variation of productivity with mine climate. **Mine visit**.

Contribution to Exit Level Outcome:

1. Problem solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3. Engineering design (Course Outcomes 1, 7).
4. Investigations, experiments and data analysis (Course Outcomes 3, 4, 6, 7).
5. Engineering methods, skills and tools, including information technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7).
6. Sustainability and impact of engineering activity (Course Outcomes 1, 2, 3, 4, 5, 6, 7).

Learning and Teaching Strategies/Activities

The course will be facilitated through the following teaching learning activities:

1. Four lecture periods per week for 12 weeks
2. One tutorial or practical session per week for 12 weeks
3. Weekly consultation sessions
4. At least a visit to an underground mine.

Student Assessment Strategies

Students will be assessed through continuous assessments activities and a final examination

1. The Continuous Assessment will be made up of the following assessment activities:

iii) Assignments (tutorials, quizzes, practical sessions and field reports): 20%

iv) Tests (At least 3 tests): 30%

2. End-of-semester examination (50%).

Criteria for qualifying for the Examination:

1. To qualify for the exam, a student must obtain a minimum of 50% in the design project.

Criteria for passing the course:

1. To pass this course a student should obtain a minimum exam mark of 40% and average of 50% from both the Continuous Assessment and Examination.
2. The final mark will be made of 50% Continuous Assessment and 50% Examination (1 x 3-hour paper).

Learning and Teaching Enhancement Strategies

1. Internal and external moderation of examination papers and scripts.
2. Peer-review of course outlines and teaching.
3. Students evaluation
4. Effective and efficient supervision and monitoring of assignments, tests, and examination.
5. Weekly consultation hours

Prescribed Learning Resources

1. McPherson, M.J. (1993) Subsurface ventilation and environmental engineering. DOI: 10.1007/978-94-011-1550-6, Springer, Netherlands.
2. Chaudhuri, A.B. (2006) Mine Environment and Management: An Indian scenario. ISBN 13: 9788170244837, Ashish Pub. House.

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12.5.4 YEAR 4 OF (19BMNE) BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

12.5.4.1 YEAR 4 SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).
Co-requisite(s)	**TEGT3742 Entrepreneurship**

Content: Engineering as a profession: Engineering societies and registration procedure for different / engineering disciplines. **General principles of Engineering ethics:** statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration. Technology policy:** utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace.** Impact of Engineering activity social, economic, cultural, environmental and sustainability.

Learning Outcomes: On completing the course students should be able to:

- Discuss the role of various Engineering disciplines and societies
- Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
- Discuss the use of Engineering codes and standards
- Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
- Demonstrate knowledge of the laws of arbitration
- Discuss the role of technology policy on the acquisition of technological know-how
- Discuss the responsibility of an engineer to health and safety at the workplace
- Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 4 and 5 (Law), 7 (health and safety), 8)

10 Engineering Professionalism (Course Outcomes 1, 2, 3, 6)

ECN Exit Level Outcomes Assessed:

10 ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitutes satisfactory performance?

After consideration of the 3 term papers, 3 tests and 3 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Professionalism**" in a manner that is considered: "not satisfactory", "satisfactory" or "Excellent". The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Module Title:	**PROJECT MANAGEMENT**
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group project plus presentation, 3 Tests, 4 assignments/case studies)
Pre-requisite(s)	**TEGT3761 Fundamentals of Economics**

Module Description: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale Engineering projects**: inception to completion, appropriate contacts; general conditions of contract for Engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on Engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team

Contribution to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

10 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**
Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**
Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitutes satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project

management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitutes satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**MINE HEALTH, SAFETY AND ENVIRONMENT**
Code	TMNU3831
NQF Level	8
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% **%** (At least 2 Assignments , 3 Tests , group project presentation and group project report) and Examination 50% (1 x 3 hour paper)
Co-requisite(s)	(TMNC3791 Mine Ventilation and Climate Control), (TMNS3762 Surface Mining)

Contents: Safety organization in mines; personal protective equipment, causes of mine accidents; accident statistics and records keeping; industrial hygiene; basic first aid; analysis of health and safety problems in the Namibian mining industry. **Surface and underground Mine safety precautions:** during stripping, drilling and blasting, extraction-loading and haulage, opening of stope driving of tunnels Safety precaution during mining with dredges. Safety precaution in the use and transportation of explosives and their accessories, Explosive magazines, **Mine environment**: Mine dust, mine gases, mine fires, mine water, noise, illumination, mine air, radioactive and toxic substances. Health, safety and environmental issues in the mining of radioactive substances like uranium. **Health Issues:** Different occupational diseases associated with mining, silicosis from fine silica dust, cancer associated with coal mining. Slope stability, Analysis of water and soil quality using ASTM standard and USEPA. **Mine Communication. Mine Law and Regulations**: Mining and the environment; mining legislation. Minerals (Prospecting and Mining) Act; mineral rights. **Environmental issues**: Environmental Impact Assessment (EIA); **Environmental pollution:** definitions, causes and interrelationships. Gaseous and particulate pollutants and their sources, **Mine atmosphere:** detection of mine gases, physiological effects, inflammation and detonation, gas layering and diffusion. Dust hazards. Pollution monitoring and control, methods of controlling gaseous and particulate pollutants, **Mine effluents**: effects on air, surface and ground water, and land. Spontaneous combustion, acidic mine drainage etc. Methods of effluent treatment, Impact of mining on mine environs effects on agriculture, surrounding habitats, etc. Mine drainage: water recovery and re-cycling mine reclamation and rehabilitation, mine closure and different types mine reclamation methods. **Case Studies**: Typical case studies on health and safety problems in mines. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:

1. Analyse safety and health issues at the mine and how to control them
2. Relate the knowledge of environmental issues of mining projects and how to control them
3. Relate occupational disease associated with mining and symptoms
4. Explain various techniques used in mine communication
5. Discuss basic knowledge of legal aspects of mining safety and the environment as stipulated in the Minerals (Prospecting and Mining) Act
6. Discuss mineral rights and the general mine law
7. Discuss procedures for carrying out environmental impact assessment (EIA) of mine projects and treatment of mine effluents

Contribution to Exit Level Outcome:

2	Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7)
6	Professional and Technical Communication (Course Outcomes 4, 5, 6, 7)
7	Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6, 7)
9	Independent Learning Ability (Course Outcomes 5, 6, 7)
10	Engineering Professionalism (Course Outcomes 5, 6, 7)
11	Engineering Management (Course Outcomes 5, 6, 7)

Module Title:	UNDERGROUND MINING
Code	TMNU3811
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2assignments, 3 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMNE3711 Excavation Engineering**

Contents: Historical and present-day methods of exploitation: of hard rock mineral deposits; selection of mining techniques; location of shafts. Shaft sinking; shaft station layouts. Major development layout; level, horizon and panels methods of development, Conventional and specialized development. **Mining systems**: Methods of extraction of deposits, short-walls and long-walls mining systems mine design parameters Mining processes in underground operations **Mechanization of operations and special technologies**: Design: practical design exercises for exploiting tabular ore deposits. **Exploitation of massive ore bodies**: open stopping, room and pillar mining, cut and fill stopping, shrinkage mining, post pillar cut and fill mining, block caving, continuous block caving, forced caving, sublevel caving, sundry mining methods. **Coal mining methods**: the safe and efficient exploitation of underground coal deposits by means of board and pillar, pillar extraction, rib-pillar, short wall, long wall and specialized thick- and thin-seam techniques. **Coal mining equipment**, panel design and production potential., market identification, plant design, mine design, layout scheduling **Trackless mining**: selection and operation of underground trackless equipment for massive mining. Practical design exercise.

Learning Outcomes: On completing the course students should be able to:

1. Explain shaft locations techniques
2. Explain mine development methods
3. Design and select mining methods and specify parameters for safe underground extraction
4. Design and analyse different design techniques and mechanical technologies used in massive mining
5. Discuss the mining systems and factors to be considered for safe working environment.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3 Engineering Design (Course Outcomes 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5)

Module Title:	ROCK ENGINEERING
Code	TMNS3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNU3791 Soil and Rock Mechanics

Contents: Introduction to Rock Engineering: Definition of terms and importance of rock mechanics; applications of rock Engineering to Mining, Civil and Petroleum Engineering. **Physical and Mechanical properties:** Porosity Density; Permeability; Strength: Slaking and Durability: Sonic velocity as an index to degree of fissuring; **Classification and Index properties of rocks** – Geological classification of rocks (crystalline rocks, organic rocks); Classification of rock masses for Engineering purposes. Rock strength and Failure Criteria Modes of failure of rocks Common Laboratory strength tests (Uniaxial, Tri-axial, Brazilian, Flexural tests); Stress-Strain behaviour in compression; Effect of confining pressure; **Discontinuities in rocks**: crack, fissure, fracture, bedding plane. **Application of rock Engineering in surface mines** Slope stability analysis. Application of the complete Stress-Strain curve The Mohr Coulomb failure criterion; the effect of water; The influence of the principal Stress ration on failure; Empirical criteria of failure; Coulomb-Navier criterion of failure of rocks; Griffith brittle failure Criterion. Elastic properties, **Applications of rock Engineering in underground openings:** Support systems design and selection – caving and subsidence. Roof and ground control. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:

1. Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
2. Discuss strength and deformation characteristics of rock masses
3. Explain mechanical properties of rock masses
4. Discuss failure criteria for rocks and rock masses

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)

Module Title:	MINE MANAGEMENT PRINCIPLES AND FINANCIAL VALUATION
Code	TMNS3831
NQF Level	8
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 3 Tests) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMNU3742 Technical Valuation

Contents: Management Principles: History of management theory; managerial conceptual thinking; management work within the business. Organizing and determinants of organization, Planning and organization of mines, Controlling, leading, determination of shift, daily, monthly and yearly production, Managerial activities and tools; time management; attributes of a manager, industrial relations and legislation. **Risk management**: risk management terminology; functions and principles of risk management; introduction to risk assessment; due diligence; requirements of the Mine Health and Safety Act. **Introduction to financial analysis**: Introduction; financial statements; behaviour of costs; time value of money; capital value decisions; inflation; discounted cash flow models. **Funding**: sources of funding, cost of capital, gearing; **Revenue**: metals and minerals market, price influences, hedging and option pricing, margins and marginality; Reporting: annual reports, financial statements, competent persons report, valuations and acquisitions, takeovers. **Applied financial analysis**: financing of projects; depreciation and depreciation methods, replacement, taxation, applied valuation; evaluation of alternatives: organizational objectives, investor expectations, mining company growth, economic valuation of Investment alternatives, quantitative methods applied. **Decision making**; structure of decision making, feasibility studies, decision making criteria, economic value add, sensitivity analyses, comparative valuations, benchmarking and ranking. Investment analysis: techno-economic analysis of mining projects, financial analysis, intangible analysis, risk assessment and risk management. Financial valuation of a coal mine, **Coal as a commodity**: coal quality, coal utilization and marketing.

Learning Outcomes: On completing the course students should be able to:

1. Explain knowledge of general management principles
2. Discuss the planning an organisation of mines
3. Illustrate a simple organisation chart of a mine
4. Discuss techniques of time management
5. Explain the industrial relations and legislation pertaining to the mining industry.
6. Explain principles and functions of risk management
7. Analyse financial management and principles
8. Discuss various funding sources and funding mechanisms for mines
9. Apply financial analysis in the decision making process

Contribution to Exit Level Outcome:

2	Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
4	Investigations, Experiments and Data Analysis (Course Outcomes 7, 9)
7	Sustainability and Impact of Engineering Activity (Course Outcomes 5, 8)
10	Engineering Professionalism (Course Outcomes 4, 5, 8, 9)
11	Engineering Management (Course Outcomes 1, 4, 6, 7)

12.5.4.2 YEAR 4 SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMNR3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	Continuous 100% Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s	TCER3891 Research Proposal, All third year modules

Contents A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:

1. Apply skills necessary to carry out a technological or Engineering investigation.
2. Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
3. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
4. Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Contribution to Exit Level Outcome:

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5 Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6 Professional and Technical Communication (Course Outcomes 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**
Demonstrate competence to formulate and conduct investigations and experiments.
5. **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**
Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.
9. **INDEPENDENT LEARNING ABILITY**
Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: one Seminar presentation (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 4, 5, 9 assessed as follows:

ECN Exit Level Outcome 4 - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitutes satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 9 – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. In the course of the research project, students are supposed to show their ability to engage in independent learning through well-developed learning skills and awareness of up-to-date tools, techniques and new developments in Engineering and technology as well as the need to access, comprehend and apply knowledge acquired outside formal instruction and guidance from the supervisor.

What constitutes satisfactory performance?

After consideration of student's individual conduct in the course of the research project, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** The supervisor will be expected to give examples of cases where the student demonstrated independent learning skills in the course of the research project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report to beef up independently learned components, within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	**MINING DESIGN PROJECT**
Code	TMND3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s	**All third year modules**

Contents An essential element of Engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated Engineering drawings or computer source codes consistent with professional Engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:

1. Identify and formally state problems that can be solved using Engineering knowledge and skills.
2. Apply practical skills in the design of Engineering components, assemblies and/or systems.
3. Apply knowledge of creativity, innovation, safety, ergonomics and good Engineering practice in the design process.
4. Develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4, 6)
9 Independent Learning Ability (Course Outcomes 2, 6)
10 Engineering Professionalism (Course Outcomes 4, 7)
11 Engineering Management (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**
Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively.

3 **ENGINEERING DESIGN**
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

6. **PROFESSIONAL AND TECHNICAL COMMUNICATION**
Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 1, 3, 6 assessed as follows:

ECN Exit Level Outcome 1 – **PROBLEM SOLVING**

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgment through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 – **ENGINEERING DESIGN**

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognize and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimization.

What constitutes satisfactory performance?

After consideration of the section of the final design report that deals with Engineering ***Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering ***Design***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Engineering ***Design*** in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 6 - **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final design report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of design report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitutes satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Module Title:	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate Engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
2. Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3. Discuss the role of engineers in the management and organization of Engineering enterprises
4. Discuss in details the main technical activities undertaken during the attachment

ENGINEERING POSTGRADUATE STUDIES

UNAM

UNIVERSITY OF NAMIBIA

N. POSTGRADUATE TRAINING PROGRAMMES AT JEDS

N.1 School of Engineering and the Built Environment

- Master of Science (MSc) in Civil Engineering (Structures)
- Master of Science (MSc) in Civil Engineering (Transportation)
- Master of Science (MSc) in Civil Engineering (Water)
- Master of Science in Water Resources Management
- Master of Science in Mechanical Engineering (by Thesis)
- Master of Science Electrical Engineering (by Thesis)
- Master of Science Electronics and Computer Engineering (by Thesis)
- Master of Science Metallurgical Engineering (by Thesis)
- Master of Science Mining Engineering (by Thesis)
- Master of Science (Civil Engineering) (by Thesis)
- Doctor of Philosophy in Engineering

TERMS OF REFERENCE OF THE POSTGRADUATE STUDIES COMMITTEES

1. COMPOSITION:

Members of the Faculty PGSC will be nominated by each department and approved by the relevant Faculty Board according to the following criteria:

(a) Chairperson: Faculty HoD for Postgraduate Studies.
(b) At least one member from each department/campus with a PhD, except departments without PhD holders where a Masters holder with extensive research experience may serve. Schools will function as departments with regards to representations at Faculty Committees.
(c) Secretary: Faculty Officer or Assistant Faculty Officer.
(d) Faculty or Campus Representative on URPC should be a member.
(e) Any other staff member, on invitation, as need arises.

2. QUORUM RULES:

The quorum of the Faculty Postgraduate Studies Committee shall be one half plus one of the members holding office at the time of the meeting.

3. TERMS OF REFERENCE:

(a) To ensure quality control of all research proposals in accordance with Postgraduate guidelines;
(b) To critically scrutinize and approve research proposals and submit approved research proposals for noting to the UNAM Postgraduate Studies Committee (UNAM PGSC);
(c) To organize postgraduate seminars for all postgraduate students admitted into the Faculty in accordance with Postgraduate guidelines;
(d) To ensure that submitted Master and Doctorate research proposals and theses/dissertations comply with the guidelines;
(e) To monitor progress of postgraduate students and make recommendations to the UPGSC for approval;
(f) To recommend the appointment of postgraduate examiners and supervisors to the UPGSC for approval;
(g) To submit notifications of intent to submit theses/dissertations for noting to the UPGSC.
(h) To recommend new and revised postgraduate programmes to the UPGSC;
(i) To compile and submit to the Centre for Postgraduate Studies (CPGS) annual reports on postgraduate activities (through the chairperson);
(j) To monitor equity and regional representation in postgraduate student admissions;
(k) To assist postgraduate students in obtaining ethical clearance certificates from RPC through their faculty representatives on RPC;
(l) To recommend Masters and Doctoral *Viva Voce* Panels to CPGS.
(m) To inspect the final bound copies and digital formats (in pdf format) of theses/dissertations of graduating students before they are submitted to the CPGS;
(n) To develop and maintain a faculty database of postgraduate students and their progress;
(o) To process and submit claim forms for payment of supervisors and examiners;
(p) To submit agenda items for UPGSC to the PGS secretariat (chairperson);
(q) To undertake any other duties that may be assigned to the Faculty PGC by the UPGSC or CPGS that relate to postgraduate studies.

O. REGULATIONS AND GUIDELINES FOR POSTGRADUATE PROGRAMMES

PREAMBLE

The guidelines and regulations presented in this prospectus are intended to familiarise Faculties, Schools, Centres and students with the University of Namibia's (UNAM's) Postgraduate programmes.

O.1. POSTGRADUATE TRAINING PROGRAMMES AT JEDS

Students who are on full time employment should take studies on a part time basis.

O.1.1. POSTGRADUATE DIPLOMA PROGRAMMES

1) UNAM makes provision for Postgraduate Diploma programmes in selected fields as approved by Senate.
2) Postgraduate Diploma programmes offer specialised training, which is career-oriented.
3) Postgraduate Diploma programmes have a minimum of **one year** duration for **full-time** students, and **two years** for **part-time** students; are **taught** programmes (i.e. involve lectures, seminars, practicals, written tests and examinations, etc.); and also include a small independent research component.

O.1.2. MASTER'S DEGREE PROGRAMMES

1) Postgraduate training programmes at Master's degree level are of two types:
   (a) Master's degree by research culminating in a thesis.
   (b) Taught Master's degree involving at least one academic year of coursework followed by a mini thesis.
2) Students admitted to Master's degree programmes enrol on either a full time or part time basis. Master's degree programmes have minimum of two years duration for full-time students and three years for part-time students; and **a maximum of three years for full time students and maximum of five years for part-time students,** unless otherwise stipulated by programme specific regulations.

O.1.3. DOCTORAL PROGRAMMES

1) Doctoral programmes at UNAM are normally undertaken by research and the writing of a dissertation unless otherwise approved by Senate. The duration of a doctoral programme is a minimum of three for full-time studies and four years for part-time students; and **a maximum of four years for full time students and maximum of six years for part-time students.**
2) Doctoral study opportunities at UNAM are offered where the departments have the necessary qualifications for admission, where the relevant Department has the necessary research facilities and infrastructure, and where sufficiently qualified and experienced academics are available and ready to provide effective supervision.

O.1.4. APPROVAL OF POSTGRADUATE PROGRAMMES

All programmes should be considered by the UNAM Postgraduate Studies Committee to ensure that they adhere to the UNAM Postgraduate regulations and standards of quality, before these programmes are recommended by the Academic Planning Committee (APC) to Senate for approval.

O.2. REGULATIONS AND GUIDELINES GOVERNING POSTGRADUATE APPLICATIONS

O.2.1 ELIGIBILITY FOR ADMISSION/ PROCEDURES TO APPLY FOR POSTGRADUATE STUDIES

UNAM welcomes students with a range of qualifications from all over the world. Applicants must fulfil the minimum admission requirements for entry as well as English Language requirement (if relevant) as indicated. Competition for places in some programmes is extremely high, and the minimum requirement given may not be sufficient to be admitted. **Due to this, applicants may be requested to undergo further screening processes.**

O.2.2 POSTGRADUATE DIPLOMA

1) Prospective students must be in possession of a relevant Bachelor's degree from UNAM or any other recognised institution.
2) Students who do not comply with (1) above may also be considered according to the University approved Recognition of Prior Learning (RPL) Policy.

O.2.3 MASTER'S DEGREE

1) Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the chosen field of study.
2) In addition, prospective students must satisfy Faculty specific requirements as indicated in the admission requirements of the relevant programme (e.g. minimum two years teaching experience and a screening test for M.Ed. admission).

O.2.4 DOCTOR OF PHILOSOPHY DEGREE AND OTHER DOCTORAL PROGRAMMES

1) Prospective candidates must be in possession of a NQF level 9 Master's degree or equivalent from UNAM or any other recognised institution, in the chosen field of study.
2) Students who enrolled for a Master's degree by thesis only may be considered for upgrading into the Doctoral Programme if, during the second year of registration they demonstrate sufficient original contribution(s) to knowledge as motivated by the supervisors through the Faculty Postgraduate Studies Committee and approved by the UNAM PGSC.

O.3 APPLICATION PROCEDURES FOR POSTGRADUATE STUDIES

O.3.1 APPLICATION FORMS

Applications for postgraduate studies should be made on a University **postgraduate application form** which is available on request from the Office of the Registrar, Student Records Section, and can also be downloaded from the UNAM Webpage: http://www.unam.edu.na

Before completing the application form, applicants must familiarise themselves with all aspects pertaining to postgraduate studies as set out in this prospectus. Applicants must also acquaint themselves with the different modes of the programmes offered (e.g. taught programmes or by thesis/dissertation only, full time or part time). Applicants must ensure that all relevant documentation is submitted with the application form, together with a **non-refundable application fee**. Receipt of the application will be acknowledged by mail.

Prospective students with qualifications obtained from an institution outside Namibia (or non-accredited institutions in Namibia) must submit a Namibia Qualifications Authority (NQA) evaluation for such qualification together with their application forms compulsory. Please Note: this process takes at least 30 days and proof of submission to NQA will NOT be accepted.

All Master's by Thesis and Doctorate by Dissertation must submit a research topic concept note (maximum two pages) together with the application form. No consideration will be given to applications without the concept note.

Incomplete applications will not be considered.

The closing date for taught Master's and taught Doctoral applications is end of **July** of each year or as advertised **(No late applications will be accepted).** Application for Master's and Doctoral programmes by thesis/dissertation only, will be accepted throughout the year.

O.3.2 PROCESSING OF APPLICATIONS

The completed application forms will be processed and forwarded by the Student Records Section to the Centre for Postgraduate Studies which will in turn forward the applications to the relevant Faculty/School/Department Admission Committees.

O.3.3 ADMISSION OF STUDENTS

The Department/School recommends admission through the Faculty to the Centre for Postgraduate Studies taking into account the applicant's fulfilment of the minimum admission requirements, availability of supervisors and space. A provisional admission letter indicating further conditions to be met as applicable will be issued to prospective student.

Master's by Thesis and Doctoral programmes by Dissertation
The relevant Faculty PGSC will recommend Supervisor(s) according to the applicant's area of study to the UNAM PGSC for approval.
Upon approval of the supervisor(s) by the UNAM Postgraduate Studies Committee and verification of other conditions, an admission letter is issued by the Centre.
It is the responsibility of the student to ensure that the supervision agreement (Annex 1) is signed with the supervisor. After verification of this agreement by the Faculty PGS Officer the student may register during the next registration period (first week of the month).
Master's and Doctoral Programmes by coursework
Upon recommendation by the relevant Department/School, the FPGSC will recommend a supervisor(s) according to the applicant's area of study to the UNAM PGSC for approval, at least six months before the start of the research component.

