Faculty of Engineering & Information Technology

Open your mind

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NOTE

This Faculty Yearbook is valid for 2020 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 Faculty 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 2020.

The fact that particulars of a specific programmes, subjects or modules have been included in this Faculty Yearbook does not necessarily mean that such programme, subject, or module will be offered in 2020 or any subsequent year.

This Faculty Yearbook should be read in conjunction with the General Information and Regulations Yearbook.
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The Faculty of Engineering and Information Technology is located at the Jose Eduardo dos Santos Campus of the University in Namibia in Ongwediva northern Namibia. The Faculty 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 Faculty 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 Faculty 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 pursue 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 Faculty 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 Faculty has graduate 2 PhD students and one masters 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 Faculty of Engineering and Information Technology 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 Faculty 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 Faculty in Ongwediva.

The Faculty 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 Keneth Matengu, the Vice Chancellor of the University of Namibia, who continues to support the growth of the Faculty 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 Faculty financially and in kind. In particular, I wish to single out the Government of India, for their very generous donation of US$12.3 million for Phase II of the Faculty, the German Government, for their generous donation of Euros 13.0 million channelled via GIZ and KfW Development Bank, and NamPower, who in 2013 completed the construction and installation of a Mini Sub-Station at the Ongwediva Engineering Campus worth about N$ 2 million. Many thanks are also due to the members of the University Management for their unwavering support, the Faculty Management Committee and the Academic, Administrative and Technical Staff of the Faculty of Engineering and Information Technology for their hard work; and the entire Student Body of the Faculty, for their commitment, discipline and perseverance.

Dr. Petrina Johannes
Dean
## FIRST SEMESTER 2020

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 6 January</td>
<td>Start of Summer School (until 26 January)</td>
</tr>
<tr>
<td>Thu 9 January</td>
<td>University opens (2020 academic year)</td>
</tr>
<tr>
<td>Thu 17 Jan – Fri 24 Jan</td>
<td>On-Line Registration: Senior Engineering Students</td>
</tr>
<tr>
<td>Tue 21 January</td>
<td>Academic staff resumes office duties</td>
</tr>
<tr>
<td>Tue 21-23 Jan</td>
<td>Registration of Pre- Engineering Students in Windhoek</td>
</tr>
<tr>
<td>Wed 22 Jan</td>
<td>Registration of Pre- Engineering Students at JEDS Campus for HP Campus</td>
</tr>
<tr>
<td>Thu 23 Jan</td>
<td>Registration of 1st Year Eng. Students at JEDS Campus</td>
</tr>
<tr>
<td>Fri 24 Jan</td>
<td>Orientation of First Year Eng. Students at JEDS Campus</td>
</tr>
<tr>
<td>Mon 27 January</td>
<td>Lectures commence for FIRST SEMESTER</td>
</tr>
<tr>
<td>29 Jan- 30 Jan</td>
<td>Registration of Postgraduate Senior Engineering Students</td>
</tr>
<tr>
<td>Wed 11 March</td>
<td>Management Meeting: Faculty of Engineering and IT (14:30) (Agenda closes 04 Mar)</td>
</tr>
<tr>
<td>Mon 16 March</td>
<td>First semester BREAK starts</td>
</tr>
<tr>
<td>Mon 23 March</td>
<td>Lectures resume after first semester break</td>
</tr>
<tr>
<td>Wed 15 April</td>
<td>Faculty Board Meeting – Faculty of Eng. and IT (Curriculum changes and new programmes) (14:30) (Agenda closes 01 April)</td>
</tr>
<tr>
<td>Fri 08 May</td>
<td>Lectures end for FIRST SEMESTER</td>
</tr>
<tr>
<td>Thu 14 May</td>
<td>Regular Examinations commence (all Eng. Students)</td>
</tr>
<tr>
<td>Fri 29 May</td>
<td>1st Semester Exams end for Senior Engineering Students</td>
</tr>
<tr>
<td>Fri 29 May</td>
<td>End of FIRST SEMESTER for Senior Eng. students</td>
</tr>
<tr>
<td>Mon 01 Jun – Fri 10 July</td>
<td>Industrial Attachment commence for Senior Eng. Students (6 weeks)</td>
</tr>
<tr>
<td>Fri 05 June</td>
<td>Regular Examinations end for First Year Eng. Students</td>
</tr>
<tr>
<td>Mon 15 June</td>
<td>Special/Suppl. Exams start for 1st Year Eng. Students</td>
</tr>
<tr>
<td>Wed 17 Jun</td>
<td>Faculty Management Meeting – Faculty of Eng. and Info Tech (14:30) (Agenda closes 03 Jun)</td>
</tr>
<tr>
<td>Fri 26 June</td>
<td>End of first semester for First Year Engineering Students</td>
</tr>
<tr>
<td>Mon 22 Jun – Fri 26Jun</td>
<td>Industrial Attachment visits</td>
</tr>
<tr>
<td>Mon 29 Jun – Fri 03 July</td>
<td>Mid-year Break</td>
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</tbody>
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## SECOND SEMESTER 2020