O.3.4 STUDY PERMIT REQUIREMENTS

According to the Immigration Control Act of 19 August 1993, all International students (SADC and Non-SADC) must be in possession of a valid approved Study Permit and Visa before entering Namibia for the purpose of studying. All prospective (first and senior) students are required to apply for a Study Permit and Visa on the prescribed forms obtainable from the University of Namibia or at the Namibian Embassy in any country or the nearest Namibian Embassy or Ministry of Home Affairs and Immigration (Namibia) website.

Only persons with permanent Namibian Residence, Refugees or Asylum Seekers and Diplomatic representatives are exempted from applying for a Study Permit and Visa. The mentioned categories are exempted on condition that they provide the relevant documentation (i.e. Permanent Residence Permit, approved and endorsed Refugee/ Political Asylum Seekers status, a Courtesy Visa which confirms diplomatic status) to the University of Namibia.

Study Permits, Work Permits and Tourist Visas are not interchangeable. Kindly note that candidates in possession of a work permit will need to apply for a study permit if offered provisional admission to the University of Namibia.

The University of Namibia and the Ministry of Home Affairs and Immigration (Namibia) have a temporary arrangement that students may apply for their Study Permits during the duration of the scheduled registration period.

O.4 REGULATIONS AND GUIDELINES GOVERNING REGISTRATION OF ADMITTED STUDENTS

O.4.1 REGISTRATION FOR MASTER'S/DOCTORAL BY THESIS/DISSERTATION ONLY

O.5.1.1 Registration of admitted students

1) All postgraduate students are expected to adhere to the deadline dates for registration as stipulated in the Faculty, Postgraduate and General Regulations Prospectuses.
2) All Postgraduate Students shall be required to register for the **compulsory module on "Academic Writing for Postgraduate Students".**
3) Students who apply for Masters/Doctoral may be required to enrol in selected modules, which will help to bridge any gaps in their earlier training or expose them to new developments in their study disciplines, as may be recommended by relevant FPGSC and approved by the UNAM PGSC. Students must pass these modules before they qualify for graduation.
4) All Postgraduate Students shall be required to register **every year** for the duration of the specific programme, unless approval has been granted for a break in studies.
5) Students who fail to register for any particular academic year will have to apply for re-admission to the programme and provide valid reasons why he/she could not register for the particular academic year.
6) A registered student may be allowed to transfer to the University of Namibia (from another institution) subject to written approval of the supervisor(s) and the relevant Postgraduate Studies governing bodies from both Universities involved. Registration is subject to the availability of suitable supervisors and all relevant processes and regulations of the University of Namibia.
7) A registered student may be allowed to transfer from the University of Namibia subject to written approval of the supervisor(s) and the relevant Postgraduate Studies governing bodies from both Universities involved.
8) No student shall be admitted as a candidate for more than one qualification at the same time without the special permission of Senate. Likewise, no student registered at the University of Namibia shall be permitted to enroll as a student at another university at the same time.
9) Senate may, after consultation with Faculties, restrict the number of candidates who may be permitted to register for a particular course of study, in which case Faculties may, from amongst the candidates qualified to register for such a course of study, select those who will be permitted to register.

O.4.2 REGISTRATION FOR MASTER'S/DOCTORAL PROGRAMMES BY COURSEWORK

Registration of admitted students

1) All postgraduate students are expected to adhere to the deadline dates for registration/addition of modules as stipulated in the Faculty, Postgraduate and General Regulations Prospectuses.
2) Students who are registered in programmes involving coursework and a thesis/dissertation will be required to enrol for **core** and **elective** (optional) modules, as prescribed in the relevant Faculty Prospectus and in the Centre for Postgraduate Studies Prospectus under the relevant Faculty.
3) Before registering for the research component, students must sign an agreement with the approved supervisor (Annexure 1) **not later than six (6) months** before the scheduled start of the research project, as reflected in the curriculum.

O.4.3 APPROVAL OF RESEARCH PROPOSAL

Within three (3) months of signing the agreement with the approved supervisor the research proposal accompanied by all supporting documents (e.g. informed consent form, interview guide etc.) must be presented to the Faculty PGSC. The Faculty PGSC makes one of three recommendations:
Within six (6) months of registration for a Master's and within nine (9) months of registration for a Doctoral programme, the research proposal accompanied by all supporting documents(informed consent form, interview guide etc.) must be presented to the Faculty PGSC. The Faculty PGSC makes one of three recommendations:

1. Approves the research proposal and recommends it, as well as the Ethical Clearance Certificate obtained from the CRP, to the UNAM PGSC for noting and issuing of the Research Permission Letter by the Director: Postgraduate Studies;
2. Rejects the research proposal and recommends de-registration of the student to the UNAM PGSC.
3. Grants an extension period of three (3) months for re-submission after which the Faculty PGSC makes one of the following recommendations:

3.1 Approves the research proposal and recommends it, as well as the Ethical Clearance Certificate obtained from the CRP, to the UNAM PGSC for noting and issuing of the Research Permission Letter by the Director: Postgraduate Studies;
3.2 Rejects the research proposal and recommends de-registration of the student to the UNAM PGSC;
3.3 Recommends registration at a lower level for a PhD candidate (Master's by Thesis only).

O.5 COLLABORATIVE POSTGRADUATE TRAINING

1) Through collaborative arrangements, students may undertake part of their training with other institutions of higher learning that the University is collaborating with.
2) Registration of students on collaborative programmes will be guided by the particular Memorandum of Understanding.
3) The implementation of collaborative programmes should adhere to terms and conditions stipulated in the Memorandum of Understanding.

O.6 CANCELLATION AND EXEMPTION OF MODULES

1) All postgraduate students are expected to acquaint themselves with the deadline dates for cancellation and exemption of modules as stipulated in the Faculty, Postgraduate and General Rules and Regulations Prospectuses.
2) No module cancellations or cancellation of studies will be effected without the completion of the required cancellation form signed by the student and Faculty Officer: Postgraduate Studies.
3) Students have to submit a complete exemption application form before the stipulated due dates to the Centre for Postgraduate Studies after recommendation by the relevant lecturer and Head of Department.

O.7 APPLICATION FOR BREAK IN STUDIES

1) Students who are unable to register for a specific year are expected to apply before **31 October** for break in studies for the subsequent academic year, to the UNAM Postgraduate Studies Committee through the Faculty Postgraduate Studies Committee for a maximum period of one academic year. Reasonable justifications for the leave of absence should be provided.
2) When a student is on approved break in studies, the year of non-registration will not count as part of the duration of the study. However, students must re-apply before the closing date of applications for admission to activate their registration for the subsequent academic year.
3) A student who takes a break studies for a period of one (1) years will be required to:
4) Apply for re-admission to the University and Faculty/programme.
5) Satisfy all requirements for admission, and
6) Start the programme from the first year.

O.8 APPLICATION FOR LEAVE OF ABSENCE

In order to be admitted to examinations, students are required to attend at least 80% of the lectures and to complete the required elements that make up the continuous assessment mark. Students who are unable to attend classes/tests for any reason, must complete the necessary application form (obtainable from the Office of the Registrar), and supply the necessary documentation. The application must be seen by all lecturers concerned, who will provide their comments and signatures. Final approval rests with the Registrar's Office. It will be the responsibility of the student to make up for missed events/complete the relevant requirements (including tests).

O.8.1 ABSENCE DUE TO MATERNITY

Students who request absence from classes/tests for the purpose of delivery, must apply beforehand (application form obtainable from the Office of the Registrar), and provide a medical certificate, signed by a Medical Practitioner, indicating the expected date of delivery. Students will be expected to attend classes two weeks prior to and after the date of delivery. Should the date of delivery differ from the expected date students, on resumption of classes, will be expected to furnish a medical certificate stating the new date. A new, late application for absence from classes must be completed by the student in such cases.

O.8. 2 ABSENCE DUE TO FUNERALS

Students who miss classes/tests due to funeral attendance must, prior to departure, apply for absence from classes (application form obtainable from the Office of the Registrar). On return, the student must supply satisfactory proof which confirms that the student attended the funeral. On receipt of the above mentioned, the application will be processed further. Students should note that absence from classes/tests should not exceed one week.

O.8.3 ABSENCE DUE TO ILLNESS AND OTHER REASONS

- Students who miss classes/tests due to illness, must produce a valid medical certificate, signed by a Medical Practitioner, stating the period of absence and nature of the illness. An application for absence from classes must be completed by all students before or not later than five days after the illness, depending on the circumstances (application form obtainable from the Office of the Registrar). Students who are in possession of surgery dates, etc. will be expected to apply for absence from classes prior to their leave of absence. Permission will only be granted for emergency cases. The Registrar's Office reserves the right to reject such applications if the illness does not warrant absence from classes/tests.
- Students should note that reasons such as over-sleeping, car trouble, transport problems, misreading the examination timetable, etc. will not be considered as valid reasons for missing tests / classes / examinations.

O.9 COURSEWORK EVALUATION AND GRADING

1) Students who are registered for postgraduate programmes by coursework will be examined according to procedures approved by Senate.
2) In all Faculties, the meaning attached to letter grades awarded by examiners is as follows:

Grade	Interpretation	% Equivalence
A	Distinction	80 and above
B	Very Good	70 – 79
C	Good	60 - 69
D	Satisfactory	50 - 59
E	Fail	49 and below

3) Before a student can proceed to the thesis/dissertation research phase (in the case of coursework programmes), s/he must first pass all coursework modules. Subject to faculty regulations, a student with one module outstanding may register for the research project, provided that the outstanding module is not Research Methodology or module that deals with research or data analysis.

O.10 THESIS/DISSERTATION RESEARCH

1) Students who successfully complete the coursework phase, or who are registered for postgraduate studies by thesis/dissertation alone, undertake research in an approved research topic, and write a thesis/dissertation. This shall be after a specified period set by the relevant Committees and approved by Senate.
2) **Thesis** and **Dissertation** research may include an artistic/aesthetic component, presented in the form of a composition, a theatre/musical performance, and/or an exhibition of original works, as a partial fulfilment of the requirements for a **Master's** or **Doctoral** degree, respectively.
3) As a standard practice, every thesis/dissertation shall be accompanied by a declaration stating that it has not been submitted for a similar degree in any other university (Annex 2).
4) The thesis must contain a concise and comprehensive **abstract** of between 200-300 words and 300-400 words for the dissertation, indicating the main findings and major conclusions of the research. The abstract should be Times New Roman, font size 12, and 1.5 line spaced.

O.11 REGULATIONS ON THE TEACHING AT POSTGRADUATE LEVEL

1) To teach and supervise students at the master's and doctoral programme levels, a member of staff shall have a doctoral degree or equivalent in the discipline of the postgraduate programme being offered.
2) To teach and supervise students at the postgraduate diploma programme levels, a member of staff shall have a Master's or equivalent in the discipline of the postgraduate programme being offered.
3) Members of staff without PhD or equivalent qualifications but with specialised expertise can co-teach with members of staff holding doctoral degrees.

O.12 GUIDELINES ON THE RESEARCH SUPERVISION OF POSTGRADUATE STUDENTS

O.12.1 ASSIGNMENT OF SUPERVISORS

1) Every postgraduate student shall be assigned a supervisor/supervisors (at least **one** (1) supervisor for Master's students and **two (2)** supervisors for Doctoral candidates) nominated by the relevant Department, recommended by the relevant Faculty Postgraduate Committee and approved by the UNAM Postgraduate Studies Committee on recommendation of the Faculty Postgraduate Studies Committee.
2) Where the student's research topic is multidisciplinary in nature, or where there is need for additional expert supervision in the same discipline, or where the student's postgraduate training programme involves sandwich arrangements, one or more additional supervisors may be appointed.
3) Postgraduate student supervisors will be appointed from suitably qualified members from UNAM Faculties/Centres; where there is a need to appoint an external supervisor there should be another supervisor from UNAM.
4) A supervisor for Master's and Doctoral students must have a doctoral degree and expertise in the field of study that he/she is expected to supervise. In addition, the supervisor must have relevant research and publication experience.
5) For purposes of mentorship, the co-supervision at all levels is strongly recommended. A supervisor without a doctoral degree will be considered to supervise Master's students (normally as a co-supervisor) subject to approval by the UNAM PGSC.

O.12.2 GENERAL DUTIES AND RESPONSIBILITIES OF POSTGRADUATE SUPERVISORS

1) The supervisor must have a thorough understanding of the University's Postgraduate Regulations and Guidelines, in order to effectively guide the student towards attaining the stipulated standards.
2) The supervisor has the responsibility of ensuring that their students make progress in their studies. Where there are problems affecting the student's research progress, these shall be communicated to the UNAM Postgraduate Studies Committee through the Head of the relevant Department and the Faculty Postgraduate Studies Committee.
3) Supervisors should understand that:
   (a) The Master's thesis research programme is designed as a **training** course, whereby it is intended that the student will:
      * be exposed, acquire and apply fundamentals of research,
      * acquire certain new techniques and methods of research,
      * learn how to present the results of research in a scholarly manner, and
      * make some contribution to knowledge.
   (b) Master's students require close and careful supervision because they usually lack previous research experience, especially during the early stages of their theses (when learning about research methodology, experimental design and research technique) and also when preparing the initial drafts of their theses.
4) The supervisor of a Doctoral candidate should recognise that the candidates, in most cases, will have acquired some research experience when they were Master's degree students. What is expected of the Doctoral candidate is thus qualitatively and quantitatively more than outlined above for Master's degree students. Here the supervisor expects the candidate to:
   * make a **distinct and original contribution** to **knowledge**, of fact and/or theory;
   * produce a considerable amount of **original work**;
   * undertake a more critical and extensive review of the relevant literature than is the case for Master's students, and
   * exercise considerable initiative in conducting the research.
5) After completion of a research proposal, the doctoral candidate should be able to work **independently** and be **guided** rather than be directed by his/her supervisor. It is, nevertheless, the supervisor's responsibility to guide the candidate in the right direction.
6) During the initial phase, the supervisors have the responsibility of assisting their candidates in the design and formulation of appropriate postgraduate research projects.
7) Supervisors should be able to determine, through their previous research experience, potential impediments to the research problem and advise the students on what can be achieved meaningfully, within the time allocated for the study.
8) The supervisors have the responsibility of monitoring the student's research progress throughout the research period:
   (a) Both the supervisor and the student must submit **compulsory** report on the progress of the student to the relevant Departmental HoD before the end of each semester (Annex 3A and 3B). The Faculty PGSC will study the reports and take the necessary steps to resolve problems (where necessary).
   (b) Where the departmental HoD is the supervisor, the deputy dean of faculty should sign.
   (c) A summary report of all progress reports received and recommendations from the Faculty PGSC on problems identified and actions taken must be tabled during the **July and November** UNAM PGSC meetings.
   (d) In order to ensure that the thesis/dissertation research proposals benefit from inputs from other academics in the Departments, every Faculty offering postgraduate programmes shall, in consultation with the supervisors, arrange at least one **compulsory** research seminars, which will enable the candidates to refine and improve the research proposal, report on progress and learn from others.
9) The supervisor has the ultimate responsibility of assisting the student to give an appropriate title to the thesis/dissertation, and to guide him/her on the presentation of the research results in the form of a scholarly thesis/ dissertation, in accordance with the set guidelines.
10) The supervisor and student should have regular meetings to discuss progress on the research project.
11) Although the writing of the postgraduate thesis/dissertation is the responsibility of the student, it is the supervisor's role to ensure that the standards set by the University are adhered to. The supervisor should:
   (a) Be accessible to the student during the critical stage of thesis/dissertation writing;
   (b) Discuss the drafts of the thesis/ dissertation with the student throughout the process;
   (c) Read the student's thesis/ dissertation carefully and critically, indicating where improvements are needed, e.g., where there is paucity of information, and where the important findings could be published, etc.
   (d) At the conclusion of the work, read the entire thesis/ dissertation, and advise whether or not it is in a form suitable for presentation to examiners;
   (e) But should not be responsible for personally editing language usage in the thesis, or correcting typographical errors. He/she should however, point out language and typographical errors.
12) If the student has two or more supervisors, one of these should be appointed as main supervisor and the rest as co-supervisor(s).
13) Should a supervisor be away from the University for more than three consecutive months, an acting supervisor must be appointed. In the case of absence of main supervisor, the co-supervisor will act. Where a student has only one supervisor an acting supervisor must be appointed by UNAM PGSC on recommendation of the FPGSC.
14) Where continued supervision is a condition of sabbatical or extended research leave, the Head of Department must ensure that these conditions are adhered to.
15) Where a supervisor retires or resigns from the University, he/she shall cease from supervising any student(s) under his charge, unless there is an agreement in writing for the continued supervision of the student(s).
16) If, in the course of the student's research, a situation develops whereby:
   (a) there is a breakdown in communication between the student and the supervisor;
   (b) there are personal clashes and conflicts between the two;
   (c) the student refuses to follow the supervisor's advice;
   (d) a change will enhance the progress of the student the case should be reported in writing to the Head of the relevant Department by either the supervisor or the student. The Head of Department has the responsibility to hear both sides of the case (that is, from the supervisor and the student) with a written report and recommendation to the FPGSC for possible action. The FPGSC will study the report and take action or make a recommendation (where applicable) to the UPGSC.

17) Staff members from research institutions will be allowed to supervise ten (10) students; the main supervision will be counted as 1 and co-supervision as 0.5 students, respectively. To ensure adequate supervision, a single staff member shall not supervise more than five (5) postgraduate students at any given time. Staff members' supervision responsibilities should be taken into consideration by Heads of Departments when other teaching duties are assigned.

O.12.3 REMUNERATION OF SUPERVISORS

All supervisors will be remunerated upon approval of the graduation of the student by AEC, according to the tariffs determined by the University from time to time (Annex 17). Progress reports of the student during the duration of the study, signed by the supervisor(s), should accompany the claim form (Annex 18).

O.13 REGULATIONS AND GUIDELINES GOVERNING THE SUBMISSION OF THESES AND DISSERTATIONS FOR EXAMINATION

O.13.1 NOTICE OF INTENT TO SUBMIT THE THESIS/DISSERTATION FOR EXAMINATION

1) At least **three (3) months** prior to the scheduled date for the submission of the **thesis** and **four (4) months** prior to the scheduled date for the submission of the **dissertation**, the respective postgraduate students shall, through their supervisors, Departments and Faculty PGSC, submit a written notice, to the UPGSC, declaring their intention to submit their theses/dissertations (Annex 4A). This is in order to allow sufficient time to organise the appointment of examiners before the submission of the thesis/dissertation.
2) Students who submit a notice of intent within a shorter period than specified in paragraph 1 above should note that the examination might be delayed.
3) Students who fail to submit their theses or dissertations within the time period indicated in the notice of intent should note that the examination of their thesis/dissertation may be delayed as new examiners may need to be appointed.
4) The abridged curriculum vitae of internal and external examiners nominated by relevant Faculty PGSC and Annex 4B shall be submitted together with the notice as per Annex 4A for approval by the UNAM Postgraduate Studies Committee (see Annex 5 for the format of the abridged curriculum vitae).
5) Student shall submit **three** ring bound copies of the Master's thesis and **four** ring bound copies of the doctoral dissertation (including soft copy in word version) through the relevant HoD postgraduate studies to the Centre for Postgraduate Studies for examination by the **end of October of each year**. The submission of the bound copies should be accompanied by a signed form (Annex 6).
6) Students submitting the thesis or dissertation after the due date may not graduate and must re-register and **pay the required fees** for the subsequent academic.
7) Students with no re-admission statuses must appeal for re-admission for the subsequent academic year, irrespective of the fact that the thesis or dissertation might have been submitted for examination.

O.13.2 APPOINTMENT OF EXAMINERS

1) Every Master's thesis submitted shall be examined by at least two examiners approved by the UNAM Postgraduate Studies Committee on recommendation by the Faculty Postgraduate Studies Committee. At least one of the examiners in each case must be external to the University of Namibia, except when the student is a staff member in which case **all** examiners must be external. **The supervisor(s) should not be one of the examiners.**
2) Upon receipt of the notice of intent from the student, the Head of the Department should complete and submit Annex 4B together with the abridged CV's of the potential examiners to the FPGSC for recommendation and approval by the UNAM PGSC. Heads of Departments must declare any potential conflict of interest in the nomination and appointment of examiners. **Examiners may NOT be selected from the pool of moderators already approved for modules in the specific taught programme.**
3) In the case of doctoral dissertations, at least three examiners shall be appointed, of whom two must be external to the University, except **when the student is a staff member in which case all examiners must be external. The supervisor(s) should not be one of the examiners.**
4) Internal and External Examiners will be appointed on the basis of their expertise, independent from appointment of external moderators already approved for modules in the specific programme.
5) The examiner should not have any direct involvement in the research project of the student and must declare any past or present (personal or professional) connections with the student. Before final appointment the examiner should declare any direct conflict of interest by signing Annex 7.
6) An examiner for Master's students and Doctoral candidates must have a doctoral degree and expertise in the field of study that he/she is expected to examine. In addition, the examiner must have relevant research and publication experience.
7) The Director: Centre for Postgraduate Studies shall issue a letter of appointment to the thesis or dissertation examiners (Annex 8).
   Examiners shall complete examination in the following periods: Mini thesis (Master's) = 6 weeks; Thesis (Master's) by research = 6 weeks; and Doctoral dissertation = 8 weeks.

O.14 REGULATIONS AND GUIDELINES GOVERNING THE EXAMINATION OF THE SUBMITTED MASTER'S THESES AND DOCTORAL DISSETATIONS

O.14.1 EXAMINATION OF MASTER'S THESES AND DOCTORAL DISSERTATIONS

1) Each examiner shall be required to examine the thesis or dissertation in detail and submit his/her comprehensive assessment under the following headings:
   (a) **Appropriateness of the thesis title.** Comment on the appropriateness of the title as it relates to the content of the thesis or dissertation.
   (b) **Introduction:** comment on the validity of the research problem, the extent to which the questions or objectives address the identified research problem and the justification for the study.
   (c) **Completeness of the Literature Review**. Comment on the ability of the student to describe other researcher's contributions to similar problems. The literature review should lead the reader to a good understanding of what is already known about the research topic, what gaps of knowledge exist, what the study was intended to contribute, and what hypotheses guided the study. The examiners should comment on the candidate's familiarity with the literature.
   (d) **Research Methods**: The examiners should also comment on the appropriateness of the research methods (and instruments, where relevant) employed in the study. Where applicable, comment on ethical considerations should be included.
   (e) **Presentation of the Results**: The examiners should comment on the manner in which the findings of the study are presented. If tables of data are provided, are they reduced statistically? Are the statistical analyses appropriate? If illustrations are provided, are they of publishable quality? Is the description of the research results of adequate clarity and scholarship?
   (f) **Discussions and Conclusions**: Are the conclusions clearly presented? Are they logical and supported by data? Has the candidate sufficiently indicated how his/her results compare with those of others, as cited in the literature? From the thesis/dissertation, is his/her contribution to new knowledge clearly brought out? In the case of Doctoral dissertations, is there evidence of sufficient originality? If there are weaknesses in the thesis/ dissertation, what are the shortcomings?
   (g) **Recommendations:** Are the recommendations formulated address what was not reported in the thesis? Will the recommendations lead to addition of new knowledge to the current study?
   (h) **Language and Technicalities:** Is the language used clear and concise? Are there major typographical errors? Is a language editor needed? (Where applicable).
   (i) **References:** Are all the references cited in the text recorded on the reference list (and vice versa)? Are recent references used? Are the references used appropriate to the study? Is there consistence in the style of referencing used?

   Summary: The examiner should present a summary indicating whether s/he recommends the thesis or dissertation for a postgraduate degree award. Exam should allocate marks for the thesis by following guidelines in Annex 9, and complete the Summary Form (Annex 10 and 11).
2) All examination reports must be submitted to the Director: Centre PGS within a stipulated time from the date of receipt of the documents. If the assessments are not received within two months, new examiners may be appointed.
3) The Director: Centre for Postgraduate Studies will forward the reports to the relevant HoD PGS, who will be responsible for distributing the reports to the supervisor.
4) Once the relevant HoD PGS has received **all** the reports for a particular student he/she removes the names and affiliation of the examiner as well as the allocated marks and distributes the amended report to the supervisor.
5) The supervisor will share the reports with the student to make the indicated corrections. Where the reports contain conflicting recommendations, the supervisor will guide the student in addressing them.
6) The revised thesis or dissertation together with a comprehensive table of corrections must be submitted to the supervisor to verify that all corrections have been made before the thesis or dissertation is bound.
7) Upon evaluation of the thesis, the examiner will recommend one of the following:
   a) PASSES subject to MINOR corrections ($\geq$ 50%)
   b) PASSES subject to MAJOR corrections ($\geq$ 50%)
   c) RE-SUBMIT FOR RE-EXAMINATION (no mark allocated)
   d) FAIL (< 50%)

   A thesis re-submitted for re-examination shall be re-examined by the same examiner and awarded a maximum mark of 50%.
8) Upon evaluation of the dissertation, the examiner will recommend one of the following:
   a) PASSES subject to MINOR corrections
   b) PASSES subject to MAJOR corrections
   c) RE-SUBMIT FOR RE-EXAMINATION
   d) FAIL

   No marks should be allocated for the dissertation. A dissertation re-submitted for re-examination shall be re-examined by the same examiner.
9) (a) Where a Master's thesis is recommended for re-submission, **it must be re-submitted within 6 months,** failure to do so the student will be deemed to have failed the thesis and will not be re- admitted.
   (b) Where a Doctoral dissertation is recommended for re-submission**, it must be re-submitted within 12 months,** failure to do so the student will be deemed to have failed the dissertation and will not be re- admitted.
10) Where a thesis or dissertation is submitted for re-examination, the examiner should indicate whether the student has satisfactory addressed the identified shortcomings in the first submission.
11) In cases where the examiners of the thesis disagree in their recommendations (fail versus pass), Faculty PGSC should recommend an independent external examiner to the UNAM PGSC for approval to serve as arbiter on the thesis.
12) Where two examiners fail a dissertation the student will be deemed to have failed the dissertation and will not be re- admitted.
13) Where one examiner fails a dissertation, Faculty PGSC should recommend an independent external examiner to the UNAM PGSC for approval to serve as arbiter on the thesis or dissertation.
14) For both theses and dissertations the assessment of the arbiter will be FINAL.
15) A **copy of the first version** of the thesis or dissertation submitted for examination will be sent to the arbiter.
16) In cases where the difference in the pass marks allocated for a thesis, by the internal and external examiner, is **20% or more**, the Departmental Head must set up a departmental committee (excluding the supervisor and internal examiner) to study the case and recommend a mark for the

thesis and provide a motivation on the decision to the UNAM PGSC, through the Faculty PGSC. Where the departmental Head is the supervisor or the examiner, the Dean shall appoint an independent person to study the case and recommend a mark for the thesis and provide a motivation for his/her decision to the UNAM Postgraduate Studies Committee.

17) **All examination reports**, including any reports that recommended a fail must be submitted by the faculty PGS HoD to the UNAM Postgraduate Studies Committee for recommendation to AEC.

18) A postgraduate student, who disagrees with the results of the examination as approved by AEC, may appeal to the HoD PGS within two weeks after the release of the results giving reasons and evidence to support the appeal.

O.14.2 PUBLICATION FROM A THESIS OR DISSERTATION

Students are encouraged to publish work from their thesis/dissertation in accredited journals. The following acknowledgements must be included in such publications:

"This work forms part of a Master/PhD study undertaken at the University of Namibia".

Any publication from thesis/dissertation must show UNAM as the student's affiliation.

A list of publications and conference presentations by the student, that was part of their study, should be listed in the thesis immediately after the abstract.

O.14.3 VIVA VOCE EXAMINATION FOR STUDENTS REGISTERED BY THESIS OR DISSERTATION

1) In addition to writing a thesis or dissertation, the postgraduate students who are registered for Master's by Thesis and all Doctoral students, shall appear for a *viva voce* examination, to defend the submitted work before a panel of specialists on the subject.
2) The Centre for Postgraduate Studies is responsible for administering the *viva voce* examinations for doctoral students while the respective Faculties/departments are responsible for administering the *viva voce* examinations for master's students.
3) The *viva voce* examination shall take place only after the UNAM PGSC is satisfied that the thesis or dissertation submitted by the student is considered by the examiners to be of an acceptable standard.
4) The questions to be asked in the *viva voce* examination shall primarily be focused on the student's thesis or dissertation research area. **The public can attend and WILL BE PERMITTED to ask questions.**
5) The ***viva voce* panel** shall consist of the examiners and supervisors of the thesis or dissertation.
6) The Chairperson of the *viva voce* panel shall be a senior academic (at least at the rank of Associate Professor for Doctoral students and Senior lecturer for Master's students) and shall not be one of the supervisors or examiners. The *viva voce* panel (including the chairperson) shall be approved by **the Director of the CPGS** on recommendation of the relevant HoD PGS.
7) The main supervisor must provide the relevant HoD PGS with an electronic copy of the corrected thesis or dissertation, who will distribute it, together with copies of the examiners' reports to the panel members at least two weeks before the date of the *viva voce* examination.
8) All members of the *viva voce* panel must acquaint themselves with the postgraduate processes and procedures.
9) The functions of the *viva voce* panel shall be:
   (a) To ascertain that:
      * the thesis/dissertation presented (the data, methodology, analysis and findings) is the original work of the student
      * the shortcomings identified during the examination process have been addressed.
      * the broader subject area in which the study is based is fully grasped by the student.
      * any weaknesses in the thesis/dissertation can be adequately clarified by the student,

   (b) to make a definite recommendation to AEC through the UNAM PGSC, as to whether the student be deemed to have **passed** or **failed** the study (Annex 12).
10) The *viva voce* panel shall, as far as possible, endeavour to reach a unanimous decision on the student's performance. Where the panellists are unable to reach a consensus as to whether the student passes or fails, a vote may be taken to arrive at a reasonable decision. A majority vote shall be required for passing the *viva voce* examination.
11) (a) At the end of the viva voce, the panel shall sign a *viva voce* Examination Results Form (Annex 12) making a specific recommendation to AEC through the UNAM PGSC on the student's performance.

    (b) The Chairperson of the panel shall also submit to the UNAM PGSC a **comprehensive report** (Annex 13) signed off by the *viva voce* panellists. This should be done within one week of the examination. The report should include, an attendance register, challenges faced with the *viva voce* examination, a summary of the presentation, the discussion during the *viva voce* examination, any strong/weak points identified during the presentation and discussions, including any specific recommendations to the student.
12) The duration of the *viva voce* shall be **two hours for masters and three hours for PhD**.
13) The Chairperson of the *viva voce* Panel should announce the recommended outcome of the examination to the audience; but the qualification can only be awarded after approval by AEC.

O.14.4 SUBMISSION OF FINAL BOUND THESES OR DISSERTATIONS

After all the corrections as recommended by the examiners (including those from the viva where applicable) have been made to the satisfaction of the supervisor(s), **five** fully bound copies of the theses or dissertations shall be submitted to the Faculty PGSC for inspection before submission to the Centre for Postgraduate Studies. Where a student has been supervised by more than one supervisor, an additional copy for each additional supervisor must be provided. In addition, an electronic version of the thesis or dissertation compiled as a single document in **PDF** format shall be submitted. Please note that the final thesis or dissertation must be in the format as prescribed in B19.

O.14.5 PRESENTING STUDENTS FOR GRADUATION

The Faculty Officer: will only submit the names of students for graduation approval by AEC on recommendation of the UNAM PGSC when the following conditions have been met:

1) Updated academic record reflecting the eligibility of the student for graduation.

2) Completed checklist confirming, amongst others, that corrections have been effected after receipt of examiners reports and *viva voce* examinations, (including a table of corrections), where applicable.
3) All signed examination reports (including, where applicable, arbiter/failed examination report).
4) Five (5) bound copies and one (1) electronic copy (in PDF format) of the Thesis or Dissertation have been submitted as per Regulation B.16.4.

O.14.6 REMUNERATION OF EXAMINERS

All examiners will be remunerated upon receipt of the examination report compiled using the examination guidelines in B.16.1, according to the tariffs determined by the University from time to time.

O.14.7 AWARDING OF A QUALIFICATION AT A LOWER LEVEL

1) A student who is de-registered for a taught Masters programme due to failure to successfully complete the research component, may be awarded a relevant and existing Postgraduate Diploma in the field provided that all the taught modules are passed and the research component is re-written and passed as a research project/paper. Award of this PGD is subject to approval by AEC on recommendation of the UNAM PGSC.
2) A student who was awarded a Postgraduate Diploma according to paragraph (1) above, will not be allowed to register for the same taught master programme at a later stage.
3) A student who fails a Masters by research, may be allowed to re-apply for re-registration on a completely different topic or a taught Masters programme.
4) A student who fails a PhD, may be allowed to re-write the dissertation in the format of a thesis incorporating all the recommended amendments and corrections of the examiners within a period of 12 months after the release of the results. The re-submitted thesis will be examined according to the regulations of Masters degrees.
5) A Student who was awarded a Master's degree according to paragraph (4) above, and wish to apply for a Doctoral programme at a later stage, will have to choose a different topic.

O.15 POSTGRADUATE FEES

All registered students shall pay the various categories of fees as approved by the University Council on recommendation of appropriate Committees of UNAM (Refer to Student Fees booklet and PG Studies Fees brochure).

O.16 GUIDELINES ON THE WRITING OF POSTGRADUATE WORK

O.16.1 GUIDELINES ON THE WRITING OF RESEARCH PROPOSALS

Outline of the proposal

All research proposals must be prepared according to the following layout:

Title of the proposed study (refer to Annex 14 for the format of the title page)

The title of the mini thesis/thesis/dissertation research proposals should be clear and concise. From the title, one should be able to infer clearly the subject of the mini thesis/thesis/dissertation. This means that the title should be self-explanatory and limited to the scope of the study.

1. Introduction

1.1 **Background of the study**

Give a general overview and background of the research problem.

1.2 **Statement of the problem**

Students should concisely formulate their research problems by clearly indicating research issues they would like to investigate in their studies. This should include the purposes of their studies

1.3 **Either objectives of the study or research questions (NOT BOTH)**

Based on the statement of the problem, students should state either objectives or research questions of their studies. They should do this unambiguously.

1.4 **Hypotheses of the study (where applicable)**

Where applicable, particularly in the Natural Sciences, students should state unequivocal and testable hypotheses that are based on theory and on the statement of the problem. Each hypothesis should have a clear rationale.

1.5 **Significance of the study**

Students should state the importance of their studies, the anticipated contribution of such studies to knowledge and to socio-economic progress.

1.6 **Limitation of the study**

Students should indicate the logistical, resource and other limitations of their studies and indicate the possible impact of such limitations.

1.7 **Delimitation of the study**

Students should indicate the specific scope of the study, providing the rationale for such delimitation.

2. Literature Review and where applicable, the theoretical framework

Students should prepare critical, synthesised and integrated literature reviews that should demonstrate the need and justification of their studies. The reviews should show gaps in knowledge, theoretical and methodological shortcomings, need for further research, unanswered questions, and disagreements in literature and theoretical frameworks that may need to be revised to resolve controversies. In addition, the reviews should demonstrate what has been done in research areas of interest and what remains to be investigated.

3. Research Methods

3.1 Research Design

Students should provide clear statements on either quantitative or qualitative research designs they intend to use. It is not necessary to provide the definitions of the research designs. However, they should specify how they intend to use particular research designs in their studies. They should not merely provide the distinction between the two generic designs.

Population (where applicable)

Students should, where applicable, specify the population to which they would like to confine their research/studies.

3.2 Sample (where applicable)

Students should clearly explain how they intend to draw samples from the target populations. They should specify how they intend to appropriately use either quantitative or qualitative sampling techniques to draw research samples. Merely describing what these sampling techniques are is inadequate.

3.3 Research Instruments (where applicable)

Research instruments and measures that would be used to collect data should be clearly provided under this section.

3.4 Procedure

The manner in which data would be collected should be explained here. How research instruments would be used to collect data should be specified in this section.

3.5 Data analysis (where applicable)

In this section, students should provide specific descriptive and/or statistical tests that they would employ to analyse their data, and rationale. Mere reference to particular quantitative data analysis statistical packages and electronic qualitative data analysis procedures would not be sufficient.

3.6 Budget (where applicable)

3. Research Ethics

Students should provide detailed information about ethical issues and *how* they will address potential ethical dilemmas when conducting their research.

4. References

Students should use the referencing format approved by respective faculties/departments. Where there is no prescribed referencing format by faculty/department, the ***American Psychological Association*** **(APA)** becomes the default. There must be consistency between sources cited in the text of the proposal and sources of information indicated in reference lists. Unless critical in the area of research, primary and secondary sources of information cited shall not be more than 10 years old. Students should use refereed/verifiable sources of information.

Research proposals submitted for consideration by the Faculty Postgraduate Studies Committee shall capture the above information in a clear and concise manner and not exceed the maximum page number stated below:

a) Master's by coursework (mini thesis) shall not exceed 6 pages
b) Master's by research shall not exceed 8 pages.
c) Doctoral Degree shall not exceed 10 pages.

In all cases the research proposal should be **Times New Roman, font size 12, double spaced** and on one side of the paper.

The faculty PGSC recommends the research proposal to UNAM PGSC for noting after evaluating the proposal using Annex 15, and issuing of the Research Permission Letter (Annex 16) by the Director: Postgraduate Studies;

De-registration of postgraduate students who fail to make progress

Faculties shall deregister postgraduate students who fail to make progress as stipulated under B.6.2.

O.17. REGULATIONS AND GUIDELINES FOR WRITING AND PRESENTATION OF POSTGRADUATE THESES AND DISSERTATIONS

Broad Guidelines on Mini Thesis/Thesis/Dissertation Manuscript Preparation

Typing/Word-processing

The document must be typed and printed on good quality white A4 paper. The typescript must be clear, Times New Roman, font size 12, double spaced and on one side of the paper.

Pagination

The preliminaries (i.e., parts preceding the Introduction) must be in lower case Roman numerals (i.e.: (i), (ii), (iii), (iv)...), beginning with the title page which should not be numbered. The pages in the main body of the document should be numbered in Arabic numerals (i.e.: "1", "2", "3", "4"...) consecutively throughout. The page numbers should be centred in the lower margin.

Margins

The left margin must be 4.0 cm; the right hand margin must be 2.5 cm; the top margin must be 2.5 cm, and the bottom margin must be 2.5 cm.
The title page must be organised according to (Annex 14)

Components of the preliminary pages (<u>Each starting on a separate page</u>)

Abstract

Following the title page, the mini thesis/thesis/dissertation shall contain an abstract which concisely and comprehensively summarises the essential points and conclusions emanating from the research. The abstract should be between 200-300 words (not exceeding 1 page) in the case of Master's theses, and 300-400 words (not exceeding 2 pages) for Doctoral dissertations. Furthermore, it should include the purpose of the study, a brief overview of the methodology used, the main findings, major conclusions and recommendations. The abstract should not contain headings with 1.5 line spaced.

List of Publication(s)/Conference(s) proceedings

A list of publications and conference presentations by the student, that was part of their study, should be listed in this section. Any publication from thesis/dissertation must show UNAM as the student's affiliation.

Table of Contents

The Table of Contents shall be generated to include level three subheadings.

List of Tables

If there is a list of Tables, these should be consecutively numbered in Arabic numerals following the guidelines of the relevant department/faculty approved referencing style.

List of Figures

If there is a list of Figures, these should be consecutively numbered in Arabic numerals following the guidelines of the relevant department/faculty approved referencing style.

List of Abbreviations and/or Acronyms

Acronyms and non-standard abbreviations should be listed alphabetically in bold; the definitions should not be bolded.

Acknowledgements

The document shall also contain an Acknowledgements section, in which the candidates express their appreciation and gratitude to all the people and institutions which rendered help in the course of the study.

Dedication

If the candidate wishes to dedicate the document to any person, the dedication should be concisely written, and should appear in the preliminaries.

Declarations

The document shall contain the various declarations as outlined in (Annex 2)

Body of the Thesis/Dissertation

a) Master Theses should broadly follow the outline in the proposal (B18.1). In addition it should include results, discussions, conclusions and recommendations as detailed below.

Tables, text figures, diagrams and photographic illustrations should be numbered in separate sequence, and be referred to by number in the text. Each table and figure should have a concise but comprehensive caption. The illustrations should be of publishable quality (600 dpi or higher).

Results:

- Data should be presented in a clear and concise and informative manner.
- A variety of forms might be used to present data, however the same data **must not** be presented in more than one form(for example tables and figures)
- Where applicable primary data should be attached as an appendix and not appear in this section

Discussions:

- It should not merely be a description of the findings (tables and figures)in words
- This section forms the core of the document and therefore need to be a critical analysis of the results and demonstrate insight and understanding of the findings.
- Results and findings must be discussed in context and linked to literature and the stated research aims.
- The discussion must address the objectives and/or questions of the study

Conclusions:

- This should not be a repeat of the results and /or discussion
- It should relate directly to the main objective(s) of the study.
- It must indicate whether the problem was solved, what was learned through the research, what remains to be learned, weaknesses and shortcomings of study, strengths of study as well as possible applications of study (how it can be used).

Recommendations

- Must emanate from the research findings and must be feasible
- Gives opinion on what measures should be adopted to solve the problem based on the conclusions made.
- May endorse the research findings as the solution to the problem or may propose an alternative route.
- Identify information gaps or inconsistences and suggest further studies to address these.

References

Should follow the department/faculty specific referencing style

Appendices

Should be numbered sequentially and can include the following:

- Ethical clearance certificate
- Research permission letter
- Other relevant permissions (where applicable), e.g., collection permits, informed consent documents, etc.
- Data collection Instruments such as questionnaires, interview protocols, pre and post-tests etc.
- Any other relevant data such as supplementary information, raw data etc.

b) Doctoral Dissertations should follow a **stand-alone chapter** (journal publication) approach.
Tables, text figures, diagrams and photographic illustrations should be numbered in separate sequence, and be referred to by number in the text. Each table and figure should have a concise but comprehensive caption. The illustrations should be of publishable quality (600 dpi or higher).

Introduction Chapter (Chapter 1)

This chapter must introduce the study and provide a comprehensive overview of the research problem, and broadly follow the guidelines as indicated above.

Literature Review (Chapter 2)

- This chapter must provide a comprehensive literature review and broadly follow the guidelines as indicated in (B.19).
- This should demonstrate critical understanding and comprehension of the current state of knowledge in the area of research and lead to the motivation for the study.
- The literature should focus on recent developments in the area of study.

Stand-alone chapters

Each Faculty and/or department has a choice to decide whether to use a stand-alone chapter or use the guidelines for Master thesis.
Guidelines for stand-alone chapters are as follows:
Each of these chapters **introduces and represents an independent research aim/objective/question** and should follow the outline below:
Title, Abstract, Keywords, Introduction, Materials and Methods, Results and Discussion, Conclusion, and References (Should follow the approved department /school/ faculty specific referencing style).

Concluding chapter

This chapter integrates all findings of the study and conclusions with feasible recommendations/reflections. Original contribution(s) to knowledge must be clearly pointed out.

Appendices

Should be numbered sequentially and can include the following:

- Ethical clearance certificate
- Research permission letter

- Other relevant permissions (where applicable), e.g., collection permits, informed consent documents, etc.
- Data collection Instruments such as questionnaires, interview protocols, pre and post-tests etc.
- Any other relevant data such as supplementary information, raw data etc.

Language

The presentation of the thesis or dissertation shall be in English. The use of a language other than English requires approval of the UNAM PGSC. In such cases, the abstract must be in both English and the approved language.

Length of Theses/Dissertations

The suggested guidelines are as follows (A4 double spacing):

(a) **Master's theses for coursework programmes(Mini Theses)**: The recommended length of Mini theses for coursework programmes is as follows:
- Mini Theses with less than 100 credits: a minimum of 15,000 words and a maximum of 22,000 words (not exceeding 90 pages).
- Mini Theses between 100–140 credits: a minimum of 18,000 words and a maximum of 30,000 words (**not exceeding 120 pages**).
- Mini Theses above 140 credits: a minimum of 30,000 words and a maximum of 37,000 words (not exceeding 150 pages).

(b) **Master's theses (by research)**:
- The recommended length of a Master's thesis is a minimum of 30,000 words and a maximum of 45,000 words (**not exceeding 180 pages**).

(c) **Doctoral dissertations**:
- The recommended length of a Doctoral dissertation is a minimum of 46,000 words and a maximum of 75,000 words (**not exceeding 300 pages**).

Binding of Theses/Dissertations

(a) Candidates should ensure that when binding the theses/dissertations, the spine shall contain the name of the candidate, the degree for which it was submitted, and the year of degree award **(graduation year).**

(b) The colour of the cover for Master's theses shall be **red** and that for Doctoral Dissertations shall be **black**.

Note: The thesis/dissertation MUST be subjected to plagiarism software i.e. Urkund.

ANNEX 1
SUPERVISION AGREEMENT BETWEEN GRADUATE STUDENT AND SUPERVISOR

This **supervision agreement** between

Name of student: ……………………………………………………………………..
Student number: ………………………………………………………………………
Faculty: ……………………………………………………………………………….
Department: ………………………………………………………………………….
and (on behalf of UNAM)
Name of supervisor: ……………………………………………………………………………………………….
Department: …………………………………………………………………………………….
And (if applicable)
Name of co- supervisor: …………………………………………………………………

Department: ……………………………………………………………………………….

Regarding post-graduate research for the degree of: ……………………………………..
Research topic: ……
……
……………………………………………………………………………………...

By signing this document, both student and supervisor(s) acknowledge their understanding and obligations of the general expectations and responsibilities regarding the supervision of the thesis/dissertation as contained in the UNAM Postgraduate Studies regulations prospectus.

…………………………………………….	…………………………………………….	…..…………
Name of Student	**Signature**	**Date**
……………………………………………..	…………………………………………….	……………………………………
Name of Supervisor	**Signature**	**Date**
…………………………………………….	……………………………………	………………………………………
Name of co-supervisor (where applicable)	**Signature**	**Date**
……………………………………………..	…………………………………………….	……………………………
…………………………………………		
Name of Department HoD	**Signature**	**Date**
……………………………………………..	…………………………………………….	………………………………
Name of Faculty HoD: PGS	**Signature**	**Date**

ANNEX 2

DECLARATIONS WHICH MUST BE CONTAINED IN THE SUBMITTED THESES/ DISSERTATIONS

Format of declarations to be included in every thesis/dissertation:

DECLARATIONS

I, [student's name], hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

No part of this thesis/dissertation may be reproduced, stored in any retrieval system, or transmitted in any form, or by means (e.g. electronic, mechanical, photocopying, recording or otherwise) without the prior permission of the author, or The University of Namibia in that behalf.