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>Fri 10 – Sat 11 July</td>
<td>Open Day/Career Fair</td>
</tr>
<tr>
<td>Mon 13 July</td>
<td>Lectures commence for SECOND SEMESTER</td>
</tr>
<tr>
<td>Mon 13 - 17 July</td>
<td>Special/Suppl. Exams for Senior Engineering Students for Semester 1</td>
</tr>
<tr>
<td>Wed 22 July</td>
<td>Faculty Board Meeting – Faculty of Eng. and IT (Examiners/Moderators/ Promotion of students) (14:30) (Agenda closes 08 July)</td>
</tr>
<tr>
<td>Mon 24 August</td>
<td>Second semester BREAK starts</td>
</tr>
<tr>
<td>Mon 31 August r</td>
<td>Lectures resume after second semester break</td>
</tr>
<tr>
<td>Wed 16 Sept</td>
<td>Faculty Management Meeting – Faculty of Eng. and IT (14:30) (Agenda closes 02 Sept)</td>
</tr>
<tr>
<td>Tue 22 October</td>
<td>Regular Examinations commence (Main UNAM with core Modules)</td>
</tr>
<tr>
<td>Fri 23 October</td>
<td>Lectures end for SECOND SEMESTER</td>
</tr>
<tr>
<td>Tue 27 October</td>
<td>Regular Examinations commence for Senior Engineering students</td>
</tr>
<tr>
<td>Thu 12 November</td>
<td>Regular Examinations end for all UNAM students</td>
</tr>
<tr>
<td>Fri 20 November</td>
<td>Special/Suppl. Examinations start (until 26 Nov) for all UNAM students</td>
</tr>
<tr>
<td>Fri 27 Nov</td>
<td>Faculty Board of Examiners</td>
</tr>
<tr>
<td>Fri 02 December</td>
<td>End of second semester</td>
</tr>
<tr>
<td>Tue 15 December</td>
<td>End of academic year</td>
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## 2021 ACADEMIC YEAR

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>Mon 7 January</td>
<td>Start of Summer School (until 26 January 2021)</td>
</tr>
<tr>
<td>Mon 11 January</td>
<td>University opens (2021 academic year)</td>
</tr>
<tr>
<td>Thu 21 January</td>
<td>Academic staff resumes office duty</td>
</tr>
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DUE DATES FOR THE 2020 ACADEMIC YEAR

(i) GENERAL

<table>
<thead>
<tr>
<th>DATE</th>
<th>GENERAL DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 January</td>
<td>Last day for appeals (Semester 2 &amp; Double modules – Regular and Supplementary/ Special examinations of November 2019)</td>
</tr>
<tr>
<td>7 February</td>
<td>Last day for application of retention of continuous assessment (CA) mark and Last day for application for exemption(s)</td>
</tr>
<tr>
<td>7 February</td>
<td>Last day for Late Registration (Late fee payable)</td>
</tr>
<tr>
<td>7 February</td>
<td>Last day for approval of exemption(s)</td>
</tr>
<tr>
<td>7 February</td>
<td>Last day for approval of module(s) &amp; qualification changes</td>
</tr>
<tr>
<td>12 February</td>
<td>Last day for recommendation of retention of continuous assessment mark and Promotion Examinations by Faculties</td>
</tr>
<tr>
<td>14 February</td>
<td>Last day for approval of retention of continuous assessment mark and Promotion Examination by Examinations Department</td>
</tr>
<tr>
<td>28 February</td>
<td>Promotion Examination</td>
</tr>
<tr>
<td>29 April</td>
<td>Last day for change of offering types at Regional Centres (Semester 1 modules)</td>
</tr>
<tr>
<td>3 August</td>
<td>Last day for Appeals (Semester 1 Modules - Regular and Supplementary/ Special examinations of June 2019)</td>
</tr>
<tr>
<td>21 August</td>
<td>Last day to submit outstanding documentation</td>
</tr>
<tr>
<td>20 September</td>
<td>Last day to change offering types at Regional Centres (Semester 2 modules)</td>
</tr>
<tr>
<td>18 September</td>
<td>Last day to cancel enrolment</td>
</tr>
<tr>
<td>30 October</td>
<td>Last day to submit Theses and Dissertations for examinations</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>DATE</th>
<th>CANCELLATION DUE DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 April</td>
<td>Last day to cancel Semester 1 modules</td>
</tr>
<tr>
<td>18 September</td>
<td>Last day to cancel Semester 2 modules</td>
</tr>
<tr>
<td>18 September</td>
<td>Last day to cancel Double modules (module that extends normally over one academic year)</td>
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<table>
<thead>
<tr>
<th>DATE</th>
<th>FINANCE DUE DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 March</td>
<td>Last day to cancel Semester 1 and Double modules with 100% credit</td>
</tr>
<tr>
<td>03 April</td>
<td>Last day to cancel Semester 1 modules with 50% credit</td>
</tr>
<tr>
<td>5 June</td>
<td>Last day to cancel Double modules with 50% credit</td>
</tr>
<tr>
<td>07 August</td>
<td>Last day to cancel Semester 2 modules with 100% credit</td>
</tr>
<tr>
<td>31 August</td>
<td>Last day to cancel Semester 2 modules with 50% credit</td>
</tr>
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### 2020 ACADEMIC YEAR: UNAM MAIN