I, [student's name], grant The University of Namibia the right to reproduce this thesis in whole or in part, in any manner or format, which The University of Namibia may deem fit.

……………………………………………..	………………………………………	……………
Name of Student	**Signature**	**Date**

ANNEX 3A:	**PROGRESS REPORT**

(To be completed by student for main and co-supervisors)

CENTRE FOR POSTGRADUATE STUDIES
Semester……, 20……..

Student Name: ……
Student Number: ……
Postgraduate Programme Student is enrolled in: ……………………………………………………………………………
Student Contact Details Tel and Email Address: ……………………………………………………………………………..

Mode of study: Full Time/Part Time: ……………………………………………………………………………………………….
Academic year of first registration: …………………………………………………………………………………………….
Research Title: ………..
Supervisor's Name: ………..
PROGRESS TO DATE:

a)	On a scale of 1 to 5 (with 1 being poor and 5 excellent), indicate your progress according to your plan of study. If you rate 1-2, please provide details on a separate page.	1	2	3	4	5
b)	Please indicate the frequency of your face to face academic consultation **this semester** with your supervisor	0	1-3		4-6	>6
c)	Please indicate the frequency of other forms of academic communication with your supervisor (never, less frequent, more frequent)	Telephone				
		e-mail				
		Social media				
d)	Are there any other problems/issues that you would like to draw to the attention of the Faculty/Centre for Postgraduate Studies?	YES			NO	
	If yes, have you discussed these problems with your Supervisor or Head of Department?	YES			NO	
	Has the problem been resolved?	YES			NO	
	Do you require any further intervention to address these issue(s)? If yes, please provide details on a separate page.	YES			NO	

Comments: (You may use a separate page for your comments)

…………………………………………… ……………….. ……………………
Name of student **Signature** **Date**

…………………………………………… ………………….. ……………………
Name of Departmental HOD **Signature** **Date**

ANNEX 3B: PROGRESS REPORT
(To be completed by each supervisor, main and co-supervisors)

CENTRE FOR POSTGRADUATE STUDIES
Semester……20……
Student Name: ……...........
Student Number: ……
Postgraduate Programme Student is enrolled in: ……………………………………………………………………………………….
Student Contact Details Tel and Email Address: ………………………………………………………………………………………
Mode of study: Full Time/Part Time: ………………………………………………………………………………………………….
Academic year of first registration: ……………………………………………………………………………………………………….
Research Title: …….
Supervisor's Name: ……………………………………………………………….

PROGRESS TO DATE:

<table>
<tr><td rowspan="1">a) On a scale of 1 to 5 (with 1 being poor and 5 excellent), indicate student progress according to plan of study. If you rate 1-2, please provide details on a separate page.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>b) Please indicate the frequency of your face to face academic consultation this semester with your student</td><td>0</td><td>1-3</td><td>4-6</td><td colspan="2">>6</td></tr>
<tr><td rowspan="3">c) Please indicate the frequency of other forms of academic communication with your student(never, less frequent, more frequent)</td><td colspan="3">Telephone</td><td colspan="2"></td></tr>
<tr><td colspan="3">e-mail</td><td colspan="2"></td></tr>
<tr><td colspan="3">Social media</td><td colspan="2"></td></tr>
<tr><td rowspan="4">d) Are there any other problems/issues that you would like to draw to the attention of the Faculty/Centre for Postgraduate Studies?
If yes, have you discussed these problems with the student or Head of Department?
Has the problem been resolved?
Do you require any further intervention to address these issue(s)? If yes, please provide details on a separate page.</td><td colspan="3">YES</td><td colspan="2">NO</td></tr>
<tr><td colspan="3">YES</td><td colspan="2">NO</td></tr>
<tr><td colspan="3">YES</td><td colspan="2">NO</td></tr>
<tr><td colspan="3">YES</td><td colspan="2">NO</td></tr>
</table>

Comments: (You may use a separate page for your comments)

……………………………… ……………… ……………………
Name of Supervisor **Signature** **Date**
…………………….......... ……………….. ……………………
Name of Department HoD **Signature** **Date**

ANNEX 4A: NOTICE OF INTENTION TO SUBMIT THESIS/DISSERTATION FOR EXAMINATION
(To be completed by student)

Date …………………………

The UNAM Post Graduate Committee
The University of Namibia
Private Bag 13301
WINDHOEK
Namibia

Dear Director,

NOTICE OF INTENTION TO SUBMIT THESIS/DISSERTATION FOR EXAMINATION

I, ____ (Student no :______________________) hereby notify the Postgraduate Studies Committee of my intention to submit my thesis / dissertation on _________ (date) for examination. I attach the abstract of my thesis/dissertation.

The title of my thesis/dissertation is:--

…………………………………………… …………………………………………… ……………
Name of Student **Signature** **Date**

…………………………………………….. …………………………………………… …………….
Name of Supervisor (Main/Co-) **Signature** **Date**

ANNEX 4B:	REQUEST FOR APPOINTMENT OF EXAMINERS

CENTRE FOR POSTGRADUATE STUDIES

Student Number:		
Surname and Initials:		
Department and Faculty		
Degree (Masters/PhD)		
Title of thesis/dissertation:		
Main Supervisor		Affiliation:
Co-Supervisor		Affiliation:
Co-Supervisor		Affiliation:
Co-Supervisor		Affiliation:
External Examiner		Affiliation:
External Examiner		Affiliation:
External Examiner		Affiliation:
Internal Examiner		Affiliation:

I hereby declare that there is no conflict of interest in the nomination of the abovementioned examiners.

…………………………………………….. ……………………………………………. …..…………
Name of HOD: Department **Signature** **Date**

Recommended by FPGSC on………………………………………….. **Resolution no**:…………………………**.**

…………………………………………….. ……………………………………………. ……………
Name of HOD: PGS **Signature** **Date**

ANNEX 5:

RECOMMENDED FORMAT OF SUMMARIZE CURRICULUM VITAE

CENTRE FOR POSTGRADUATE STUDIES

Title:		**Initials:**
Surname:		
Name/s:		
Academic or equivalent institution to which affiliated:	**Past:**	**Present:**
Present Academic Rank	**Professor**	
Work and employment experiences	**Past:**	**Present:**
Physical Contact Details (Courier Delivery Address):		
Telephone numbers	**Office:**	**Cell:**
Email address/		
Academic Qualifications and Year Obtained/Institution	**Qualification/s and Year/s Obtained**	
Area/s of Expertise/Specialisation	**Primary**	**Secondary**

Record of publications in the last 10 years	
ARTICLES IN PEERED REVIEWED JOURNALS/PROCEEDINGS	
Title and Authors: Journal/Proceedings Name	
NATIONAL AND INTERNATIONAL CONFERENCES	
Title and Authors and Conference	
CONTRIBUTION IN BOOKS, CHAPTERS IN BOOKS ECT.	
Title and Authors	Book and ISBN
List of **key research projects** undertaken or coordinated for the last 10 years, starting with the most recent:	
Record of **postgraduate student supervision** for the last 10 years, starting with the most recent:	
Title or Student Role Main/Co Supervisor	
Examiner of post graduate studies	
Title/Student and M/PhD	
Other Academic related experiences/achievements	

***The* abridged CV should not be more than three pages long**

ANNEX 6

CHECKLIST FOR SUBMITTING THESIS/DISSERTATION TO THE SCHOOL
(To be completed by the supervisor)

Faculty: ....

Department:..

Degree registered for: ....

Name of Student: ....

Student Number:...

Title of thesis/dissertation: ....

Name(s) of supervisor(s): ....
………
…………………………………………………………………………………………

Date when the thesis/dissertation was sent to examiners: ………………………………

Date when comments on the thesis/dissertation were received from examiners: …………………………….

Table of corrections received from student: Yes……… No…………

Supervisor(s) checked the thesis/dissertation to verify that the student made the revisions according to the table of corrections Yes……… No…………

Supervisor checked the thesis/dissertation for conformity with regards to formatting before binding:

Yes……… No……….

……………………………………	………………………………………	….………
Name of Supervisor	**signature**	**Date**
……………………………………	……………………………	……………
Name of HOD: department	**signature**	**Date**

Date when the bound copies of the thesis/dissertation were submitted to Faculty Postgraduate Studies Committee for inspection and noting…………………………………..

……………………………………	………………………………………	…………….
Name of HOD: FPGS	**signature**	**Date**

All conditions pertaining to the submission of thesis/dissertation have been met

……………………………………	………………………………………	……………
Name of Faculty Officer CPGS	**signature**	**Date**

ANNEX 7

WILLINGNESS TO SERVE AS AN EXAMINER AND DECLARATION OF POSSIBLE CONFLICT OF INTEREST

I , ……………………………………………………………….. am willing to serve as examiner for student ………………………… and hereby declare the following possible areas of conflict of interest regarding the examination of the thesis/dissertation titled: ………
………
………………………………………………………………………………………………..

POSSIBLE AREA OF CONFLICT	DETAILS
Family (e.g. cousin, in-law)	
Other Personal relationship (e.g. friend)	
Professional (e.g. colleague, research collaborator, co-author)	
Others	
None	

……………………………… ……………………………… ……………

Name of Examiner **Signature** **Date**

ANNEX 8
EXAMINER APPOINTMENT LETTER

Date
Examiner Physical Address
Telephone
E-mail

Dear Prof/Dr XXX

Examination of Thesis/Dissertation: Mr/Ms XXX

I am pleased to inform you that you have been appointed as an examiner for the above mentioned student. The manuscript is enclosed herewith. Attached, also find the guidelines for the compilation of the report and the relevant forms to be filled in.

Please return the comprehensive report and completed forms in electronic format within **8 weeks from the date of receipt of the manuscript** to the **Director, Centre for Postgraduate Studies** (directorpgs@unam.na). If there is a need to return the hardcopy of the manuscript, kindly do so via DHL to the return address provided. However, note that no reports or forms should accompany the manuscript.

Please acknowledge receipt of the manuscript. Should you be unable to complete the examination by the indicated time frame, given your other commitments, kindly inform me accordingly.

Best regards

Dr PT Johannes
Associate Dean: School of Engineering and the Build Environment
Tel: +264 65 2 324022
E-mail: pjohannes@unam.na

Cc. HOD: Postgraduate Studies (e-mail)

ANNEX 9
MARK ALLOCATION OF MASTER's THESIS
Name of Student: ………………………………………………………………………………………………………......
Student Number: ……………………………………………………………………………………………………..
Thesis title: ………
………..

Assessment Criteria	**Allocated mark**	**Maximum mark**
Title: (appropriateness, clear and informative)		2
Abstract: (concise, outlines aims of study, methodology, findings and conclusions)		4
Introduction: background/orientation of study (sufficient and relevant)		3
Introduction: problem statement (clear and logical progression from literature to aims of the study)		3
Introduction: objectives/hypothesis/research questions (well formulated and relevant to the problem statement)		3
Literature review: (relevant, recent, critical, comprehensive and logically/theoretical integrated)		10
Research methods: (clear, detailed, informative, appropriate and supported by literature)		10
Results: Data collected (adequate and relevant)		7
Results: Data analysis (appropriate, relevant to aims and objectives/hypotheses/research questions)		10
Results: Data presented (technical aspects , appropriate, concise, informative and clear)		7
Discussions: Critical, comprehensive, logically integrated, linked to literature, acknowledgment and discussion of limitations, significance and implications of the findings		25
Conclusion and recommendations: clear, concise and supported by data, findings must relate/respond to the objectives/hypotheses/research questions. Recommendations must be linked to the findings		5
Contribution to knowledge: originality and relevance to subject area		3
References: Appropriate format, consistency between in-text citation and reference list		5
Language and technicalities: clear and legible language use and format		3
TOTAL		**100**

…………………………………………….. ……………………………………………. ………………………….
Name of Examiner **Signature** **Date**

ANNEX 10
SUMMARY OF EXAMINATION RESULTS (MASTER THESIS)

Name of student: ……………………………………………………………………………………………………….

Thesis title: ……
………..
………..
Faculty:………………………………………………………………………………………………………...

	EXAMINERS RECOMMENDATIONS	**(X)**
1.	Thesis PASSES subject to MINOR corrections Mark allocated: ………… (≥ 50%)	
2.	Thesis PASSES subject to MAJOR corrections as indicated in the report Mark allocated: ………… (≥ 50%)	
3.	Thesis MUST BE RE-SUBMITTED FOR RE-EXAMINATION after one or more of the following (specify): **(No mark to be allocated)**	
	3.1 Additional literature review	
	3.2 Additional data collection	
	3.3 Additional data analysis	
	3.4 Thesis re-write	
	3.5 Other (specify in Main Report)	
4.	Thesis FAILED (reasons specified in Main Report). Mark allocated: ………… (≤ 50%)	

…………………………………………….. ……………………………………………. ………………………….
Name of Examiner **Signature** **Date**

Interpretation of the grading scale:
% Equivalence Interpretation
80 and above Distinction
70 – 79 Very Good
60 – 69 Good
50 – 59 Satisfactory
49 and below Fail

ANNEX 11
SUMMARY OF EXAMINATION RESULTS (PhD/DOCTORAL DISSERTATION)

Name of student: ……………………………………………………………………………………………….

Dissertation Title: ……………………………………………………………………………………………………….
………..
………..
Faculty:……………………………………………………………………………………...

	EXAMINERS RECOMMENDATIONS	(X)
1.	Dissertation PASSES subject to MINOR corrections	
2.	Dissertation PASSES subject to MAJOR corrections as indicated in the report	
3.	Dissertation MUST BE RE-SUBMITTED FOR RE-EXAMINATION after one or more of the following (specify):	
	3.1 Additional literature review	
	3.2 Additional data collection	
	3.3 Additional data analysis	
	3.4 Dissertation re-write	
	3.5 Other (specify in Main Report)	
4.	Dissertation FAILED (reasons specified in Main Report).	

……………………………………………..   ……………………………………………   …………………………
Name of Examiner   **Signature**   **Date**

ANNEX 12
***VIVA VOCE* EXAMINATION RESULTS FORM (NO MARK SHOULD BE ALLOCATED – ONLY PASS/FAIL)**
(To be attached to the detailed report by the Viva Voce Chairperson)

Name of Student: ………

Degree registered for: …………………………………………………………………………

Thesis/Dissertation Title: …………………………………………………………………………………………………….
……......
……

Date: ……………………………

No.	**EXAMINERS' RECOMMENDATION**	**(X)**
1.	**PASS**	
1.1	Student PASSES and no additional adjustments are required.	
1.2	Student PASSES SUBJECT TO minor corrections and revisions	
2.	**FAIL**	
2.1	Student FAILS, but should be given another chance of defending the thesis/dissertation after rectifying the identified weaknesses	
2.2	Student FAILS OUTRIGHT	

Name*	**Designation**	**Affiliation**	**Signature**
	Chairperson		
	External Examiner		
	External Examiner		
	External/Internal Examiner		
	Main supervisor		
	Co-supervisor		
	Co-supervisor		
	Other		

- The *VIVA VOCE* Panel Chairperson should prepare a more detailed report according to instructions contained in **B.16.3 under *Viva voce* Examinations**.
- *In case of disagreement, each panellist shall show against his/her signature which recommendation (e.g., 1.1, 1.2, 2.1 or 2.2) s/he prefers.*

ANNEX 13
***TEMPLATE FOR VIVA VOCE* CHAIRPERSON REPORT**

Name of Student: ………………………………………………………………………………………………………..

Degree registered for: ……………………………………………………………………………………

Thesis/Dissertation Title: ……………………………………………………………………………………………………….
……
………………………………………………………………………………………

Date of Viva Voce examination : ……………………………

1. **Panel members in attendance**
2. **Challenges faced with the examination (e.g. logistical arrangements)**
3. **Summary of the presentation by the student**
4. **Summary of the discussions during the examination**
5. **Strong and/or weak points identified during the presentation and discussions**
6. **Specific recommendations to the student where applicable**

We hereby declare that this report is a true reflection of the Viva Voce examination:

Name*	Designation	Affiliation	Signature
	Chairperson		
	External Examiner		
	External Examiner		
	External/Internal Examiner		
	Main supervisor		
	Co-supervisor		
	Co-supervisor		
	Other		

External panellists who are unable to sign off the report must acknowledge approval of the report via e-mail

ANNEX 14

(Research Proposal/Summary/Mini Thesis/Thesis/Dissertation title page)

EVALUATION OF SELECTED NAMIBIAN MEDICINAL PLANTS FOR ANTI-HIV PROPERTIES

A RESEARCH PROPOSAL/ A MINI THESIS/THESIS/DISSERTATION SUBMITTED IN PARTIAL FULFILMENT/FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE (SPECIFIC DEGREE NAME IN FULL)/DOCTOR OF PHILOSOPHY IN SCIENCE (BIOLOGICAL SCIENCES)

OF

THE UNIVERSITY OF NAMIBIA

BY

....
(NAME OF STUDENT)

....
(STUDENT NUMBER)

....
MONTH AND YEAR OF GRADUATION

MAIN SUPERVISOR: Name (Affiliation)………………………………………………………………………………………

CO-SUPERVISOR(S): Name (Affiliation)………………………………………………………………………………………

NB: INDICATE **IN FULFILMENT** WHEN THERE IS NO COURSEWORK AND IN **PARTIAL FULFILMENT** WHEN THERE IS COURSEWORK

ANNEX 15
POSTGRADUATE STUDIES

CHECKLIST FOR APPROVAL OF RESEARCH PROPOSALS (TO BE COMPLETED BY THE SUPERVISOR)

Faculty: ………………………………………………………………………… **Department:** ……..……………………………

Postgraduate Programme Student is enrolled in: ……………………………………………………………………..

Name of Student: ……………………………………………………………. **Student number:** ..……………

Title of Study to be conducted: ……………………………………………………………………………………….

Instructions: Tick (√) **YES** or **NO** in the space provided to indicate whether particular actions and tasks were undertaken. In addition, indicate the dates when the actions or tasks were undertaken.

	NATURE OF ACTION TAKEN	RESPONSE CHOICES				DATE WHEN ACTION WAS TAKEN
1	The student is registered at UNAM for the current academic year	**YES**		**NO**		
2	The research proposal has been prepared under the guidance of a supervisor or supervisors.	**YES**		**NO**		
3	The student successfully completed the seminar at department and/or faculty level.	**YES**		**NO**		
4	The research proposal has been considered and recommended at departmental level.	**YES**		**NO**		
5	The research proposal has been considered by the Faculty Postgraduate Studies Committee the following resolution was taken: **RESOLUTION NUMBER: …………………………………………….**	**Approved**				
		Rejected				
		Extended				
6	Where extension was granted and the proposal re submitted, the research proposal has been considered by the Faculty Postgraduate Studies Committee the following resolution was taken: **RESOLUTION NUMBER: …………………………………………….**	**Approved**				
		Rejected				
7	The research proposal has been submitted to the UNAM PGSC for noting.	**YES**		**NO**		

…………………………………………………………… …………………………………………….. ……………….
Name of the Main Supervisor **Signature of the Main Supervisor** **Date:**

…………………………………………………………… ………………………………….. …………………
Name of the Co-Supervisor **Signature of the Co- Supervisor** **Date:**

Name and Signature of the School Chairperson: …………………………………………………………….
Date:…………………………………….

ANNEX 16

RESEARCH PERMISSION LETTER

Student Name

Student number

Programme

Approved research title

TO WHOM IT MAY CONCERN

I hereby confirm that the above mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

--- ……………………………..

Dr PT Johannes **Date**
Associate Dean: School of Engineering and the Build Environment
Tel: +264 65 2 324022
E-mail: pjohannes@unam.na

ANNEX 17
POSTGRADUATE TARIFFS LIST

A. PhD EXAMINATION AND SUPERVISION

	Examination	Supervision
Internal	N$ 2,500	N$ 4,000
External	N$ 5,000	N$ 10,000

B. MASTER EXAMINATION AND SUPERVISION

	Examination	Supervision
Internal	N$ 2,000	N$ 2,000
External	N$ 2,500	N$ 5,000

ANNEX 18

POSTGRADUATE CLAIM FORM FOR EXAMINATION/SUPERVISION

SECTION A	**PERSONAL DETAILS**	
NAME OF CLAIMANT and TITLE (Prof/Dr/Mr/Mrs/Ms)		
STAFF NUMBER (**UNAM STAFF ONLY**)		
RESIDENTIAL/PHYSICAL ADDRESS (**NB**) ERF: STREET NAME: TOWN/CITY:		
SECTION B	**DETAILS OF SERVICE PROVIDED**	
NAME OF STUDENT		
FACULTY		
TITLE OF THESIS/DISSERTATION		
DEGREE (PhD / Masters)		
TYPE OF SERVICE (Examination / Supervision)		
AMOUNT CLAIMED	**N$**	
SECTION C	**FULL BANK DETAILS**	
BANK and COUNTRY (**NB**)		
BRANCH NAME		
BRANCH CODE		
TYPE OF ACCOUNT		
ACCOUNT NUMBER		
FULL NAME AND SURNAME OF ACCOUNT HOLDER		
BANK PHYSICAL ADDRESS		
IBAN NUMBER (INTERNATIONAL BANK ACCOUNT NUMBER)		
SWIFT CODE (required for foreign banking)		
SECTION D	**CLAIMANT SIGNATURE AND DATE**	
SIGNATURE____________________________	DATE:_________________	
SECTION E	**OFFICIAL VERIFICATION**	
	SIGNATURE	DATE
Checked by HOD: Department		
Checked by HOD: PGS		
Approval by Director: CPGS		
Finance Department:		

*** ALL CLAIMS MUST BE ACCOMPANIED BY RELEVANT EVIDENCE ON THE SERVICE BEING CLAIMED FOR:**
Examiner: Detailed examination report
Supervisor: Bi-annual progress reports for the duration of the study
Note: Claimants outside Namibia and South Africa, must please attach a copy of ID or Passport
Please note there is NO payment for chairing or participating in a *viva voce* examination panel.

P. SCHOOL OF ENGINEERING AND THE BUILT ENVIRONMENET

OFFICE OF THE DEAN
☏ (264 65) 232 4004 🖷(+264 65) 232 4085 💻 pnshivute@unam.na ✉ P O Box 3624 ONGWEDIVA, NAMIBIA

12.6 The School of Engineering and the Built Environment may award the following postgraduate qualifications:

Qualification Code	Qualification Name	Study Period
19MCVS	Master of Science (MSc) in Civil Engineering (Structures)	2 FT and 3 PT
19MCVT	Master of Science (MSc) in Civil Engineering (Transportation)	2 FT and 3 PT
19MCVW	Master of Science (MSc) in Civil Engineering (Water)	2 FT and 3 PT
19MELE	Master of Science in Engineering (Electrical Engineering) (by Thesis only)	2
19MECE	Master of Science in Engineering (Electronics and Computer Engineering) (by Thesis only)	2
19MMEC	Master of Science in Engineering (Mechanical Engineering) (by Thesis only)	2
19MMET	Master of Science in Engineering (Metallurgical Engineering) (by Thesis only)	2
19MMIN	Master of Science in Engineering (Mining Engineering) (by Thesis only)	2
19MSCE	Master of Science in Civil Engineering (By Thesis)	2
19MWRM	Master of Science in Water Resources Management **(No intake 2022)**	2
19DPEG	Doctor of Philosophy in Engineering	3

F.F.222[19MCVE]

P CURRICULUM FOR THE MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (STRUCTURES)

P. 1 .DEGREE NAME: MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (STRUCTURES) 19MCVS [19MCVE]

P.2 PURPOSE AND RATIONALE OF THE PROGRAMME

The **purpose** of the degree programme for **Master of Science in Civil Engineering (Structures**) of the University of Namibia is to offer advanced training to civil engineers so as to prepare them to become specialists in Structural Engineering. The MSc Civil Engineering (Structures) degree programme covered here consists of advanced taught courses plus one year of research by thesis at Level 9 of the National Qualifications Framework (NQF) in Namibia.

Graduates of the MSc Civil Engineering (Structures) degree programme will be equipped with knowledge and skills to work in industry, do consultancy or carry out further research in the areas of structural engineering. The students will gain an advance knowledge in the planning, analysing, design and management (maintain, repair, rehabilitate and retrofit) of civil engineering structures such as houses, high rise buildings, high volume containers, storage silos and bridges, amongst others.

The **rationale** of this qualification is based upon the fact that the Department of Civil Engineering has produced over 130graduate engineers and there are many other Civil engineering graduates from other national and international institutions. These Civil Engineers need to further their studies in the field of Civil Engineering. Having demonstrated the success of its Bachelor's degree programme, and having received confirmation from the Engineering Council of Namibia that these graduates are registerable as Professional Engineers, the Faculty has developed a curriculum for the degree of Master of Science in Civil Engineering to enable its Graduate Engineers and holders of Bachelor of Science in Civil Engineering from other institutions to undertake further studies in the field of Civil engineering and thereby build capacity for researchand consultancy in this field.

P.3 CRITERIA FOR ADMISSION

Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (Honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the field of Civil Engineering.

P.4 MODE OF DELIVERY

Full time and part time on a blended learning approach at JEDS Campus

P.5 DURATION OF STUDY

The minimum duration for the Master of Science in Civil Engineering degree programme is two (2) years of full-time study or three (3) years of part time study. The degree must be completed within four (4) years of full-time study or five (5) years of part time study.

P.6 ASSESSMENT CRITERIA

- Reference is made to the University's General Information and Regulations Prospectus and Guidelines for Postgraduate Students for detailed examination and promotion rules.
- For assessment purposes, all courses shall normally carry a component of Continuous Assessment and University Examination. Continuous Assessment (CA) shall normally consist of **Written Tests plus Assignments and/or Lab, and Reports/Mini Projects.**
- Unless otherwise specified, the CA Mark shall be made up of **50%** Written Tests and **50%** Assignments and/or LabReports/Mini Projects.
- A candidate will be eligible to write a University Examination (UE) in a given course only if he/she has obtained the required Continuous Assessment Mark of at least 40% in that course unless state otherwise in the Faculty prospectus.

- University Examinations will be administered at the end of the semester.
- Courses with 18 or more credits shall have **3-hour** examination papers. Courses with 12 credits shall normally have **2-hour** examination papers.
- The Final Examination Mark shall normally be made up of **50%** Continuous Assessment and **50%** UniversityExamination.
- The minimum Pass Mark in any course as determined by the Final Examination Mark is **50%.**

P.7 MAXIMUM NUMBER OF MODULES PER YEAR

	Full Time	Part Time
First year:	144 Credits	90 Credits
Second year:	144 Credits	84 Credits
Third Year:		150 credits

P.8 ADVANCEMENT AND PROGRESSION RULES MASTER OF SCIENCE IN CIVIL ENGINEERING (STRUCTURER)

1. First Year to Second Year of Study (Full Time Students)

Full Time students must have passed at least 120 Credits, including Statistics and Research Method to be able to proceedfrom Year 1 to Year 2 of study.

1. First Year to Second Year of Study (Part Time Students)

Part Time students must have passed at least 74 Credits to be able to proceed from Year 1 to Year 2 of study.

2. Second Year to Third Year of Study (Part Time Students)

Part Time students must have passed all 90 credits of Year 1, and at least at total of at least 30 Credits of Year 2, includingStatistics and Research Method to be able to proceed from Year 2 to Year 3 of study.

P.9 No Re-admission Rule

A student must meet the following minimum requirements in a given year of study to be readmitted into the programme.

1. Minimum requirements for Full time StudentsFirst
year: 60 Credits
Second year: Passed all first-year courses (144 Credits) plus SEBE Board approved thesis proposal

2. Minimum requirements for Part time Students

First year:	42 Credits
Second year:	Passed all first-year courses (90 Credits) and passed 24 credits from Second year courses.
Third Year:	Passed all first- and second-year courses (144 credits) plus SEBE Board approved thesis proposal

P.10 Maximum Number of Credits per Year

	Full Time	Part Time
First year:	144 Credits	90 Credits
Second year:	144 Credits	84 Credits
Third Year:		150 credits

P.11 Requirements for Qualification Award

A student can graduate with the degree of **Master of Science in Civil Engineering** only if he/she has earned the **264 NQFCredits** prescribed in the curriculum.

Summary Table for all Courses in the MSc Civil Engineering (19MCVS) Programme for Full Time Students

COMPULSORY COURSES (STRUCTURES PROGRAMME) - YEAR 1 OF FULL TIME STUDENTS

SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1	Structural Dynamics	**CVS5991**	9	18	3L +2T or 2P	None
1	Advanced Structural Analysisand FEM	**CVM5951**	9	24	4L +2T or 2P	None
1	Advanced Concrete Technology	**CVC5921**	9	12	2L +1T or 1P	None
1	Statistics and ResearchMethods	**EGT5981**	9	18	3L+2T or 2P	None

1	Academic Writing for Post Graduate Studies	**UAE5819**	8	18*	4L	None
	Total credits Semester 1			**72**		
2	Advanced Structural Concrete Design	**CVM5972**	9	24	4L +2T or 2P	None
2	Advanced Structural Steel Design	**CVS5932**	9	24	4L +2T or 2P	None
2	Maintenance of Concrete Structures	**CVM5912**		24	4L +2T or 2P	None
	Total credits Semester 2			**72**		
	Total credits Year 1			**144**		

**credits not included in the overall course credits*

COMPULSORY COURSES - YEAR 2 FOR FULL TIME STUDENTS (STRUCTURES PROGRAMME)

YEAR 3 SEMESTER 1 and 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1and2	Thesis	**EGT5990**	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Key: *L – Lecture; T – Tutorial; P – Practical; S – Seminar Discussion; FW – Field Work (Fieldtrip).*
Note: Where Block Release is done, the following shall apply:
24 Credits: Block of 3 weeks in total
18 Credits: Blocks of 2 weeks in total, including Saturdays
12 Credits: Block of 1 week and 2 days

Summary Table for all Courses in the MSc Civil Engineering (19MCVS) Programme for Part Time Students
COMPULSORY COURSES (STRUCTURES PROGRAMME) – YEAR 1 PART TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Structural Dynamics	**CVS5991**	9	18	3L +2T or 2P	None
1	Advanced Structural Analysisand FEM	**CVM5951**	9	24	4L+2T or 2P	None
	Total credits Semester 1			**42**		
2	Advanced Structural Concrete Design	**CVM5972**	9	24	4L +2T or 2P	None
2	Advanced Structural Steel Design	**CVS5932**	9	24	4L +2T or 2P	None
	Total credits Semester 2			**48**		
	Total credits Year 1			**90**		

COMPULSORY COURSES (STRUCTURES PROGRAMME) - YEAR 2 OF PART TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Advanced Concrete Technology	**CVC5921**	9	12	2L +1T or 1P	None
1	Statistics and ResearchMethods	**EGT5981**	9	18	3L+2T or 2P	None
	Total credits Semester 1			**30**		
2	Maintenance of ConcreteStructures	**CVM5912**	9	24	4L+2T or 2P	None
2	Academic Writing for Post Graduate Studies	**UAE5819**	9	18*	3L +2T or 2P	None
	Total credits Semester 2			**24**		
	Total credits Year 2			**54**		

**credits not included in the overall course credits*

COMPULSORY COURSES - YEAR 3 OF PART TIME STUDENTS (STRUCTURES PROGRAMME)

YEAR 3 SEMESTER 1 and 2 OF PART TIME STUDENTS						
SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1and2	Thesis	**EGT5990**	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Key: L – Lecture; T – Tutorial; P – Practical; S – Seminar Discussion; FW – Field Work (Fieldtrip).

Note: Where Block Release is done, the following shall apply: 24
Credits: Block of 3 weeks in total
18 Credits: Blocks of 2 weeks in total, including Saturdays12
Credits: Block of 1 week and 2 days

PART B-1: COURSE SPECIFICATION: MSc Civil Engineering Programme 19MCVS (Structures)

Course Title	**ADVANCED STRUCTURAL ANALYSIS AND FEM**
Course Code	**CVM5951**
NQF Level	9
Notional Hours	240
Contact hours	4 hours lecture plus 2-hour tutorial or 3 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Semester Offered	1

The aim of this course is to advance the students' knowledge of solving statistically indeterminate structures using various methods and to master the use of the finite elements method software in structural analysis.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Solve forces and moments in static structures and statically indeterminate structures and trusses using the different matrix methods such as the flexibility and stiffness method.
2. Apply the slope deflection method to assess the elastic stability and second-order response ofstructures.
3. Evaluate elastic deformation, as well as non-linear deformation using methods of continuum visco-elastic, plasticity, damage and fracture mechanics.
4. Apply basic concepts of numerical methods used to solve different models of mechanics for structures with complex geometries.
5. Model thin and solid structures and assess linear and nonlinear problems in FEM
6. Apply numerical techniques to solve engineering problems using Finite Elements Method (FEM) computer programmes.

Course Content

This course mainly deals with matrix analysis of structures by extending the basic stiffness method of analysis. It includes the review of basic **concepts of structural analysis** and **matrix algebra**, and to how the latter provides an excellent mathematical framework for the former, **indeterminate structures, matrix concepts** and **matrix analysis of structures**. This is followed by detailed descriptions, and demonstrations through many examples, of how **matrix methods** can be applied to **linear static analysis of skeletal structures** (plane and space trusses; beams and grids; plane and space frames) by the **stiffness method**, and also the **flexibility method**. The course concludes with, the **analysis of elastic instability** and **second-order response (**Effects of axial force on flexural stiffness, solution by slope deflection method and solution by matrix method)**.** This course is also expected to enable a good understanding of how apply the matrix method to analyse statically indeterminate linear 3D frames and trusses.

Introduction to Principles of FEM, Degree of freedom / support conditions / cut principle / Equilibrium; Internal Forces / Loading and Actions / Specific load cases / Safety factors; Basic stresses / Principle stresses and failure criteria; Material parameter with failure strength and hypothesis; Stresses and deformation of thin- / thick -walled structures; FE-modelling ofthin and solid structures as 1D-, 2D and 3D model; Linear and nonlinear problems with analysis; Typical Finite Elements (1D, 2D and 3D) for deformable objects; Example of rod, beam and shell element with matrix equation.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work, computer practical and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbooks

None

Recommended Textbooks

(i) Lamaitre, J. (1991). Damage Mechanics, By Jean Lemaitre, Springer-Verlag.
(ii) Gurtin ME. (1981). An Introduction to Continuum Mechanics. Academic Press, New York
(iii) Leigh DC. (1968). Nonlinear Continuum Mechanics. McGraw Hill, New York.

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Course Title	ADVANCED CONCRETE TECHNOLOGY
Course Code	**CVC5921**
NQF Level	9
Notional Hours	120
Contact hours	2-hours lecture plus 1-hour tutorial or 1 practical session per week for one semester
NQF Credits	12
Pre-requisites	None
Semester Offered	1

This course explores the materials science of concrete; to bring about the advanced understanding of concrete behaviour.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Evaluate the impacts of concrete ingredients on concrete performance
2. Plan and execute laboratory testing on coarse and fine aggregate, water, admixture used in concrete
3. Select cement admixtures and supplementary cementitious materials for producing concrete with specific and orspecial requirements
4. Evaluate the performance of various cement-based materials including normal and high strength concrete as well as special cement composites
5. Devise concrete mixture design for high strength concrete and special concrete and specify associated testing for fresh and harden concrete.
6. Compare different special concrete available and how they are made.

Course Content

Characterization of basic ingredients for normal concrete. Important properties for fine and course aggregate, cement, water, admixtures, and supplementary cementitious materials and their effects on concrete properties and effects of admixtures, admixture side effects. Concrete **mix design**. Mixture proportioning with and without cement additives. **Concrete testing**. Testing of desirable properties for concrete in both plastic and hardened state, including strength, creep, shrinkage, elastic modulus and durability. **Concrete modelling**. Predicting and modelling concrete structural properties; concrete failure and fracture; **Quality control**. Concrete quality control, deterioration mechanisms. **Special concretes** such as high strength concrete, self-compacting concrete and fiber reinforced concrete.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, laboratorypracticals, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 written test and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of project based assignments, tests and examination

Prescribed Textbooks

None

Recommended Textbooks

(i) A.M. Neville (2011). "Properties of Concrete", 5th Ed., Pearson Education Limited, Edinburg Gate, Harlow, EssexCM20 2JE, England, ISBN: 978-0-273-75580-7

(ii) P.K. Mehta and P.J.M. Monteiro (2006). "Concrete – microstructure, properties and materials", 3rd Ed., McGraw Hill, New York.

(iii) Fulton's (2009) Fulton's Concrete Technology (9th edition). Edited by Gill Owens, Cement and Concrete Institute, Midrand, South Africa, ISBN 978-0-9584779-1-8.

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Course Title	STATISTICS AND RESEARCH METHODS
Course Code	**EGT5981**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 computer-based practicals per week for one semester
NQF Credits	18
Pre-requisites	None
Semester Offered	1

This course aims to equip students with the advanced skills needed to identify and to conduct reliable advanced research and statistical analysis as required in scientific research and industrial practice.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Define the responsibilities of a researcher, including scientific ethics, and data and code management requirements.
2. Formulate appropriate research questions/hypothesis and select appropriate research designs;
3. Apply concepts of probability, random variables, statistical inference, hypothesis testing and regression in engineering.
4. Manipulate data and use statistic software to perform statistical analysis and probability calculations
5. Develop and write scientific research proposals

Course Content

The course has three sections. The first section focused on **Research Methods**. This section will provide students with an advanced knowledge and skills to initiate, structure and conduct excellent, publishable research. It will advance research concepts covered at an undergraduate level, such as research design, research methodology and research validation. Bothqualitative and quantitative research methods will be covered at an advanced level. Concepts such as problem identification, formulation of appropriate research questions/ hypothesis, conducting related literature search and evaluation, development of a research plan, research design, data analysis, disseminate the results and development of a research proposal will be covered at an advanced level. This section will be concluded with **Research Ethics**: different citation methods and styles, importance of referencing and research ethic codes.

The second section will focus on **experimental methods and statistics**. **Statistical Data Analysis:** Introduction to statistical experimental design, ANOVA analysis, error or residue analysis, simple and multiple linear regression analysis, maximum flow theory, probability theory, discrete and continuous probability distribution, reliability and decision analysis. Use of Statistical Software**:** Use of statistical software such as SPSS, R, Mini Tab, etc.

The last section is **Research Proposal Writing:** Students apply what they have learn to write Research Proposals for research work in their fields of interest under the supervision of an academic member of staff and present the Research Proposal for assessment.

Contribution to Assessment of Exit Programme Outcome:

(3) Research capability at work or towards PhD studies

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions. Each topic covered in the lectures will be followed by exercises analyzing real data in practical computing classes using statistical software.

Assessment Strategy

Continuous Assessment **100%**, involving at least 2 written tests **25%**; Assignments **20%**; Research Proposal and ProposalPresentation **50%.**

Quality Assurance Arrangements

Research proposal and statistics components are moderated internally. Students complete an evaluation form towards theend of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Thiel, D. (2014). An introductory note for instructors. In *Research Methods for Engineers*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139542326.002

(ii) Peter RN, Coffin M, Copeland KAF. (2003). Introductory Statistics for Engineering Experimentation. Academic Press, Technology and Engineering

(iii) Jeff Wu C.F, Michael S. Hamada. (2011). Experiments: Planning, Analysis, and Optimization. John Wiley and Sons. Edition 2, illustrated. ISBN 1118211537, 9781118211533 and Sons

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Course Title	**ACADEMIC WRITING FOR POST GRADUATE STUDIES**
Course Code	UAE5819
NQF Level	8
Notional Hours	56 contact hours
Contact hours	4 hours per week for one semester
NQF Credits	18 (course is required but does not contribute any credits)
Pre-requisites	None
Semester Offered	1 and 2

This course aims to equip students with further knowledge of academic writing skills.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Access various academic sources
2. Analyse a text critically
3. Use a process approach when research writing
4. Write an academic text utilizing proper rhetoric and style
5. Format a written academic text in APA (American Psychological Association) style

Course Content

This course is a post-graduate course designed to empower students with skills and knowledge to access and critique academic sources and to synthesize information from these sources to assist them in the substantiation and development of their own claim when writing an academic paper in their respective fields of specialization. Additionally, this course will empower students when with the capacity to undertake the challenges of academic writing by exposing them to the different rhetorical and stylistic elements typical of academic texts. Finally, students will be introduced to the American PsychologicalAssociation (APA) witting style and will be equipped with the necessary skills to format an academic paper in APA style.

Contribution to Assessment of Exit Programme Outcome:

(4) Engagement in independent scholarly works through publications or conference presentations

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group workand class discussions.

Assessment Strategy

Continuous Assessment: 100% (critical reading assignment, annotated bibliography, term paper

Quality Assurance Arrangements

Internal and external moderation of test papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments and tests

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Course Title	**STRUCTURAL DYNAMICS**
Course Code	**CVS5991**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 practical session per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

Course Aim: The aim of this course is to introduce advanced concepts of dynamic loading and the response of structures to such loads, and then uses these concepts to illustrate applications in practical structure.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Apply basic concepts of structural dynamic (SD)
2. Evaluate the response of SDOF systems with and without damping to free vibration, harmonic, and arbitraryexcitations
3. Compute the dynamic response of structural components (like beams, walls, and columns) and structural systems under dynamic loads such as blast and earthquake excitations
4. Solve SD problem by applying numerical evaluation of dynamic response of SDOF Systems
5. Apply numerical techniques to engineering problems using Finite Elements computer programmes
6. Design structures resistant to systemic seismic loading, blast and impact, and wind loading

Course Content
Structural Dynamics: Types of dynamic loads; Basic background of methods available and motivation for structural dynamics. **Important mathematical concepts.** Complex numbers and Fourier analysis, matrix and vector algebra. **Dynamics of Single Degree-of-Freedom Structures**: Dynamic equation of equilibrium; Free vibration of single degree of freedom, Forced vibration: harmonic and periodic loadings; Dynamic response functions, force transmission and vibration isolation; SDOF response to arbitrary functions. Systems; **Numerical Evaluation of Dynamic Response of SDOF Systems**: Time domain analysis: finite difference methods; Frequency domain analysis: basic methodology. **Earthquake Response of SDOF Systems**: Earthquake excitation, response history and construction of response spectra; Response spectrum characteristics, tripartite plot, and design spectrum. **Multi Degree of Freedom Systems - Basics**: Dynamic equations of equilibrium, static condensation; Symmetric plan and plan-asymmetric systems. **Free Vibration Response of MDOF Systems**: Undamped systems: natural modes and their properties; Numerical solution for the eigenvalue problem; Solutionof free vibration response for undamped systems; Free vibration analysis of systems with damping. **Dynamic Analysis of Linear MDOF Systems**: Introduction, modal analysis; Response-history for earthquake excitations using modal analysis; Response spectrum analysis for peak responses; Concept of Caughey damping as a general type of proportional damping.**Generalized Single Degree of Freedom Systems**: Basic concepts, mass-spring system; Lumped mass systems; Systemswith distributed mass and elasticity; Rayleigh's method, shape function selection. **Introduction to Dynamics of Continuous Systems**: Equations of motions for axial vibration of a beam; Equations of motion for flexural vibration of a beam; Free vibration analysis; Introduction to forced vibration analysis using modal superposition method.

Contribution to Assessment of Exit Programme Outcome:
(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning
The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work,computer practicals and class discussions.

Assessment Strategy
Examination 50% (1 x 3 hours paper and 30 min oral examination per student); **Continuous 50%** (at least 2 written testsand 3 assignments as technical reports)

Quality Assurance Arrangements
Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbooks
None

Recommended Textbooks
(i) Anil K. (2007). "Dynamic of Structures, Theory and Applications to Earthquake Engineering". Chopra, 3rd edition (2007), Prentice Hill
(ii) Biggs J.M. (1964). Introduction to Structural Dynamics" McGraw Hill
(iii) FEMA 450 (2003) "NEHRP Recommended Provisions for Seismic Regulations foe New Buildings and Other Structures" available at www.fema.gov

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Course Title	ADVANCED STRUCTURAL CONCRETE DESIGN
Course Code	**CVM5972**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

Course Aim: The aim of this course is to develop an advanced understanding of the behaviour and design of reinforced concrete (RC) structures.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Assess and design and concrete structures under general conditions.
2. Execute advanced design of reinforced concrete structures and structural elements subjected to different types of individual and or combined loading.
3. Design Pre-cast and pre-stressed concrete structures and structural element and different loading
4. Optimize the design of various structural elements and systems.
5. Design of concrete structures for special accidental conditions such as fire, seismic/vibration loading and structural connections.
6. Specify methods for repair and strengthening of concrete structures
7. Design concrete bridges

Course Content

Reinforced concrete (design for torsion and combination of shear, torsion and bending; punching; design of slender columns and unbraced frames; strut and tie modelling; cracking and deflections; analysis and design of slab system, yield line methods for design of slabs, strip method for slab design, Design of walls and shear walls; Design of framed structure, design of building structures; Design for Serviceability Limit State: Deflection; Design for Serviceability Limit State: Crack). **Pre-cast** and **Pre-stressed concrete** (fundamental mechanics of the stress and deflection behaviour; creep and shrinkage, loss in pre- stressing force; continuous beams; fatigue verification). **Structural optimization**. **Accidental design situations** (structuralfire design, fire resistance of concrete structures; seismic design of concrete structures, seismic/vibration behaviour and design of beams, columns, frames, connections and structural walls). **Special topics: Design of bridges:** bridge loading, design of simply supported and continuous spans; practical fatigue design; analysis of long span bridges and; **Design of liquid retaining structures.**

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practicalsessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 assignments as technical reports,1 structural concrete design project and one fieldtrip)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination.

Prescribed Textbooks

None

Recommended Textbooks

(i) Paulay T, Priestley MJN, (1992). Seismic Design of Reinforced Concrete and Masonry Buildings. Wiley: Hoboken, NJ.
(ii) ACI Committee 318, 2014. ACI 318-14 building code requirements for structural concrete and commentary.
(iii) American Society of Civil Engineers, 2010. ASCE 7-10 Minimum design loads for buildings and other structures.