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>13 December 2019</td>
<td>End of Academic Year</td>
</tr>
<tr>
<td><strong>FIRST SEMESTER:</strong></td>
<td></td>
</tr>
<tr>
<td>06 January</td>
<td>Start of Summer School (until 26 January)</td>
</tr>
<tr>
<td>09 January</td>
<td>University Open</td>
</tr>
<tr>
<td>21 January</td>
<td>Academic staff resumes office duties</td>
</tr>
<tr>
<td>03 February</td>
<td>Lectures commence for First Semester</td>
</tr>
<tr>
<td>16 March</td>
<td>First Semester Break Starts (until 20 March)</td>
</tr>
<tr>
<td>23 March</td>
<td>Lectures resume after First Semester Break</td>
</tr>
<tr>
<td>08 May</td>
<td>Lectures end for First Semester</td>
</tr>
<tr>
<td>14 May</td>
<td>Regular Examinations commence</td>
</tr>
<tr>
<td>05 June</td>
<td>Regular Examinations end</td>
</tr>
<tr>
<td>15 June</td>
<td>Special/Supplementary Examinations start (until 19 June)</td>
</tr>
<tr>
<td>26 June</td>
<td>End of first semester</td>
</tr>
<tr>
<td>29 June</td>
<td>Start of Winter School (until 17 July)</td>
</tr>
<tr>
<td>29 June – 03 July</td>
<td>Mid-year Break</td>
</tr>
<tr>
<td><strong>SECOND SEMESTER:</strong></td>
<td></td>
</tr>
<tr>
<td>20 July</td>
<td>Lectures commence for Second Semester</td>
</tr>
<tr>
<td>24 August</td>
<td>Second Semester Break Starts (until 28 August)</td>
</tr>
<tr>
<td>31 August</td>
<td>Lectures resume after Second Semester Break</td>
</tr>
<tr>
<td>16 October</td>
<td>Lectures end for Second Semester</td>
</tr>
<tr>
<td>22 October</td>
<td>Regular Examinations commence</td>
</tr>
<tr>
<td>12 November</td>
<td>Regular Examinations end</td>
</tr>
<tr>
<td>20 November</td>
<td>Special/Supplementary Examinations start (until 26 Nov)</td>
</tr>
<tr>
<td>02 December</td>
<td>End of Second Semester</td>
</tr>
<tr>
<td>15 December</td>
<td>End of Academic Year</td>
</tr>
<tr>
<td><strong>YEAR 2021:</strong></td>
<td></td>
</tr>
<tr>
<td>07 January</td>
<td>Start of Summer School (until 25 January)</td>
</tr>
<tr>
<td>11 January</td>
<td>University opens (2021 Academic Year)</td>
</tr>
<tr>
<td>21 January</td>
<td>Academic staff resumes office duty</td>
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## A. STRUCTURE AND PERSONNEL OF THE FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