First Issue 2020
Next Revision: 2025

Course Title	**ADVANCED STRUCTURAL STEEL DESIGN**
Course Code	**CVS5932**
NQF Level	9
Notional Hours	240
Contact hours	4 hours lecture plus 2 hours tutorial or 3 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

Course Aim: The aim of this course is to provide advanced training in the design, analysis and assessment of steel and composite (steel/concrete) structures.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Differentiate between AISC's three design approaches: ASD, LRFD, and Inelastic Design
2. Explain the unique purpose of code documents related to structural steel design including the AISC Steel Construction Manual, ANSI/AISC 360, ANSI/ASTM 303, COSP, and ASCE/SEI7
3. Describe the mechanics of steel as it relates to elastic and inelastic behaviour, flexural buckling, torsional buckling, flexural-torsional buckling, lateral torsional buckling, and local buckling
4. Apply probabilistic foundation of LRFD in designing economical and reliable structures, and demonstrate how the code changed to a unified design philosophy for ASD/LRFD
5. Describe the sources of nonlinear behaviour in members and frames, including the sources of material and geometric nonlinear effects.
6. Apply nonlinear effects in a steel analysis model.
7. Design structurally stable steel frames using the following methods- Effective Length, Direct Analysis, and First-Order Analysis.
8. Recognize the role of modern computer analysis in the job of a structural engineer and understand the steps necessary to perform an essential Quality Assurance peer review
9. Analyse open and closed steel members for torsion loading.
10. Design of I-shaped, doubly symmetric plate girders.
11. Distinguish between the three types of connection design options as described in the COSP.
12. Calculate the design strength of bolt, weld, and connecting element limit states.
13. Determine for beam-to-column shear and moment connections the applicable limit states
14. Design simple and moment resisting connections using bolts and welds.
15. Explain how seismic risk is quantified by the International Building Code by using a Maximum Considered Earthquake ground motion (MCER).
16. Explain seismic building performance to owners and communities to manage expectations and provide options. Understand how ductility and fuse members are used as the basis of steel seismic design per the code "AISC 341 Seismic Provisions for Steel Buildings.
17. Describe the seismic design behaviour of moment and braced frames such as Special, Intermediate, and Ordinary per "AISC Seismic Provisions for Steel Buildings".

Course Content

Steel components and design of steel buildings (member and frame stability, structural analysis; local buckling, cross- section classification, fundamentals of torsion theory, design of combined stresses, plate girders in bending and in shear, shear moment and moment connection design and steel systems for seismic design, design of tension members, steel connections; plastic design, secondary effects, tension flange restraint; trusses and built-up columns; bracing requirements;methods of cladding; design of semi-rigid frames; industrial buildings, multi-storey buildings. **Composite construction** (design basics; construction elements: slabs, beams, beams on elastic foundations, columns; joints). **Accidental design situations** (fire design of steel structures, methods of fire protection; seismic/vibration analysis and design of steel structures).

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, and group work and class discussions.

Assessment Strategy
Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 assignments as technical reports and1 structural steel design project project)

Quality Assurance Arrangements
Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbooks
None

Recommended Textbooks

(i) Ram C. (1992) "Design of Steel Structures, Vol-2", Standard Book House, 10th Edition.
(ii) American Institute of Steel Construction (AISC). "Steel Construction Manual - Load and Resistance Factor Design (LRFD)," 13th Edition, 2005.

First Issue 2020
Next Revision: 2025

Course Title	**MAINTENANCE OF CONCRETE STRUCTURES**
Course Code	**CVM5912**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hour tutorial or 3 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 or 2

The aim of this course is to provide students with a fundamental and practical understanding on condition assessment of concrete structures and concrete repair and service life extension methods

Learning Outcomes: Upon completion of this course, students should be able to:

1. Assess and identify distress and damages to concrete and masonry structures using various tests.
2. Execute condition assessment on damaged to concrete structures and interpreted concrete deterioration processes.
3. Measure the serviceability and durability of concrete structures and materials
4. Plan and implement maintenance activities for concrete structures.
5. Select and evaluate the properties of various types of repair materials.
6. Specify various repair techniques and or rehabilitation strategies for damaged or deteriorating concrete structures

Course Content
Concrete deterioration processes and damage to concrete structures: Reinforcement corrosion, chemical and physical attack, structural damage, fire damage, cracking, and construction defects. **Serviceability and durability of concrete.** Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness and cracking. **Condition assessment of concrete structures:** planning and strategies for condition assessments, on-site diagnostic testing and visual assessment methods, non-destructive testing methods and interpretation of results, laboratory-based testing of samples and prediction of residual service life. **Repair and rehabilitation of concrete structures** philosophies and strategies for concrete repair and rehabilitation, repair methods, materials and systems, repair principles for reinforcement corrosion damaged structures, concrete surface protection and coatings, bonded concrete overlays and patch repair, principles, methods and materials for concrete crack repair, repair guidelines according to the Eurocode, service life extension methods, repair contractor's perspective, material supplier's perspective and forensic engineering: philosophy and added value.

Contribution to Assessment of Exit Programme Outcome:
(5) Engagement in independent scholarly works through publications or conference presentations
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning
The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group workand class discussions.

Assessment Strategy
Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments as technical reportsand 1 concrete maintenance or concrete rehabilitation project)

Quality Assurance Arrangements
Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Textbooks
None

Recommended Textbooks

(i) Denison Campbell, Allen and Harold Roper (1991). "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK.
(ii) Dov Kominetzky M.S. (2001). " Design and Construction Failures", Galgotia Publications Pvt Ltd., 2001
(iii) Ravishankar. K., Krishnamoorthy.T.S, (2004). "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers.

First Issue 2020
Next Revision: 2025

Course Title	**THESIS**
Course Code	EGT5990
NQF Level	9
Notional Hours	1200
Contact hours	4 hours per week average for consultation with supervisors About 20 hours per week of student individual work
NQF Credits	120
Pre-requisite	EGT5980
Co-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	Final Year Semester 1 and 2

The course aims to make the students demonstrate the ability to carry out fundamental research on a well-structured proposal and to present results and conclusions backed by available literature and appropriate scientific theories for an industrial based project.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Identify, assess and solve open-ended engineering problems creatively and innovatively
2. Apply knowledge of mathematics, basic science and structural engineering sciences from first principles to solve structural engineering problems
3. Design structural components, systems and processes while dealing with constraints, assessing financial and social costs and benefits, and taking other impacts into account
4. Plan and conduct investigations and experiments
5. Analyse and interpret data and derive information from data
6. Exercise limited structural engineering judgement
7. Use modern structural engineering methods, skills and tools to assess their outputs
8. Communicate effectively in writing and orally with supervisors, peers and subordinates
9. Recognise the impact of structural engineering activity on society and the environment
10. Be aware of the importance of engaging in lifelong learning and holding lifelong learning as a professional value
11. Recognise the need to act professionally and ethically within their own area of competence

Course Content:
Development of Thesis Document. Identify authentic research problem, formulate objectives and develop appropriate research questions or hypothesis. Identify and critically analyse and synthesise relevant literatures. Design appropriate research methods including design of experiments using appropriate statistical methods. Present data in a systematic, and well structures approach using different data presentation tools. Perform relevant statistical analysis in a manner that supports or explain the data presented or responds to the hypothesis presented. Discuss results in a way that convert data to information and draw appropriate conclusions and recommendation. Convert thesis into journal papers.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.
(3) Research capability at work or towards PhD studies.
(5) Engagement in independent scholarly works through publications or conference presentations.

Methods of Facilitation of Learning

The course will be facilitated through a well-structured research and thesis writing under the supervision of at least one senior academic member of staff.

Assessment Strategy
Continuous Assessment (100%). The thesis will be evaluated by one Internal Examiner and one External Examiner.Qualifications of Examiners as per UNAM Post Graduate Studies Committee guidelines.

Quality Assurance Arrangements

Internal and external examination of thesis as per procedures of the Post Graduate Studies Committee (PGSC)
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Next Revision: 2025

F.2222[19MCVE]

Q CURRICULUM FOR THE MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (TRANSPORTATION)

Q. 1. DEGREE NAME: MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (TRANSPORTATION) 19MCVT [19MCVE]

Q.2. Purpose and Rationale

The **purpose** of the degree programme for **Master of Science in Civil Engineering (Transportation**) of the University of Namibia is to offer advanced training to Civil engineers so as to prepare them to become specialists in Transportation Engineering. The MSc Civil Engineering (Transportation) degree programme covered here consists of advanced taught courses plus one year of research by thesis at Level 9 of the National Qualifications Framework (NQF) in Namibia.

Graduates of the MSc Civil Engineering (Transportation) degree programme will be equipped with knowledge and skills to work in industry, do consultancy or carry out further research in their areas of Transportation engineering. The students will gain an advance knowledge in the planning, analysing, design and management (maintain, repair and rehabilitate) ofsustainable transport systems, design roads and railway systems with appropriate safety measures, supervise road construction, design airport runways and manage transport logistics.

The **rationale** of this qualification is based upon the fact that the Department of Civil Engineering has produced over 130graduate engineers and there are many other Civil engineering graduates from other national and international institutions. These Civil Engineers need to further their studies in the field of Civil Engineering. Having demonstrated the success of its Bachelor's degree programme, and having received confirmation from the Engineering Council of Namibia that these graduates are registerable as Professional Engineers, the Faculty has developed a curriculum for the degree of Master of Science in Civil Engineering to enable its Graduate Engineers and holders of Bachelor of Science in Civil Engineering from other institutions to undertake further studies in the field of Civil engineering and thereby build capacity for researchand consultancy in this field.

Q.3 Criteria for Admission

Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (Honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the field of Civil Engineering.

Q.4 Articulation Options

This qualification serves as an entry to PhD in Civil Engineering.

Q.5 Mode of Delivery

Full time and part time using blended learning approach, at JEDS Campus

Q.6 Duration of study

The minimum duration for the Master of Science in Civil Engineering degree programme is two (2) years of full time study or three (3) years of part time study. The degree must be completed within four (4) years of full-time study or five (5) years of part time study.

Q.7 Assessment Criteria

- Reference is made to the University's General Information and Regulations Prospectus and Guidelines for Postgraduate Students for detailed examination and promotion rules.
- For assessment purposes, all courses shall normally carry a component of Continuous Assessment and University Examination. Continuous Assessment (CA) shall normally consist of **Written Tests plus Assignments and/or Lab, and Reports/Mini Projects.**
- Unless otherwise specified, the CA Mark shall be made up of **50%** Written Tests and **50%** Assignments and/or LabReports/Mini Projects.
- A candidate will be eligible to write a University Examination (UE) in a given course only if he/she has obtained the required

Continuous Assessment Mark of at least 40% in that course unless state otherwise in the Faculty prospectus.

- University Examinations will be administered at the end of the semester.
- Courses with 18 or more credits shall have **3-hour** examination papers. Courses with 12 credits shall normally have **2-hour** examination papers.
- The Final Examination Mark shall normally be made up of **50%** Continuous Assessment and **50%** UniversityExamination.
- The minimum Pass Mark in any course as determined by the Final Examination Mark is **50%.**

Q.8 ADVANCEMENT AND PROGRESSION RULES 19MCVT (TRANSPORT)

1. First Year to Second Year of Study (Full Time Students)

Full Time students must have passed at least 120 Credits, including Statistics and Research Method to be able to proceed from Year 1 to Year 2 of study.

2. First Year to Second Year of Study (Part Time Students)

Part Time students must have passed at least 60 Credits to be able to proceed from Year 1 to Year 2 of study.

3 Second Year to Third Year of Study (Part Time Students)

Part Time students must have passed all 78 credits of Year 1, and at least at total of at least 42 Credits of Year 2, includingStatistics and Research Method to be able to proceed from Year 2 to Year 3 of study.

Q.9 NO RE-ADMISSION RULE

A student must meet the following minimum requirements in a given year of study to be readmitted into the programme.

1. Minimum requirements for Full time Students First year:

60 Credits

Second year: Passed all first-year courses (144 Credits) plus FEIT Faculty Board approved thesis proposal

2. Minimum requirements for Part time Students

First year: 42 Credits

Second year: Passed all first-year courses (78 Credits) and passed 24 credits from Second year courses.

Third Year: Passed all first- and second-year courses (144 credits) plus FEIT Faculty Board approved thesis proposal

3. Maximum Number of Credits per Year

	Full Time	Part Time
First year:	144 Credits	78 Credits
Second year:	144 Credits	102 Credits
Third Year:	-	144 credits

Q.10 Requirements for Qualification Award

A student can graduate with the degree of **Master of Science in Civil Engineering** only if he/she has earned the **264 NQFCredits** prescribed in the curriculum.

Summary Table for all Courses in the MSc Civil Engineering (19MCVT) Programme for Full Time Students

COMPULSORY COURSES (TRANSPORTATION PROGRAMME) - YEAR 1 OF FULL TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Transport Policy and Regulations	**CVR5961**	9	12	2L +1T or 1P	None
1	Transport Modelling	**CVM5979**	9	24	4L +2T or 2P	None
1	Statistics and ResearchMethods	**EGT5981**	9	18	3L +2T or 2P	None
1	Urban Transport Engineering	**CVT5919**	9	24	4L+2T or 2P	None
1	Academic Writing for Post Graduate Studies	**UAE5819**	8	18*	4L	None
	Total Credits Semester 1			**78**		
2	Advanced Road Design and Safety Management	**CVT5959**	9	24	4L +2T or 2P	None
2	Public Transport SystemsDesign and Operations	**CVT5989**	9	18	3L +2T or 2P	None
2	Advanced Pavement Engineering	**CVT5932**	9	24	4L+2T or 2P	None
	Total Credits Semester 2			**66**		
	Total Credits Year 1			**144**		

credits not included in the overall course credits

COMPULSORY COURSES - YEAR 2 FOR FULL TIME STUDENTS (TRANSPORTATION PROGRAMME)

YEAR 3 SEMESTER 1 and 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1 and 2	Thesis	EGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Summary Table for all Courses in the MSc Civil Engineering (19 MCVT) Programme for Part Time Students

COMPULSORY COURSES (TRANSPORTATION PROGRAMME) - YEAR 1 OF PART TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Academic Writing for Post Graduate Studies	**UAE5819**	8	18*	4L	None
1	Transport Policy and Regulations	**TCVR5961**	9	12	2L+1T or 1P	None
1	Transport Modelling	**CVM5979**	9	24	4L +2T or 2P	None
	Total Credits Semester 1			**36**		
2	Advanced Road Design and Safety Management	**CVT5959**	9	24	3L +2T or 2P	None
2	Public Transport Systems Design and Operations	**CVT5989**	9	18	3L+2T or 2P	None
	Total Credits Semester 2			**42**		
	Total Credits Year 1			**78**		

credits not included in the overall course credits

COMPULSORY COURSES (TRANSPORTATION PROGRAMME) - YEAR 2 OF PART TIME STUDENTS

SEM	COURSE NAME *(ELECTIVES)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Statistics and Research Methods	**TEGT5980**	9	18	3L+2T or 2P	None
1	Urban Transport Engineering	**TCVT5919**	9	24	4L+2T or 2P	None
	Total credits Semester 1			**42**		
2	Advanced Pavement Engineering	**TCVT5932**	9	24	4L+2T or 2P	None
	Total credits Semester 2			**24**		
	Total credits Year 2			**66**		

COMPULSORY COURSES - YEAR 3 FOR PART- TIME STUDENTS (TRANSPORTATIONPROGRAMME)

YEAR 3 SEMESTER 1 and 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1and2	Thesis	TEGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

PART B-2: COURSE SPECIFICATION: MSc Civil Engineering Programme 19 MCVT *(Transportation)*

YEAR 1 SEMESTER 1

Course Title:	**TRANSPORT POLICY AND REGULATION**
Course Code	**CVR5961**
NQF Level	9
Notional Hours	120
Contact hours	2-hours lecture plus 1-hour tutorial or 1 practical session per week for one semester
NQF Credits	12
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to: provide students with a theoretical understanding the formulation of policies that guide the development of integrated multi-modal systems; explore integrated approaches to the planning and regulation of urban land use and transport systems

Learning Outcomes: Upon completion of this course, students should be able to:

1. Manage complex dynamics of urban land use and transport systems;
2. Identify the operating characteristics of alternative transport modes, and be able to assess the appropriateness ofdifferent modes to different urban contexts, demand conditions and operating environments;
3. Recognize the essential nature of the planning process and its key moments;
4. Select the components of transport management processes;
5. Assess important policy challenges and debates facing the reform, regulation and subsidisation of transport systems;
6. Select alterative competition regulation systems based on their relative strengths and weaknesses.

Course Content

Transport in urban systems: conceptual framework: the role of transport in urban activity systems; travel need and travel behaviour; systems of urban transport provision; urban activity systems and land use patterns: the role of the urban land market and urban planning; conceptualisation of the land use-transport connection; generic city forms and associated transport networks. **Planning intervention in urban activity and transport systems**: rationale for planning intervention as a field of public action/policy; evolution of approaches to planning and associated planning processes and methods in both the land use and transport planning arenas. **Approaches to integrated land use-transport planning**: emerging approaches to integrated land use-transport planning: current concepts (transit-oriented development, public transport corridors); selected case studies of integrated land use-transport planning in practice. **Transport management**: the development of transport management approaches; organisational and legislative frameworks for transport management; theoretical perspectives on travel choice, behavioural change and traffic flow; road space management; travel demand management. **Regulation and competition**: policy debates on subsidisation and competition regulation; mode alternatives analysis; industry structures; approaches to regulation and competition; licensing and contracting.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(5) Engagement in independent scholarly works through publications or conference presentations
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning
The course will be facilitated through the following learning activities: Lectures and written assignments.

Assessment Strategy
Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 written tests and 2 assignments as technical reports)

Prescribed Textbooks
None

Recommended Textbooks
NA

Quality Assurance Arrangements
Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.
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Course Title:	**TRANSPORT MODELLING**
Course Code	**CVM5979**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to teach principles of transport systems analysis with a focus on mathematical methods and models to analyse transport systems at various scale levels (microscopic, mesoscopic and macroscopic) and the integration between them.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Apply the fundamentals of transport systems analysis.
2. Apply various transport modelling methods to various stages of the transport planning process.
3. Use the key mathematical and statistical foundations of transport modelling, including for calibration and validation.
4. Assess microscopic, mesoscopic and macroscopic transport modelling approaches, and operate them;
5. Synthesise various transport data survey techniques and devise them to be used transport modelling;
6. Select appropriate modelling tools for specific transport problems, and evaluate the basic operation of these modelling tools;
7. Setup and run transport models;
8. Interpret and justify the results generated by different modelling tools.

Course Content
Travel data collection and processing: Different methodological approaches to data collection, including big data approaches; potential measurement problems; different ways to process and analyse data, and to fulfil mathematical and statistical requirements. **Traffic flow theory**: Techniques for calculating Levels-of-Service; understanding fundamental trafficspeed-flow-density diagrams; modelling traffic flows; traffic impact assessment methods. **Transport modelling**: Strategic and policy appraisal models; macroscopic (conventional four-stage model), mesoscopic and microscopic models; mathematical theory; the calibration, validation and verification process; appropriateness of the use of models for different purposes and theoretical critiques. **Mathematics and statistics**: network optimization; network heuristics; choice modelling.

Contribution to Assessment of Exit Programme Outcome:
(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures and computer exercises.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 modelling assignments as technicalreports and a group design project)

Prescribed Textbook

None

Recommended Textbooks

NA

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

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Course Title	**STATISTICS AND RESEARCH METHODS**
Course Code	**EGT5981**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 computer-based practicals per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to equip students with the advanced skills needed to identify and to conduct reliable advanced research and statistical analysis as required in scientific research and industrial practice.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Define the responsibilities of a researcher, including scientific ethics, and data and code management requirements.
2. Formulate appropriate research questions/hypothesis and select appropriate research designs;
3. Apply concepts of probability, random variables, statistical inference, hypothesis testing and regression in engineering.
4. Manipulate data and use statistic software to perform statistical analysis and probability calculations
5. Develop and write scientific research proposals

Course Content

The course has three sections. The first section focused on **Research Methods**. This section will provide students with an advanced knowledge and skills to initiate, structure and conduct excellent, publishable research. It will advance research concepts covered at an undergraduate level, such as research design, research methodology and research validation. Bothqualitative and quantitative research methods will be covered at an advanced level. Concepts such as problem identification, formulation of appropriate research questions/ hypothesis, conducting related literature search and evaluation, development of a research plan, research design, data analysis, disseminate the results and development of a research proposal will be covered at an advanced level. This section will concluded with **Research Ethics**: different citation methods and styles, importance of referencing and research ethic codes.

The second section will focus on **Experimental Methods and Statistics**. **Statistical Data Analysis:** Introduction to statistical experimental design, ANOVA analysis, error or residue analysis, simple and multiple linear regression analysis, maximum flow theory, probability theory, discrete and continuous probability distribution, reliability and decision analysis. Use of Statistical Software**:** Use of statistical software such as SPSS, R, Mini Tab, etc.

The last section is **Research Proposal Writing:** Students apply what they have learn to write Research Proposals for research work in their fields of interest under the supervision of an academic member of staff and present the Research Proposal for assessment.

Contribution to Assessment of Exit Programme Outcome:

(3) Research capability at work or towards PhD studies

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions. Each topic covered in the lectures will be followed by exercises analyzing real data in practical computing classes using statistical software.

Assessment Strategy

Continuous Assessment **100%**, involving at least 2 Tests **25%**; Assignments **20%**; Research Proposal and Proposal Presentation **50%.**

Quality Assurance Arrangements

Research proposal and statistics components are moderated internally. Students complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(iv) Thiel, D. (2014). An introductory note for instructors. In *Research Methods for Engineers*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139542326.002

(v) Peter RN, Coffin M, Copeland KAF. (2003). Introductory Statistics for Engineering Experimentation. Academic Press, Technology and Engineering

(vi) Jeff Wu C.F, Michael S. Hamada. (2011). Experiments: Planning, Analysis, and Optimization. John Wiley and Sons. Edition 2, illustrated. ISBN 1118211537, 9781118211533 and Sons

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Course Title	**ACADEMIC WRITING FOR POST GRADUATE STUDIES**
Course Code	UAE5819
NQF Level	8
Notional Hours	56 contact hours
Contact hours	4 hours per week for one semester
NQF Credits	18 (course is required but does not contribute any credits)
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 and 2

This course aims to equip students with further knowledge of academic writing skills.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Access various academic sources
2. Analyse a text critically
3. Use a process approach when research writing
4. Write an academic text utilizing proper rhetoric and style
5. Format a written academic text in APA (American Psychological Association) style

Course Content

This course is a post-graduate course designed to empower students with skills and knowledge to access and critique academic sources and to synthesize information from these sources to assist them in the substantiation and development of their own claim when writing an academic paper in their respective fields of specialization. Additionally, this course will empower students when with the capacity to undertake the challenges of academic writing by exposing them to the different rhetorical and stylistic elements typical of academic texts. Finally, students will be introduced to the American PsychologicalAssociation (APA) witting style and will be equipped with the necessary skills to format an academic paper in APA style.

Contribution to Assessment of Exit Programme Outcome:

(5) Engagement in independent scholarly works through publications or conference presentations

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group workand class discussions.

Assessment Strategies

Continuous Assessment: 100% (critical reading assignment, annotated bibliography, term paper)

Quality Assurance Arrangements

Internal and external moderation of test papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments and tests

First Issue 2020
Next Revision: 2025

Course Title:	**ADVANCED ROAD DESIGN AND SAFETY MANAGEMENT**
Course Code	**CVT5959**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

The aim of this course is to equip students with advanced knowledge of road infrastructure safety management tools at different levels (network, road sections, intersection) and development (planning and design) of infrastructure safety measures.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Design a road alignment and cross section based on, but not limited to, road safety considerations
2. Preform road traffic accident analysis.
3. Develop road infrastructure safety management (Network Safety Management, Road Safety Audit, Road Safety Inspection, Blackspot Management).
4. Apply Accident Prediction Models (APM) and crash modification factors (CMF).
5. Plan, design and assess measures to improvement traffic safety at sections or junctions.
6. Evaluate and use specific road design software tools.