### A.1. OFFICE OF THE DEAN

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Title</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dean</strong></td>
<td>Dr. Petrina Johannes BSc (Civil Eng), MSc (Civil Eng), PhD (Civil Eng) (USA)</td>
<td>Tel: (+264 65) 232 4022</td>
<td></td>
</tr>
<tr>
<td><strong>Secretary to the Dean</strong></td>
<td>Ms. Melinda Christiaan</td>
<td>Tel: (+264 65) 232 4002</td>
<td>Fax: (+264 65) 232 4069</td>
</tr>
<tr>
<td><strong>Faculty Officer</strong></td>
<td>Mrs. Paulina N. Kashihakumwa</td>
<td>Tel: (+264 65) 232 4004</td>
<td>Fax: (+264 65) 232 4085</td>
</tr>
<tr>
<td><strong>Human Resources Officer</strong></td>
<td>Mrs. Jacqueline Nghidamwasha</td>
<td>Tel: (+264 65) 232 4078</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Tel: (+264 65) 232 4069)</td>
<td></td>
</tr>
<tr>
<td><strong>Campus Accountant</strong></td>
<td>Mrs. Erastus Tulonga Beata</td>
<td>Tel: (+264 65) 232 4009</td>
<td></td>
</tr>
<tr>
<td><strong>Systems Administrator</strong></td>
<td>Mr. Gerson Hailundu</td>
<td>Tel: (+264 65) 232 4044</td>
<td></td>
</tr>
<tr>
<td><strong>Deputy Dean</strong></td>
<td>Dr. Fillemon N. Nangolo</td>
<td>Tel: (+264 65) 232 4005</td>
<td></td>
</tr>
<tr>
<td><strong>Examinations Officer</strong></td>
<td>Mrs. Tekla Ndevashiya</td>
<td>Tel: (+264 65) 232 4107</td>
<td></td>
</tr>
<tr>
<td><strong>Student Support Officer</strong></td>
<td>Mrs. Lovisa Amon</td>
<td>Tel: (+264 65) 232 4093</td>
<td></td>
</tr>
</tbody>
</table>

General enquiries regarding the Faculty of Engineering and Information Technology and qualifications offered by the Faculty should be directed to:

The Faculty Officer  
Faculty of Engineering and Information Technology  
University of Namibia, Engineer. Jose Eduardo Dos Santos Campus  
7501 Nandjembo 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)
A.2. ACADEMIC DEPARTMENTS

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
Academic Programmes: Bachelor of Science in Civil 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 INDUSTRIAL ENGINEERING
Academic Programmes: Bachelor of Science in Mechanical Engineering (Honours)

DEPARTMENT OF MINING AND METALLURGICAL ENGINEERING
Academic Programmes: Bachelor of Science in Mining Engineering (Honours)
                        Bachelor of Science in Metallurgical Engineering (Honours)

DEPARTMENT OF INDUSTRIAL AND WORKSHOP TRAINING
B. NATURE OF THE CURRICULUM OF BACHELOR OF SCIENCE IN ENGINEERING

B.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 Faculty of Engineering and Information Technology admitted its first intake of students. In February 2012, the Faculty launched an additional programme, Bachelor of Science in Electronics and Computer engineering.

Following the launch of the programmes, the Faculty 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 Faculty 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 Faculty 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 Faculty 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.

B.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 Faculty of Engineering and Information Technology in Ongwediva Campus. The GRN will also fund the construction of Phase IV of the Faculty (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 Faculty. In addition, local industry is working in partnership with the Faculty 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 Faculty.

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 Faculty (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 Faculty (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 Faculty of Engineering and Information Technology.

B.3. ESSENTIAL CURRICULUM REQUIREMENTS

The curriculum for the degrees of Bachelor of Science in Engineering consists of a Pre-Engineering Year (=19BPEN) plus four years of Engineering training spread over 8 semesters. The Pre-Engineering Year consists of basic sciences and mathematics modules that are meant for students who enter the University after obtaining the National Senior Secondary Certificate (NSSC) at NSSC-O level (IGCSE level), or the NSSC-H level Certificate (HIGCSE Certificate) but with weak grades in Mathematics and Physical Science. Subjects in the Pre-engineering
Year (Year Zero) include Mathematics, Physics, Chemistry, Statistics and Fundamentals of Engineering. The Pre-Engineering Year also includes the University of Namibia core modules of English Communication and Study skills, English for Academic Purposes, Computer Literacy and Contemporary Social Issues.

The First Year of Engineering (=19BENG) is common to all engineering disciplines and is the entry point for students who completed secondary school and obtained the National Senior Secondary Certificate (NSSC) at NSSC-H level (HIGCSE level) and obtained grades 1 or 2 in Mathematics and Physical Science and grade 3 or better in English. Common subjects in the First Year of Engineering include English for Academic Purposes, Contemporary Social Issues, Physics, Chemistry, Workshop Training, Engineering Mathematics, Engineering Mechanics, Materials Science, Engineering Drawing, Fundamentals of Engineering, Computing Fundamentals and Fundamentals of Electrical Engineering.

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 the semester breaks of the Second, Third and Fourth Year of Engineering.

B.4 REQUIREMENTS FOR ACCREDITATION

B.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**.
B.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.

<table>
<thead>
<tr>
<th>KNOWLEDGE AREA</th>
<th>MINIMUM CREDITS</th>
<th>MIN PERCENT CONTENT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATHEMATICAL SCIENCE</td>
<td>56</td>
<td>10</td>
</tr>
<tr>
<td>NATURAL SCIENCES</td>
<td>56</td>
<td>10</td>
</tr>
<tr>
<td>ENGINEERING SCIENCES</td>
<td>180</td>
<td>32</td>
</tr>
<tr>
<td>ENGINEERING DESIGN AND SYNTHESIS</td>
<td>72</td>
<td>13</td>
</tr>
<tr>
<td>COMPLEMENTARY STUDIES</td>
<td>56</td>
<td>10</td>
</tr>
<tr>
<td>SUBTOTAL (MINIMUM)</td>
<td>420</td>
<td>75</td>
</tr>
<tr>
<td>DISCRETIONARY (FOR REALLOCATION) – MAX</td>
<td>140</td>
<td>25</td>
</tr>
<tr>
<td>TOTAL</td>
<td>560</td>
<td>100</td>
</tr>
</tbody>
</table>

**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.
B.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.
C. 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.

C.1. DEGREE NAMES AND CODES

The Faculty of Engineering and Information Technology 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) (19BEPF)
Bachelor of Science in Industrial Engineering (Honours) (19BINE)

C.2. PROGRAMMES ON OFFER IN 2019

(i) Bachelor of Science in Civil Engineering (Honours) (19BCVE)
(ii) Bachelor of Science in Electrical Engineering (Honours) (19BECE)
(iii) Bachelor of Science in Electronics and Computer Engineering (Honours) (19BCEE)
(iv) Bachelor of Science in Mechanical Engineering (Honours) (19BMEE)
(v) Bachelor of Science in Metallurgical Engineering (Honours) (19BMLE)
(vi) Bachelor of Science in Mining Engineering (Honours) (19BMNE)

C.3. ADMISSION REQUIREMENTS

C.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) or NSSC-H level (HIGCSE level) with passes in at least five subjects, which add up to at least 25 points, calculated using the specified UNAM scale. Equivalent qualifications are acceptable. The Faculty of Engineering and Information Technology may administer an entrance test when admission places are scarce.

C.3.2. MINIMUM ENTRY INTO PRE-ENGINEERING YEAR (=19BPEN)

The minimum entry requirements for admission into the Pre-engineering Year are as follows:

(a) 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, or

(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 27 points in five subjects and meeting the above requirements for Mathematics and Physical Science, and a “D” symbol in English at NSSC-O level (IGCSE level) or equivalent qualification.

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

(e) Admission to the Faculty of Engineering and Information Technology through Mature Age Mode is possible only with those who possess valid Grade 12 Certificates.
### C.3.3. MINIMUM ENTRY INTO THE FIRST YEAR OF ENGINEERING (=19BENG)

The minimum entry requirements for admission into the First Year of Engineering are as follows:

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

(b) 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

(c) At least 30 points in five subjects and meeting the above requirements for Mathematics and Physical Science, and a "D" symbol in English at NSSC-O level (IGCSE level) or equivalent qualification.

(d) Students who have completed the First Year of Science at UNAM with passes in Physics, Chemistry and in all Mathematics and Statistics modules may be 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 Faculty of Science does not qualify for admission into the Faculty of Engineering and Information Technology.

### C.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.

### C.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.

### C.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.

### C.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 which 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 fulfi the requirements of the Engineering Council of Namibia.
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 to fulfill the requirements of the Engineering Council of Namibia.

or a sub-minimum passing mark of 50% in the University Examination in order to fulfill the requirements of the Engineering Council of Namibia.

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

C.8. ACADEMIC ADVANCEMENT RULES

C.8.1. PRE-ENGINEERING TO FIRST YEAR OF ENGINEERING

(a) A student should normally pass Fundamentals of Engineering and all the Science, Mathematics and Statistics courses within one academic year in order to proceed to the First Year of Engineering. Failed University Core courses (excluding Fundamentals of Engineering) can be carried forward to the First Year of Engineering. Those who do not qualify will be allowed to repeat only once provided they have passed at least 50% of the prescribed courses.

(b) Students who repeat the Pre-Engineering Year should normally pass all the prescribed courses (including University core courses) by the end of the repeat year of Pre-Engineering in order to proceed to the First Year of Engineering.

C.8.2. FIRST YEAR TO SECOND YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed at least 110 Credits (67% of the total 164 Credits in Year 1). 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.

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

A student must have passed at least 110 Credits (67% of the total 164 Credits in Year 1). 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.

1. Bachelor of Science in Electrical Engineering (Honours)

A student must have passed at least 110 Credits (67% of the total 164 Credits in Year 1). 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.

1. Bachelor of Science in Mechanical Engineering (Honours)

A student must have passed at least 110 Credits (67% of the total 164 Credits in Year 1). 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.

1. Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed at least 110 Credits (67% of the total 164 Credits in Year 1). 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.

1. Bachelor of Science in Mining Engineering (Honours)

A student must have passed at least 110 Credits (67% of the total 164 Credits in Year 1). 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.

C.8.3. SECOND YEAR TO THIRD YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed all 164 credits prescribed in the First Year. In addition, the student must have passed at least 112 credits of Year 2 (78% of the total 144 credits in 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.
2. Bachelor of Science in Electronics and Computer Engineering (Honours)

A student must have passed all 164 credits prescribed in the First Year. In addition, the student must have passed at least 110 credits of Year 2 (78% of the total 140 credits in 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 all 164 credits prescribed in the First Year. In addition, the student must have passed at least 116 credits of Year 2 (78% of the total 148 credits in 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. Bachelor of Science in Mechanical Engineering (Honours)

A student must have passed all 164 credits prescribed in the First Year. In addition, the student must have passed at least 106 credits of Year 2 (78% of the total 136 credits in 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 164 credits prescribed in the First Year. In addition, the student must have passed at least 110 credits of Year 2 (78% of the total 140 credits in 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 164 credits prescribed in the First Year. In addition, the student must have passed at least 102 credits of Year 2 (78% of the total 140 credits in 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.

C.8.4. THIRD YEAR TO FOURTH YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed all 144 credits prescribed in the Second Year. In addition, the student must have passed at least 106 credits of Year 3 (78% of the total 136 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

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

A student must have passed all 140 credits prescribed in the Second Year. In addition, the student must have passed at least 110 credits of Year 3 (78% of the total 140 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

3. Bachelor of Science in Electrical Engineering (Honours)

A student must have passed all 148 credits prescribed in the Second Year. In addition, the student must have passed at least 103 credits of Year 3 (78% of the total 132 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

4. Bachelor of Science in Mechanical Engineering (Honours)

A student must have passed all 136 credits prescribed in the Second Year. In addition, the student must have passed at least 112 credits of Year 3 (78% of the total 144 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

5. Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed all 140 credits prescribed in the Second Year. In addition, the student must have passed at least 112 credits of Year 3 (78% of the total 144 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.
6. **Bachelor of Science in Mining Engineering (Honours)**

A student must have passed all **132** credits prescribed in the Second Year. In addition, the student must have passed at least **116** credits of Year 3 (78% of the total 148 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

### C.9. MAXIMUM NUMBER OF CREDITS PER YEAR

1. **Bachelor of Science in Civil Engineering (Honours)**

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

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>160 credits</td>
</tr>
<tr>
<td>Second</td>
<td>191 credits (140 credits of second year plus 54 Credits of first year)</td>
</tr>
<tr>
<td>Third</td>
<td>170 credits (140 credits of third year plus 30 Credits of second year)</td>
</tr>
<tr>
<td>Fourth</td>
<td>170 credits (140 credits of fourth year plus 30 Credits of third year)</td>
</tr>
<tr>
<td>Fifth</td>
<td>112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.</td>
</tr>
</tbody>
</table>

3. **Bachelor of Science in Electrical Engineering (Honours)**

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

4. **Bachelor of Science in Mechanical Engineering (Honours)**

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

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

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

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>164 credits</td>
</tr>
<tr>
<td>Second</td>
<td>184 credits (132 credits of second year plus 52 Credits for first year)</td>
</tr>
<tr>
<td>Third</td>
<td>178 credits (148 credits of third year plus 30 Credits for second year)</td>
</tr>
<tr>
<td>Fourth</td>
<td>174 credits (140 credits of fourth year plus 34 Credits for third year)</td>
</tr>
<tr>
<td>Fifth</td>
<td>112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.</td>
</tr>
</tbody>
</table>
C.10. MINIMUM REQUIREMENTS FOR RE-ADMISSION

1. Bachelor of Science in Civil Engineering (Honours)

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

- At least 54 credits by the end of the first year (at least 33% of total credits in Year 1).
- At least 132 credits of Year 1 (80% of Year 1) plus 58 credits of Year 2 (40% of Year 2) by the end of the second year.
- All 164 prescribed Year 1 credits plus at least 116 credits of Year 2 (80% of Year 2) plus at least 54 credits of Year 3 (40% of Year 3) by the end of the third year.
- 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)

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

- At least 54 credits by the end of the first year (at least 33% of total credits in Year 1).
- At least 131 credits of Year 1 (80% of Year 1) plus 56 credits of Year 2 (40% of Year 2) by the end of the second year.
- All 164 prescribed Year 1 credits plus at least 131 credits of Year 2 (80% of Year 2) plus at least 56 credits of Year 3 (40% of Year 3) by the end of the third year.
- 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)