Course Content

Geometric Design: Principles and objectives of geometric design, design challenges, safety effects of road geometry. **Road Traffic Accident Analysis:** Differentiation of accident severity, types of accidents, kind of accidents and causes of accidents, analysis of traffic accident reports. **Road Infrastructure Safety Management**: Methods to calculate and rank the safety level of road stretches (Network Safety Management); Organisation and tools for analysing the possible qualitative impact of design elements on road traffic safety of all road user groups (Road Safety Audit); Organisation and tools to assess the road elements and condition important for road traffic safety (Road Safety Inspection); Define and analyse sections and junctions with a high accident load, develop and asses (CBA) counter measures (Blackspot Management). **Accident Prediction Model and Crash Modification Function**: Knowledge and application of different APM and CMF. **Road Infrastructure Safety Improvements:** Plan, design and asses Road Infrastructure Improvements Measures. **Road Design Tools:** Knowledge and application of software tools for the design of roads.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Textbooks

None

Recommended Textbooks

N/A

First Issue 2020
Next Revision: 2025

Course Title:	PUBLIC TRANSPORT SYSTEMS DESIGN AND OPERATIONS
Course Code	**CVT5989**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 1 practical session per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

This course aims to develop an advanced understanding of public passenger transport system design, operations management and governance.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Provide an overview of the theory and practice associated with the design and operations of public transport systems
2. Identify and address key challenges of public transport systems design and operations
3. Select specific design, operations and management components that make up bus and rail based public transport systems
4. Justify the interactions between the different components of public transport design and operations, i.e. service quality, passenger demand, infrastructure, transit operations and evaluation;
5. Apply mathematic methods and techniques to design and optimize public transport systems and networks, to calculate public transport capacity, and to derive time tables and crew schedules
6. Compare challenges of public transport systems design and operations management in Namibia / SouthernAfrica and formulate their implications for the competitiveness of public transport

Course Content

Service quality: public transport systems, mobility and public transport use in Namibia, required service qualities, public transport systems hierarchy and networks. **Urban planning and passenger demand**: transit, land use and urban structure, public transport network design, transit-oriented development (TOD), public transport demand, public transport demand modelling. **Bus and rail infrastructure:** bus infrastructure and bus rolling stock, capacity of bus systems, bus system capacity, rail infrastructure and rail rolling stock, capacity of rail systems. **Stations and operations**: operational aspects, time table scheduling, intermodal stations. **Evaluation:** operational cost coverage, financial analysis, economic cost benefitevaluation. **Governance:** role and responsibilities of different stakeholders**.**

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures andsystems
(3) Research capability at work or towards PhD studies
(4) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 modelling assignments as technicalreports and a group design project)

Prescribed Textbooks

Reader with articles

Recommended Textbooks

N/A

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

First Issue	2020
Next Revision	2025

Course Title:	**URBAN TRANSPORT ENGINEERING**
Course Code	**CVT5919**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

The aim of this course is to equip students with advanced knowledge of the planning, design and operations of urban transport. It covers a range of topics that are essential for the transportation engineer to manage urban transport problems, including for peri-urban spaces.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Analyse urban transport and the role of advanced planning and engineering therein
2. Evaluate transport sustainability, including related to transport equity
3. Develop traffic management and travel demand management (TDM)
4. Assess urban road safety
5. Formulate design decisions for non-motorized transport, including around universal access
6. Perform traffic flow calculations, including for pedestrians
7. Compute capacity/level of service of junctions, roundabouts, stretches and networks using appropriate software
8. Plan and design intersections with advanced traffic light systems (adapted and coordinated systems) using appropriate software
9. Calculate and visualize area-wide mobility and accessibility measures in a geographical information system, and comment on the level of transport equity
10. Perform statistical tests on transport data and critically comment on transport data survey approaches
11. Select and conduct appropriate impact assessment methods to various urban transport problems
12. Critically rate measures to improve urban road safety.
13. Conduct integrated transport planning and set up a design for a defined case study

Course Content

Urban Transport: State-of-knowledge on urban transport systems, including informal systems. **Non-Motorized Transport:** principles, geometric design, universal design **Network Design:** network structures, network analysis, models **Traffic Flow Theory**: vehicle following, pedestrian flow models, queuing theory, shockwaves, gap acceptance **Transport Management**: Intelligent Transport Systems, Traffic management systems, Parking management, Mobility management, Road pricing. **Sustainable Transport:** low-carbon transport, resilient transport systems, equitable transport systems, Mobility As A Service(MAAS). **Road Engineering:** theory of capacity and level of service methodology; application of capacity calculation for junctions, roundabouts, stretches and networks; design of traffic lights operation systems; application of relevant software. **Transport Justice:** Operationalizing accessibility and equity concepts **Urban Road Safety:** urban black spot management; measures of improving road safety; vulnerable road users. **Transport data**: Survey design, Statistics of transport data, visualizing transport data. **Impact assessment:** EIA/SEA/TIA, CBA/MCA/SMCA in an urban context.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (written 2 tests and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Textbooks

Reader with articles

Recommended Textbooks

N/A

First Issue 2020
Next Revision: 2025

Course Title	ADVANCED PAVEMENT ENGINEERING
Course Code	**CVT5932**
NQF Level	9
Notional Hours	240
Contact hours	4 hours lecture plus 2 hours tutorial or 2 practicals per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Elective
Semester Offered	2

This course aims to help students gain advance knowledge of pavement engineering including advance pavement materials and pavement design methods.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Apply knowledge of pavement materials behaviour to creatively select, specify and monitor construction of pavement materials.
2. Compile, review and interpret results of standardized and advanced testing of highway materials.
3. Evaluate important materials properties used in pavement design methodologies.
4. Carryout site inspection inspections and implement quality control/quality assurance of pavement materials
5. Apply pavement design methodologies creatively to design different types of pavement structures for different field conditions.
6. Identify and appraise best practices to gather data necessary for successful pavement design.
7. Compile design report emanating from for pavement design activities.
8. Identify and recommend sources of information about new and advanced design methodologies.

Course Content

Pavement materials: Soils-Aggregate Mixtures: The use of natural soils, stabilized aggregate soil mixtures and crushed rocks as road foundation and layer work in pavement structures. Relevant climatic consideration and problem areas. Compaction theory, practice and laboratory versus field consideration. Laboratory and field testing of materials that are processed, modified, stabilized or cemented. **Bituminous Materials**: types of bituminous binders, rheological properties and effects on pavement performance and binder specification methods. **Aggregate for Asphalt mixtures**: Physical properties, graduation requirements, test methods and design specification requirements. **Asphalt Mixtures**: Mixture design methodologies and testing, visco-elastic and failure properties, thermal properties and durability. **Materials for rigid pavements**: Cement production, cement compound, strength, special requirements, concrete mixture proportion, water cement ratio, curing and volume change, aggregate requirements and admixtures **Pavement Design:** Importance of highways, pavement types and behaviour underloading, pavement design concepts and design factors. **Stress and Strain Calculation**: learn about stress, strain and deflection calculation in pavements for single and multi-layered systems, visco- elasticity systems under a moving load, and stresses, deflections, dowels and joints in rigid pavements. **Traffic**: Traffic volume and loading analysis and ESAL calculations. **Materials characterisation**. Key material properties used in pavement design, including fatigue and rutting properties. **Pavement Design**: Design of flexible and rigid pavements (AASHTO Method, Asphalt Institute Method, PCA and other upcoming or commonly used pavement design methods in Southern Africa). **Drainage Design**. Importance of pavement drainage design and commonly used drainage solutions. **Design of surface treatments**: Chip seals, slurry seals and micro-surfacing. Pavement maintenance and rehabilitation strategies and pavement evaluation**.**

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.
(2) Design and synthesis of engineering structures and systems.
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, laboratorypracticals, group work and class discussions.

Assessment Strategy

CA 10**0%** at least 2 written tests, 3 assignments as technical reports and an advanced pavement design project.

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbook

(i) Hauang Y. (2004). Pavement Analysis and Design, Second Edition, Y. Huang, Prentice Hall.

Recommended Textbooks

(i) Yoder E.J and Witczak, NY. (1975). Principles of Pavement Design, 2nd Ed, John Wiley and Sons, Inc., USA
(ii) Roberts FL, PS Kandhal, DY Lee, TW Kennedy and NAPA. (1997). Hot Mix Asphalt Materials, Mixture Design, and Construction. NAPA Education Foundation.
(iii) South African National Roads Agency (SANRA) (2014),South African Pavement Engineering ManuaL,2nd Ed, SANRA SOC LTD, available at: http://www.nra.co.za/live/content.php?Session_ID=a174daae18dc519c4d22747165c9ea3candCategory_ID=148

First Issue	2020
Next Revision:	2025

Course Title	THESIS
Course Code	EGT5990
NQF Level	9
Notional Hours	1200
Contact hours	4 hours per week average for consultation with supervisors About 20 hours per week of student individual work
NQF Credits	120
Pre-requisite	EGT5980
Co-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	Final Year Semester 1 and 2

The course aims to make the students demonstrate the ability to carry out fundamental research on a well-structured proposal and to present results and conclusions backed by available literature and appropriate scientific theories for an industrial based project.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Identify, assess and solve open-ended transportation engineering problems creatively and innovatively
2. Apply knowledge of mathematics, basic science and transport engineering sciences from first principles to solve transport engineering problems
3. Design transport components, systems and processes while dealing with constraints, assessing financial and social costs and benefits, and taking other impacts into account
4. Plan and conduct investigations and experiments
5. Analyse and interpret data and derive information from data
6. Exercise limited transportation engineering judgement
7. Use modern transport engineering methods, skills and tools to assess their outputs
8. Communicate effectively in writing and orally with supervisors, peers and subordinates
9. Recognise the impact of transportation engineering activity on society and the environment
10. Be aware of the importance of engaging in lifelong learning and holding lifelong learning as a professional value
11. Recognise the need to act professionally and ethically within their own area of competence

Course Content

Development of Thesis Document. Identify authentic research problem, formulate objectives and develop appropriate research questions or hypothesis. Identify and critically analyse and synthesise relevant literatures. Design appropriate research methods including design of experiments using appropriate statistical methods. Present data in a systematic, and well structures approach using different data presentation tools. Perform relevant statistical analysis in a manner that supports or explain the data presented or responds to the hypothesis presented. Discuss results in a way that convert data to information and draw appropriate conclusions and recommendation. Convert thesis into journal papers.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.
(3) Research capability at work or towards PhD studies.
(5) Engagement in independent scholarly works through publications or conference presentations.

Methods of Facilitation of Learning

The course will be facilitated through a well-structured research and thesis writing under the supervision of at least one senior academic member of staff.

Assessment Strategy

Continuous Assessment (100%). The thesis will be evaluated by one Internal Examiner and one External Examiner. Qualifications of Examiners will be as per UNAM Post Graduate Studies Committee guidelines.

Quality Assurance Arrangements

Internal and external examination of thesis as per procedures of the Post Graduate Studies Committee (PGSC)

First Issue 2020
Next Revision: 2025

.F.2 [19MCVE]

R CURRICULUM FOR THE MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (WATER)

R. 1. DEGREE NAME: MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (WATER) 19MCVW

R. 2. Purpose and Rationale

The **purpose** of the degree programme for **Master of Science in Civil Engineering (Water**) of the University of Namibia isto offer advanced training to civil engineers so as to prepare them to become specialists in Water Engineering. The MSc Civil Engineering (Water) degree programme covered here consists of advanced taught courses plus one year of research by thesis at Level 9 of the National Qualifications Framework (NQF) in Namibia.

Graduates of the MSc Civil Engineering (Water) degree programme will be equipped with knowledge and skills to work in industry, do consultancy or carry out further research in their areas of water/ hydraulic engineering. The students will gain an advance knowledge in the planning, analysing, design and management of water supply systems, waste water treatment systems, flood control systems such as dams and channels. The students will be capable to apply hydraulic engineering approaches and manage water flow in rivers, channels, spillways, stilling basins, pressurised systems and for hydro-power utilisation.

The **rationale** of this qualification is based upon the fact that the Department of Civil Engineering has produced over 130 graduate engineers and there are many other Civil engineering graduates from other national and international institutions. These Civil Engineers need to further their studies in the field of Civil Engineering. Having demonstrated the success of its Bachelor's degree programme, and having received confirmation from the Engineering Council of Namibia that these graduates are registerable as Professional Engineers, the Faculty has developed a curriculum for the degree of Master of Science in Civil Engineering to enable its Graduate Engineers and holders of Bachelor of Science in Civil Engineering from other institutions to undertake further studies in the field of Civil engineering and thereby build capacity for research and consultancy in this field.

R.3 Criteria for Admission

Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (Honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the field of Civil Engineering.

R.4 Articulation Options

This qualification serves as an entry to PhD in Civil Engineering.

R.5 Mode of Delivery

Full time and part time using blended learning approach at JEDS Campus

R.6 Duration of study

The minimum duration for the Master of Science in Civil Engineering degree programme is two (2) years of full-time study or three (3) years of part time study. The degree must be completed within three (4) years of full-time study or four (5) years ofpart time study.

R.7 Assessment Criteria

- Reference is made to the University's General Information and Regulations Prospectus and Guidelines for Postgraduate Students for detailed examination and promotion rules.
- For assessment purposes, all courses shall normally carry a component of Continuous Assessment and University Examination. Continuous Assessment (CA) shall normally consist of **Written Tests plus Assignments and/or Lab, and Reports/Mini Projects.**
- Unless otherwise specified, the CA Mark shall be made up of **50%** Written Tests and **50%** Assignments and/or LabReports/Mini Projects.
- A candidate will be eligible to write a University Examination (UE) in a given course only if he/she has obtained the required Continuous Assessment Mark of at least 40% in that course unless state otherwise in the Faculty prospectus.
- University Examinations will be administered at the end ofthe semester.
- Courses with 18 or more credits shall have **3-hour** examination papers. Courses with 12 credits shall normally have **2-hour** examination papers.
- The Final Examination Mark shall normally be made up of **50%** Continuous Assessment and **50%** UniversityExamination.
- The minimum Pass Mark in any course as determined by the Final Examination Mark is **50%.**

R.8 Advancement and Progression Rules 19MCVW (Water)

1.First Year to Second Year of Study (Full Time Students)

Full Time students must have passed at least 120 Credits, including Statistics and Research Method to be able to proceedfrom Year 1 to Year 2 of Study.

2.First Year to Second Year of Study (Part Time Students)

Part Time students must have passed at least 52 Credits to be able to proceed from Year 1 to Year 2 of Study.

3.Second Year to Third Year of Study (Part Time Students)

Part Time students must have passed all 66 credits of Year 1, and at least at total of at least 52 Credits of Year 2, includingStatistics and Research Method to be able to proceed from Year 2 to Year 3 of study.

R.9 No Re-admission Rule

A student must meet the following minimum requirements in a given year of study to be readmitted into the programme.

1.Minimum requirements for Full time Students

First year: 60 Credits
Second year: Passed all first-year courses (144 Credits) plus FEIT Faculty Board approved thesis proposal

2.Minimum requirements for Part time Students First year: 30 Credits
Second year: Passed all first-year courses (66 Credits) and passed 36 credits from Second year courses.
Third Year: Passed all first- and second-year courses (144 credits) plus FEIT Faculty Board approved thesis proposal

3.Maximum Number of Credits per Year

	Full Time	Part Time
First year:	144 Credits	66 Credits
Second year:	144 Credits	114 Credits
Third Year:	-	144 edits

R.10 Requirements for Qualification Award

A student can graduate with the degree of **Master of Science in Civil Engineering** only if he/she has earned the **264 NQFCredits** prescribed in the curriculum.

Summary Table for all Courses in the MSc Civil Engineering (Water) (19MCVW) Programme for Full Time Students

COMPULSORY COURSES (WATER PROGRAMME) - YEAR 1 OF FULL TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Advanced Hydraulics	**CVW5921**	9	12	2L+1T or 1P	None
1	Advanced Water Supply and Wastewater Treatment	**CVE5931**	9	24	4L+2T or 2P	None
1	Surface and Groundwater Quality	**CVE5961**	9	12	2L+1T or 1P	None
1	Statistics and Research Methods	**EGT5981**	9	18	3L+2T or 2P	None
1	Academic Writing for Post Graduate Studies	**UAE5819**	8	18*	4L	None
	Total credits Semester 1			***66***		
2	Integrated Water Resources Management	**CVW5999**	9	18	3L+2T or 2P	None
2	Advanced Hydro-Engineering	**CVW5912**	9	24	4L+2T or 2P	None
2	Hydrology and Hydrogeology	**CVW5989**	9	18	3L+2T or 2P	None
2	Drought and Flood Risk Management	**CVW5992**	9	18	3L + 2T + 3 days FW	None
	Total credits Semester 2			***78***		
	Total credits Year 1			**144**		

** This course does not contribute any credits because it is at NQF Level 8.*

COMPULSORY COURSES (WATER PROGRAMME) - YEAR 2 OF FULL TIME STUDENTS

YEAR 3 SEMESTER 1 and 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** *(ALL COMPULSORY)*	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1and2	Thesis	EGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Summary Table for all Courses in the MSc Civil Engineering (Water) Programme for Part Time Students

COMPULSORY COURSES (WATER PROGRAMME) - YEAR 1 OF PART TIME STUDENTS

SEM	**COURSE NAME** *(ALL COMPULSORY)*	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO-REQUISITE*
1	Statistics and Research Methods	**EGT5980**	9	18	3L+2T or 2P	None
1	Surface and Groundwater Quality	**CVE5961**	9	12	2L+1T or 1P	None
1	Academic Writing for Post Graduate Studies	UAE5819	8	18 *	4L	None
	Total credits Semester 1			**30**		
2	Integrated Water Resources Management	**CVW5999**	9	18	3L+2T or 2P	None
2	Hydrology and Hydrogeology	**CVW5989**	9	18	3L+2T or 2P	None
	Total credits Semester 2			**36**		
	Total credits Year 1			***66***		

* *This course does not contribute any credits because it is at NQF Level 8.*

COMPULSORY COURSES (WATER PROGRAMME) - YEAR 2 OF PART TIME STUDENTS

SEM	**COURSE NAME** *(ALL COMPULSORY)*	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**EQUIVALENT CONTACT HOURS**	**PRE-REQUISITE** *CO- REQUISITE*
1	Advanced Hydraulics	**CVW5921**	9	12	2L+1T or 1P	None
1	Advanced Water Supply and Wastewater Treatment	**CVE5931**	9	24	4L+2T or 2P	None
	Total credits Semester 1			**36**		
2	Advanced Hydro-Engineering	**CVW5912**	9	24	84 Hours	None
2	Drought and Flood Risk Management	**CVW5992**	9	18	3L+2T + 3 days FW	None
	Total credits Semester 2		**42**			
	Total credits Year 2			***78***		

COMPULSORY COURSES - YEAR 3 OF PART TIME STUDENTS (WATER PROGRAMME)

YEAR 3 SEMESTER 1 and 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** *(ALL COMPULSORY)*	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1and2	Thesis	EGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Key: L – Lecture; T – Tutorial; P – Practical; S – Seminar Discussion; FW – Field Work (Fieldtrip).

Note: Where Block Release is done, the following shall apply: 24
Credits: Block of 3 weeks in total
18 Credits: Blocks of 2 weeks in total, including Saturdays12
Credits: Block of 1 week and 2 days

PART B-3: COURSE SPECIFICATION: MSc Civil Engineering Programme 19MCVW *(Water)*

Course Title:	**ADVANCED HYDRAULICS**
Course Code	**CVW5921**
NQF Level	9
Notional Hours	120
Contact Hours	2-hours lecture plus 1-hours of tutorial 1 practical sessions per week for one semester
NQF Credits	12
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to provide depth knowledge of advanced hydraulics and advanced flow phenomena as well as to apply approaches to characterise and determine complex flows based on the theoretical governing equations.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Describe properties of fluids and conditions for relative equilibrium in fluids
2. Illustrate fluid properties and applications of Bernoulli equation to fluids
3. Distinguish the characteristics of laminar flow and turbulent flow in fluids
4. Compare and identify the flow characteristics in pipes and channels
5. Demonstrate skills for flow measurements
6. Solve advanced hydraulic systems with respect to energy changes, pipe friction, loss coefficient, pressure oscillations and free surface profiles.
7. Execute numerical simulation software, including pre- and post-processing of the data and interpretation of the results

Course Content

Advanced review of Fluid Mechanics: Fluid properties; hydrostatics; and advanced hydrodynamics. The governing differential equations; pressure distributions, pressure measurement; fluids in relative equilibrium (including acceleration); forces on submerged surfaces; buoyancy (Bernoulli's equation, force, momentum, flux equation, continuity equation; ideal flow patterns, streamlines, flow nets; real flow, laminar and turbulent flow, boundary layers and drag). **Flow resistance in pressurised systems:** Dimensional analysis and models. **Advanced flow phenomena:** Variable pressure flows. Vorticity, hydraulic jump, water hammer, extremum principle. **Changing pressurised and open channel flow characteristics**: Pressure impulses and surge tank oscillations. **Flows over free surfaces**: Flow resistance in channels; Flows with uniform regiments. Damper systems. Water surface profile calculations. **Overflow and outflow:** Undisturbed and disturbed flows (back-pressured flows, bridges and culverts). **Theory and practice of numerical modelling of free surface flow**: 1D- modelling (HEC-RAS); examples of 2D-models.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools

(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy

Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Roberson JA, Cassidy JJ, Chaudry MH. 1998. Solutions Manual Hydraulic Engineering. John Wiley and Sons. ISBN-13: 978-0471244967, ISBN-10: 0471244961

(ii) Nalluri C and Featherstone RE. 2008. Civil Engineering Hydraulics. Blackwell Publishing. ISBN: 978-0-632-05514- 2.

(iii) Finnemore EJ and Franzini JB. 2002. Fluid Mechanics with Engineering Applications. ISBN-13: 978-0-07-243202-2

Software

(i) Hecras 5.0 (U.S. Army Corps of Engineers – Hydrologic Engineering Center)

Issue date: 2020

Next Revision: 2025

Course Title:	**ADVANCED WATER SUPPLY AND WASTEWATER ENGINEERING**
Course Code	**CVE5931**
NQF Level	9
Notional Hours	240
Contact Hours	4 hours lecture plus 2 hours of tutorials or 2 practical sessions per week for one semester
NQF Credits	24
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to equip students with the principles behind water supply and sanitation systems, including systems for clean water distribution and systems for wastewater collection and treatment processes.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Evaluate the impact of water pollutants on public health
2. Identify water resources suitable for drinking purposes
3. Apply appropriate methods to develop a water distribution system under different socio-economic circumstances
4. Use appropriate tools to determine water quality and provide quality assurance of drinking water
5. Discuss the most important techniques for wastewater treatment
6. Plan and use modelling tools to set up an appropriate local and regional sanitation system
7. Evaluate appropriate methods for developing a water distribution system under different socio-economic circumstances
8. Discuss tools that relate water quality aspects
9. Explain the most important techniques for waste water treatment
10. Assess planning and modelling tools for setting up an appropriate regional sanitation system.
11. Design water supply and wastewater facilities.