- A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- At least 54 credits by the end of the first year (at least 33% of total credits in Year 1).
- At least 131 credits of Year 1 (80% of Year 1) plus 59 credits of Year 2 (40% of Year 2) by the end of the second year.
- All 164 prescribed Year 1 credits plus at least 119 credits of Year 2 (80% of Year 2) plus at least 53 credits of Year 3 (40% of Year 3) by the end of the third year.
- 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)

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

- At least 54 credits by the end of the first year (at least 33% of total credits in Year 1).
- At least 132 credits of Year 1 (80% of Year 1) plus 54 credits of Year 2 (40% of Year 2) by the end of the second year.
- All 164 prescribed Year 1 credits plus at least 109 credits of Year 2 (80% of Year 2) plus at least 58 credits of Year 3 (40% of Year 3) by the end of the third year.
- 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.
Bachelor of Science in Metallurgical Engineering (Honours)

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

- At least 54 credits by the end of the first year (at least 33% of total credits in Year 1).
- At least 131 credits of Year 1 (80% of Year 1) plus 56 credits of Year 2 (40% of Year 2) by the end of the second year.
- All 164 prescribed Year 1 credits plus at least 112 credits of Year 2 (80% of Year 2) plus at least 58 credits of Year 3 (40% of Year 3) by the end of the third year.
- 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.

Bachelor of Science in Mining Engineering (Honours)

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

- At least 54 credits by the end of the first year (at least 33% of total credits in Year 1).
- At least 131 credits of Year 1 (80% of Year 1) plus 53 credits of Year 2 (40% of Year 2) by the end of the second year.
- All 164 prescribed Year 1 credits plus at least 106 credits of Year 2 (80% of Year 2) plus at least 60 credits of Year 3 (40% of Year 3) by the end of the third year.
- All 164 prescribed Year 1 credits plus all 132 prescribed Year 2 credits plus 118 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 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.

C.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 584 NQF Credits prescribed in the curriculum and has successfully completed all three Industrial Attachment sessions. The specified minimum NQF Credits include 30 Credits of Research and 34 Credits of Design Project during Semester 8 of study.

D. CURRICULUM COMPILATION

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

D.1. PRE-ENGINEERING YEAR (YEAR ZERO) 19BPEN

UNIVERSITY CORE:

ULCE3519 English Communication and Study Skills
ULEA3519 English for Academic Purposes
UCSI3580 Contemporary Social Issues
UCLC3509 Computer Literacy

FACULTY CORE:

All modules specified in the approved curriculum

D.2. YEAR 1 OF ENGINEERING 19BENG

Common to all Engineering Disciplines

FACULTY CORE:

All Year 1 modules specified in the approved curriculum

TEGW3590 Workshop Practice
### D.3. YEAR 2 OF ENGINEERING (= 19BETE; 19BEC; 19BCEE; 19BTE; 19BMEE; 19BMNE; 19BMLE; 19BCME, 19BCVE)

**FACULTY CORE:**

- TEGT3671 Engineering Mathematics III
- TEGT3641 Engineering Mechanics II
- TCME3621 Computer Science for Engineers
- TEGT3661 Computer Aided Drawing
- EGS3661 Statistics for Engineers
- TEGT3672 Engineering Mathematics IV
- TEGT3600 Industrial Attachment I (six weeks in June/July or in December/January)
- TEGT3602 HIV and AIDS Education

**DISCIPLINE SPECIFIC MODULES**

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

### D.4. YEAR 3 OF ENGINEERING

**FACULTY CORE:**

- TEGT3761 Fundamentals of Economics
- TEGT3742 Entrepreneurship
- TEGR3760 Experimental and Research Methods
- TEGT3700 Industrial Attachment II (six weeks in June/July or in December/January)

**DISCIPLINE SPECIFIC MODULES**

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

### D.5. YEAR 4 OF ENGINEERING

TEGT3800 Industrial Attachment III (six weeks in June/July or in December/January)

**FACULTY CORE:**

- TEGT3821 Society and the Engineer
- TEGM3881 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.