Course Content:
Introduction: Impact of water pollutants on environment and public health; self-purification of waste in streams; zones of purification; eutrophication. Status and challenges of water supply and sanitation sector. **Water supply:** Urban water cycle, water demand, system analysis of urban and rural water systems, water sources, water quality parameters, legislation, codes, and standards, purification, disinfection, risk management, elevation, adduction, storage, non-revenue water and leakage control, **Design of pipeline networks:** Pipe networks (simple branching circuits, single node reservoir systems, pipe reticulation systems. Permanent pressurized flows: pipeline and hydraulic network systems, pipeline construction, numerical simulation of distribution networks: hydraulics and water quality. **Wastewater:** wastewater system analysis, parameters and processes, wastewater characteristics, wastewater generation, sewage and storm water runoff, drainage systems, rational method, pipelines for foul sewers, open channels, weirs, inverted syphons, culverts. Numerical simulation of sewer and drainage systems. **Wastewater treatment:** wastewater treatment options, mechanical and biological treatment processes, waste stabilization ponds, simulation of biological treatment facilities, sludge treatment. **Operation and management:** development of integrated urban water management plans, ageing and renewal of water systems, management of water companies, regulatory issues.

Contribution to Assessment of Exit Programme Outcomes
(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning
The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy
Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presentation)

Quality Assurance Arrangements
The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks
None

Recommended Textbooks
(i) Trifunović (2006): Introduction to urban water distribution. UNESCO-IHE lecture note series
(ii) Butler, Davies (2011): Urban Drainage. Earthscan
(iii) Tchaganoboulos (MetcalfandEddy 2013): Wastewater engineering

Software

(i) EPANET (U.S. Environmental protection agency)
(ii) SWMM (U.S. Environmental protection agency)
(iii) STOAT (Wrc Water research centre, U.K.)

Issue date: 2020
Next Revision: 2025

Course Title:	SURFACE AND GROUND WATER QUALITY
Course Code	**CVE5961**
NQF Level	9
Notional Hours	120
Contact Hours	2 hours of lecture + 1 hours of practical work per week for one semester
NQF Credits	12
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	2

This course aims to expose students to the processes and agents that contribute to the quality of surface and ground water with particular reference to Namibia and the available methods of assessing and managing water quality based on existing regulations and national/international water quality standards.

Learning Outcomes: Upon completion of this module, students will be able to:

1. Correlate the key elements of water quality in terms of Water Quality Regulations.
2. Apply national and international Water Quality Standard to ascertain the quality of drinking water.
3. Assess and monitor water quality based on physical, chemical and biological parameters.
4. Designate the various types of water contaminants and how they affect water quality and public health.
5. Discuss parameters that affect the quality of surface water and groundwater and techniques for monitoringquality.
6. Critique the principle involved in groundwater restoration and the impact of hydraulic fracturing on groundwater quality.
7. Conduct a toxicology review of typical substances of concern in Namibian surface and ground water with Case Studies for geogenic, anthropogenic, heavy metal, radioactive and micro-biological contamination.
8. Implement sustainable management practices on the use of surface and ground water resources, specifically in relation to the situation in Namibia.
9. Identify ways and options for water reuse and implementation strategies.

Course Content:

Water Quality: Parameters for water quality, climate change and its impact on surface and groundwater quality, review ofWater Quality (WQ) Regulations. **WQ standards:** World Health Organization drinking water quality standards, Namibian standards, other standards. effluent standards. **WQ Assessment:** Physical, chemical and biological WQ Parameters. Analytic methods for WQ assessment; WQ modeling, WQ Index maps. WQ monitoring and sampling protocols. **Types of water contaminants**: Point source and non-point source contamination, transport processes of contaminants, fate of contaminants, impact of contaminants on water quality and health. **Surface Water:** Surface water quality such as surface run-off, use of surface water, importance of surface water to mankind. **Groundwater:** Groundwater restoration, groundwater quality (especially in arid regions), impact of hydraulic fracturing on groundwater quality. Groundwater salinization, salt water intrusions. Toxicology review of typical substances of concern in Namibian surface and ground water. **Case studies of Namibia**: Fluorides as a geogenic contaminant. Nitrates as an anthropogenic contaminant. Heavy metals as contaminant mobilized by mining. Radon and uranium in groundwater. Micro biological contamination as an indicator for insufficiently protected wells and boreholes. **Management and assessment of surface and ground water**: implementation of sustainable groundwater management plans, source water assessments, urban water management plans, integrated regional water management plans. **Water reuse**: identification of water reuse options, their implementation, advantages and impacts on a sustainable water supply in Namibian municipalities and for agricultural purposes.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, written assignments, lab practicals, group discussions and two days fieldwork.

Assessment Strategy

Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 lab report)

Quality Assurance Arrangements

Internal and external moderation of examination papers and scripts; peer review of course outlines; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination.

Prescribed Textbooks

None

Recommended Textbooks

(i) Monitoring Water Quality. Pollution Assessment, Analysis, and Remediation. Edited by: Satinder Ahuja. ISBN: 978-0-444-59395-5

(ii) Kresic, N., 2009. Groundwater Resources: Sustainability, Management and Restoration. McGraw Hill Companies Inc. USA.

(iii) Price, M., 2002. Introducing Groundwater. Taylor and Francis Group, London and New York.

(iv) Gupta, S.K. Modern Hydrology and Sustainable Water Development. 2011. Wiley-Blackwell. A John Wiley and Sons, Ltd.

Issue date: 2020
Next Revision: 2025

Course Title	**STATISTICS AND RESEARCH METHODS**
Course Code	**EGT5981**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 computer-based practicals per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 and 2

This course aims to equip students with the advanced skills needed to identify and to conduct reliable advanced research and statistical analysis as required in scientific research and industrial practice.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Define the responsibilities of a researcher, including scientific ethics, and data and code management requirements.
2. Formulate appropriate research questions/hypothesis and select appropriate research designs;3.
4. Apply concepts of probability, random variables, statistical inference, hypothesis testing and regression in engineering.
5. Manipulate data and use statistic software to perform statistical analysis and probability calculations
6. Develop and write scientific research proposals

Course Content

The course has three sections. The first section focused on **research methods**. This section will provide students with an advanced knowledge and skills to initiate, structure and conduct excellent, publishable research. It will advance research concepts covered at an undergraduate level, such as research design, research methodology and research validation. Both qualitative and quantitative research methods will be covered at an advanced level. Concepts such as problem identification, formulation of appropriate research questions/ hypothesis, conducting related literature search and evaluation, development of a research plan, research design, data analysis, disseminate the results and development of a research proposal will becovered at an advanced level. This section will concluded with **Research ethics**: different citation methods and styles, importance of referencing and research ethic codes.

The second section will focus on **experimental methods and statistics**. **Statistical Data Analysis:** Introduction to statistical experimental design, ANOVA analysis, error or residue analysis, simple and multiple linear regression analysis, maximum flow theory, probability theory, discrete and continuous probability distribution, reliability and decision analysis. Use of Statistical Software**:** Use of statistical software such as SPSS, R, Mini Tab, etc.

The last section is **Research Proposal Writing:** Students apply what they have learn to write Research Proposals for research work in their fields of interest under the supervision of an academic member of staff and present the Research Proposal for assessment.

Contribution to Assessment of Exit Programme Outcome:

(3) Research capability at work or towards PhD studies

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions. Each topic covered in the lectures will be followed by exercises analyzing real data in practical computing classes using statistical software.

Assessment Strategy

Continuous Assessment **100%**, involving at least 2 Tests **25%**; Assignments **20%**; Research Proposal and Proposal Presentation **50%.**

Quality Assurance Arrangements

Research proposal and statistics components are moderated internally. Students complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(vii) Thiel, D. (2014). An introductory note for instructors. In *Research Methods for Engineers*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139542326.002

(viii) Peter RN, Coffin M, Copeland KAF. (2003). Introductory Statistics for Engineering Experimentation. Academic Press, Technology and Engineering

(ix) Jeff Wu C.F, Michael S. Hamada. (2011). Experiments: Planning, Analysis, and Optimization. John Wiley and Sons. Edition 2, illustrated. ISBN 1118211537, 9781118211533 and Sons

First Issue 2020
Next Revision: 2025

Course Title	**ACADEMIC WRITING FOR POST GRADUATE STUDIES**
Course Code	UAE5819
NQF Level	8
Notional Hours	56 contact hours
Contact hours	4 hours per week for one semester
NQF Credits	0 (course is required but does not contribute any credits)
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 and2

This course aims to equip students with further knowledge of academic writing skills.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Access various academic sources
2. Analyse a text critically
3. Use a process approach when research writing
4. Write an academic text utilizing proper rhetoric and style
5. Format a written academic text in APA (American Psychological Association) style

Course Content

This course is a post-graduate course designed to empower students with skills and knowledge to access and critique academic sources and to synthesize information from these sources to assist them in the substantiation and development of their own claim when writing an academic paper in their respective fields of specialization. Additionally, this course will empower students when with the capacity to undertake the challenges of academic writing by exposing them to the different rhetorical and stylistic elements typical of academic texts. Finally, students will be introduced to the American Psychological Association (APA) witting style and will be equipped with the necessary skills to format an academic paper in APA style.

Contribution to Assessment of Exit Programme Outcome:

(5) Engagement in independent scholarly works through publications or conference presentations

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions.

Assessment Strategy

Continuous Assessment: 100% (critical reading assignment, annotated bibliography, term paper

Quality Assurance Arrangements

Internal and external moderation of test papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments and tests

First Issue 2020
Next Revision: **2025**

Course Title:	**INTEGRATED WATER RESOURCES MANAGEMENT**
Code	**CVW5999**
NQF Level	9
Notional Hours	180
Contact Hours	3 hours of lecture + 2 hours of tutorial/seminar per week for one semester
NQF Credits	18
Prerequisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims is to present the principles, techniques and tools used in Integrated Water Resources Management (IWRM) including Environmental Impact Assessment (EIA) and employing Geographic Information Systems (GIS).

Learning Outcomes: Upon completion of this course, students should be able to:

1. Discuss critically water resources management concepts and principles
2. Identify management functions and decision-making processes in water resources management
3. Interpret and analyze regional issues and regional projects on IWRM in Namibia
4. Evaluate measures and sensitivity analysis of IWRM tools on water related issues
5. Present existing procedures for water resources management and suggest improvements
6. Interpret risk management strategy in IWRM including mitigation measures
7. Contrast GIS and RS concepts, techniques and their application to real world situations
8. Relate to and practice the technical language of GIS and RS
9. Assemble and categorize requisite spatial data and format for water resource management.
10. Measure and evaluate environmental impacts of interaction between humans and the environment
11. Discuss planning tools and modeling approaches for environmental impact assessment (EIA) of water projects and their legal implications.

Course Content

Climate change and water resources: Impact of climate change and challenges. Case study Namibia. **International approaches and worldwide examples of IWRM.** Management of water resources: Catchment management, wetlands management, water conservation, implementation strategies and management techniques. Adoption of the principles of IWRM and the impact on water resources of different stakeholders - examples from Africa, Asia and South America. Development and use of river, lake, wetlands, and other water assets. **National and trans-boundary strategies:** Policies, goals, institutional arrangements for IWRM. Review of implemented guidelines and directives, e.g. European Water Framework Directive. **Data acquisition and processing:** Acquisition of data for water quantities and quality. Overview of important advanced state-of-the-art measurement techniques for IWRM. Pre- and post-processing of in-situ data. Data validation. Transformation of algorithms into training and practice-oriented water data processing systems. **Management approaches for IWRM:** Global research, data sources and international initiatives regarding water. Evaluation of annual water budget. Water abstraction, licensing, consultation procedures. **Risk identification and assessment:** Water conservation and capacity building for water conservation. **GIS principles:** Characteristic of and modeling spatial data; projections and coordinate systems; data sources, entry and editing; GPS; visualization and cartographic design. **Applied GIS:** Map algebra, local and neighborhood operations, zonal and proximity operations, and data query. **Principles of Remote Sensing**: Properties of electromagnetic, wavelength regions and their applications; sensors and satellites; image acquisition; image resolutions: spectral, spatial, temporal and radiometric; image preprocessing and display. **Applied Remote Sensing**: Digital image processing, land cover and land use classifications, change detection, rainfall estimate, and water quality assessment. **Integrated Remote Sensing and GIS**: Assembling and assessing requisite data for the application of terrain and hydrological modeling. Assess, interpret and synthesize results obtained from practicals. **Use of GIS and Remote Sensing software** such as ArcGIS, ENVI, ILWIS and QGIS; ideally latest versions. **Environmental Impact Assessment (EIA)**: Data and indicators; Analysis of cause – effect interrelations; avoidance, minimization and compensation; risk management; models; goal concepts; evaluation and decision support; planning methodologies;

checklists, matrices, networks; EIA process – screening, scoping, environmental baseline; key elements of Environmental Impact Statement (EIS); Public participation in planning and decision-making; monitoring and auditing; Critically review an Environmental Impact Statement (EIS) for completeness and adequacy.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, practicals, written assignments, group discussions and two days fieldwork.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(1) Lenton R. and Muller M. (Eds.) (2009). Integrated Water Resources Management in Practice: Better Water Management for Development. Taylor and Francis. ISBN 978-1-84407-649-9 (Hardback), ISBN 978-1-84407- 650-5 (Paperback)
(2) Martinez-Santos, P., Aldaya, M.M., Llamas R. (Eds.) (2014). Integrated Water Resource Management in the 21st Century: Revisiting the Paradigm. CRC Press. ISBN 978-1-138-00143-5 (Hardback), ISBN 978-1-315-79409-9 (eBook PDF)
(3) Bolstand, P (2016). GIS Fundamentals: A First Text on Geographic Information Systems, 5th edition. XanEdu Publishing, Michigan.http://paulbolstad.net/gisbook.html
(4) U.S. EPA (2012): Assessment methodology for the environmental impact of water resources projects ISBN-13: 978-1249422136
(5) Meire, P., Coenen, M., Lombardo, C., Robba, M., Sacile, R. (Eds.) (2008). Integrated water management: practical experiences and case studies. Springer. ISBN 978-1-4020-6552-1
(6) Ruppel and Ruppel-Schlichting (2016): Environmental Law and Policy in Namibia http://www.environment- namibia.net/

Journals

(1) Environmental Impact Assessment Review (Elsevier)
(2) Impact Assessment and Project Appraisal (International Association for Impact Assessment IAIA)

Issue date: 2020
Next Revision: 2025

Course Title:	ADVANCED HYDRO-ENGINEERING
Code	**CVW5912**
NQF Level	9
Notional Hours	240
Contact Hours	4-hours lecture plus 2- hours of tutorial/practical per week for one semester
NQF Credits	24
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to provide in-depth knowledge of the design of hydraulic structures and machinery including costal engineering problems, e.g. tidal and wave motion dynamics, coastal protection structures and harbour design.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Design specific hydraulic structures and hydraulic machinery
2. Construct different types of hydropower plants including pump-storage-plants and determine the mean annual usable energy capacity
3. Determine hydraulic pressure transients in pipelines and dimension surge tanks
4. Design ducts and pipes with all factory equipment, e.g. inlets, screens, valves, outlets etc.
5. Apply design criteria for spillways and stilling basins
6. Link river hydraulics and design of hydraulic structures
7. Quantify dam safety procedures
8. Develop river bank erosion protection
9. Apply culvert and bridge hydraulics
10. Evaluate the mean sea level and the process of storm surge genesis
11. Apply wave theories and wave prediction, refraction and diffraction prediction
12. Design adequate coastal protection structures.

Course Content

Patterns and design of hydraulic structures: Weirs, earth fill dams/rock fill dams, seepage control concepts and monitoring, failure mechanisms; gravity concrete dams, concrete arch dams, buttress dams, control gates, screens, inlets, pipelines and channels, outlets, spillways, stilling basins, surge tanks. **Hydropower plants:** Determining design parameters; design of hydropower plants (micro, mini and large) including pump-storage-plants; determination of mean annual energy capacity at a hydropower plant site with specific hydrological and topographic boundary conditions. **Application of specific design criteria:** River hydraulics and design of hydraulic structures, river bank protection measures, culvert and bridge hydraulics. **Coastal Engineering: Water levels and bathymetry:** Development of the mean sea level (MSL) and extreme storm surges, especially in Namibia. Influence of climate change. **Tidal system dynamics:** Basic understanding of the genesis of tides and waves (wave theory). **Time series analysis:** Working with time series, e.g. water levels, wind data, extreme value statistics and their applications to coastal engineering. **Coastal protection structures and harbour design**:Design of typical coastal protection structures, such as dikes, revetments, groints, caissons for harbour design and other protection and harbour facility design approaches.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools

(2) Design and synthesis of engineering structures and systems

(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments, 1 lab report and 1 seminar presentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Tanchev L. 2014. Dams and Appurtenant Hydraulic Structures. CRC Press Balkema. ISBN 978-1-138-00006-3

(ii) Chanson H. 2002. The Hydraulics of Stepped Chutes and Spillways. Swets and Zeitlinger. ISBN 90 5809 352 2

(iii) Shore Protection Manual, US Army Coastal Engineering Research Center. ISBN: 0-89499-176-0

Issue date: 2020

Next Revision: 2025

Course Title:	HYDROLOGY AND HYDROGEOLOGY
Code	**CVW5989**
NQF Level	9
Notional Hours	180
Contact Hours	3-hours Lecture + - hours tutorial/practical per week for one semester
NQF Credits	18
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to expose students holistically to the hydrological cycle, its components, processes and the quantification thereof using advanced methods with focus on groundwater recharge, the interaction of surface water and groundwater.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Identify and quantify hydrological processes and their contribution to water balance using advanced methods
2. Quantify evapotranspiration and precipitation at various scales
3. Evaluate and estimate groundwater recharge
4. Perform streamflow and hydrograph analyses
5. Conduct separation techniques and tracer studies
6. Compose water sample analyses with reference to hydrochemical processes
7. Discuss procedures involved in the containment of waste disposal, monitoring of waste, landfills and sewage and determine the vulnerability of aquifers.
8. Construct and interpret various surface and groundwater models.

Course Content

Hydrological processes and water balance: precipitation, evaporation, surface run-off, interception, infiltration, groundwater flow, storage, discharge, precipitation regionalization; evapotranspiration quantification methods. **Streamflow and hydrograph analyses:** streamflow analysis; hydrograph analysis; baseflow separation techniques; tracer studies including isotopic studies; forward and inverse techniques; geology of aquifers; aquifer parameter estimation based on hydrographs; hydrograph response to pumping; artificial (managed) groundwater recharge**. Groundwater recharge:** direct, indirect, localized groundwater recharge; interaction surface water – groundwater; groundwater recharge in different climates; soil water balance modeling; chloride mass balance method, lysimeters, application of isotope techniques. **Hydrochemistry:** Thermodynamic principles applied to hydrochemistry, dissolution and precipitation reactions, redox reactions, cation exchange, the carbonate system, open and closed systems, silicate weathering. **Waste/Aquifer vulnerability:** land fill disposals; containments of waste disposals; geomembranes, combined liners; monitoring of waste/landfills; monitoring of sewage; contamination sources; saltwater intrusion; vulnerability of aquifers: concept and background. **Mini Project**: students conceive, design, synthesize and implement a mini project, individually or in a group.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer’s performance.

Prescribed Textbooks

None

Recommended Textbook

N/A

Issue date: 2020
Next Revision: 2025

Course Title:	DROUGHT AND FLOOD RISK MANAGEMENT
Code	**CVW5992**
Notional Hours	180
Contact Hours	3-hours lecture plus - hours tutorial per week for one semester , plus 3 days fieldtrip
NQF Credits	18
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	2

This course aims to provide in-depth knowledge of hydraulic and hydrological modelling and strategies for drought management, water harvesting and flood risk management.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Apply advanced concepts of modelling hydrological extremes and interpretation of the modelling results.
2. Develop appropriate regional strategies of drought protection and mitigation strategies and measures.
3. Discuss the flood risk management cycle and its component as well as appropriate information to describe the flood risk of a region.
4. Explain and select structural and non-structural measures for flood protection.
5. Prepare a flood risk management plan for a chosen region.

Course Content

Hydrological and hydraulic modelling: statistical modelling: application of extreme-value-analysis, precipitation-runoff modelling: applicable software applications, precipitation-runoff-model, data interpretation, traffic management systems, Application of flood hazard mapping. **Groundwater engineering**: distribution and movement of water through geological formations (soils, sediments and rocks); modelling of fluid flow in porous media using analytical, numerical and statistical approaches; hydrogeological investigations; concept designs and construction of wells and well fields. **Drought:** types of droughts, meteorological and hydrological description; consequences of droughts; strategies for drought protection and mitigation. **Water harvesting**: strategies of water harvesting, rainwater harvesting, floodwater harvesting, engineering structures, typical examples. **Flood risk management:** types and origins of floods; flood damages; flood risk management strategy; flood forecast; flood risk maps and flood hazard maps; emergency management; flood precaution; structural and non-structural measures; typical examples. Field trips to drought and//or flooded regions and to flood control structures.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, group work, class discussions and three days fieldwork.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 field trip report)

Quality Assurance Arrangements

Internal and external moderation of examination papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination.

Prescribed Textbooks

None

Recommended Textbook

(i) The United Nations World Water Development Report 4 (2012). Managing Water under Uncertainty and Risk. United Nations Educational, Scientific and Cultural Organization. UNESCO Publishing. ISBN 978-92-3-104235-5, ISBN 978-92-3-001045-4 (e-book) Jensen, JR (2015). Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition Pearson Education, Illinois

Issue date: 2020
Next Revision: **2025**

Course Title	**THESIS**
Course Code	EGT5990
NQF Level	9
Notional Hours	1080
Contact hours	4 hours per week average for consultation with supervisors About 20 hours per week of student individual work
NQF Credits	120
Pre-requisite	EGT5980
Co-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	Final Year Semester 1 and 2

The course aims to make the students demonstrate the ability to carry out fundamental research on a well-structured proposal and to present results and conclusions backed by available literature and appropriate scientific theories for an industrial based project.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Identify, assess and solve open-ended hydraulic engineering problems creatively and innovatively
2. Apply knowledge of mathematics, basic science and transport engineering sciences from first principles to solve water engineering problems
3. Design components, systems and processes while dealing with constraints, assessing financial and social costs and benefits, and taking other impacts into account in
4. Plan and conduct investigations and experiments
5. Analyse and interpret data and derive information from data
6. Exercise limited transportation engineering judgement
7. Use modern transport engineering methods, skills and tools to assess their outputs
8. Communicate effectively in writing and orally with supervisors, peers and subordinates
9. Recognise the impact of transportation engineering activity on society and the environment
10. Be aware of the importance of engaging in lifelong learning and holding lifelong learning as a professional value
11. Recognise the need to act professionally and ethically within their own area of competence

Course Content

Development of Thesis Document. Identify authentic research problem, formulate objectives and develop appropriate research questions or hypothesis. Identify and critically analyse and synthesise relevant literatures. Design appropriate research methods including design of experiments using appropriate statistical methods. Present data in a systematic, and well structures approach using different data presentation tools. Perform relevant statistical analysis in a manner that supports or explain the data presented or responds to the hypothesis presented. Discuss results in a way that convert data to information and draw appropriate conclusions and recommendation. Convert thesis into journal papers.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.
(3) Research capability at work or towards PhD studies.
(5) Engagement in independent scholarly works through publications or conference presentations.

Methods of Facilitation of Learning

The course will be facilitated through a well-structured research and thesis writing under the supervision of at least one senior academic member of staff.

Assessment Strategy

Continuous Assessment (100%). The thesis will be evaluated by one Internal Examiner and one External Examiner. Qualifications of Examiners will be as per UNAM Post Graduate Studies Committee guidelines.

Quality Assurance Arrangements

Internal and external examination of thesis as per procedures of the Post Graduate Studies Committee (PGSC)

First Issue: 2020
Next Revision: 2025

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