### E. 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 Faculty of Engineering and Information Technology
- **S** First Letter S represents the Faculty of Science
- **EGT** Faculty 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 module (12 credits). Also 9 is for modules with 4, 30 or 34 credits.
- **1 or 2** Semester

**Abbreviations:**

- **FEIT** Faculty of Engineering and Information Technology
<table>
<thead>
<tr>
<th>Code</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Lecture</td>
</tr>
<tr>
<td>T</td>
<td>Tutorial</td>
</tr>
<tr>
<td>PS</td>
<td>Practical Session or Laboratory Session</td>
</tr>
<tr>
<td>TEG</td>
<td>Engineering and Technology course codes</td>
</tr>
<tr>
<td>TCV</td>
<td>Civil Engineering course codes</td>
</tr>
<tr>
<td>TCM</td>
<td>Computer Engineering course codes</td>
</tr>
<tr>
<td>TEC</td>
<td>Electrical Engineering course codes</td>
</tr>
<tr>
<td>TET</td>
<td>Electronics Engineering course codes</td>
</tr>
<tr>
<td>TCE</td>
<td>Electronics and computer course codes</td>
</tr>
<tr>
<td>TME</td>
<td>Mechanical Engineering course codes</td>
</tr>
<tr>
<td>TML</td>
<td>Metallurgical Engineering course codes</td>
</tr>
<tr>
<td>TMN</td>
<td>Mining Engineering course codes</td>
</tr>
<tr>
<td>TTC</td>
<td>Telecommunication Engineering course codes</td>
</tr>
<tr>
<td>SMAT</td>
<td>Mathematics course codes</td>
</tr>
<tr>
<td>SPHY</td>
<td>Physics course codes</td>
</tr>
<tr>
<td>SCHM</td>
<td>Chemistry course codes</td>
</tr>
<tr>
<td>U___</td>
<td>University core modules</td>
</tr>
</tbody>
</table>
F. MODULES FOR THE PRE-ENGINEERING YEAR (YEAR ZERO)

F.1. NATURE OF PRE-ENGINEERING YEAR (= 19BPEN) (NSSC-O ENTRY LEVEL)

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.

F.2. FORMAT OF PRE-ENGINEERING YEAR (YEAR ZERO) 176 CREDITS

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>NQF LEVEL</th>
<th>CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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<tbody>
<tr>
<td>1</td>
<td>English Comm. and Study Skills</td>
<td>ULCE3419</td>
<td>5</td>
<td>16</td>
<td>None</td>
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<tr>
<td>1</td>
<td>Fundamentals of Engineering</td>
<td>TEGT3521</td>
<td>5</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Basic Mathematics</td>
<td>SMAT3511</td>
<td>5</td>
<td>16</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Analytic Geometry</td>
<td>SMAT3501</td>
<td>5</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Matrices and Complex Numbers</td>
<td>MAT3521</td>
<td>5</td>
<td>8</td>
<td>None</td>
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<tr>
<td>1</td>
<td>Chemistry 1A</td>
<td>SCHM3511</td>
<td>5</td>
<td>16</td>
<td>None</td>
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<tr>
<td>1 and 2</td>
<td>Contemporary Social Issues</td>
<td>UCSI3580</td>
<td>5</td>
<td>8</td>
<td>None</td>
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<tr>
<td></td>
<td>Total Credits</td>
<td></td>
<td></td>
<td>96</td>
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</table>

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>CREDIT</th>
<th>PRE &amp; CO-REQUISITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>English for Academic Purposes</td>
<td>ULEA3519</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Pre-Calculus</td>
<td>SMAT3512</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to Statistics</td>
<td>SSTS3522</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Chemistry 1B</td>
<td>SCHM3512</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Physics for Physical Sciences II</td>
<td>SPHY3512</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Computer Literacy</td>
<td>UCLC3509</td>
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<tr>
<td></td>
<td>Total Credits</td>
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<td>80</td>
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</tr>
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</table>

F.3. COURSE CONTENT FOR THE PRE-ENGINEERING YEAR (YEAR ZERO)

SEMMESTER 1

Module Title: ENGLISH COMMUNICATION AND STUDY SKILLS

<table>
<thead>
<tr>
<th>Code</th>
<th>NQF Level</th>
<th>Contact hours</th>
<th>Credits</th>
<th>Assessment</th>
<th>Pre-requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULCE3419</td>
<td>5</td>
<td>4 hours per week for 14 weeks</td>
<td>16</td>
<td>Continuous 60%; Examination 40%; (1 x 3 hour paper)</td>
<td>None</td>
</tr>
</tbody>
</table>

Module Description: This module is aimed at assisting students in the development of their reading, writing and speaking and listening skills, in order to cope with studying in a new academic environment and in a language which may not be their first language. The module also focuses on study skills that students need throughout their academic careers and beyond. The module serves as an introduction to university level academics, where styles of teaching and learning differ from those at secondary schools in that more responsibility is placed on the student. The module therefore, focuses on the skills that students need throughout their academic careers and beyond.

Learning Outcomes: Upon completion of this module, students should be able to:

- Apply effective reading skills
- Employ effective writing skills
- Demonstrate general speaking skills
- Demonstrate general listening skills
- Demonstrate effective study skills

Issue date: September 2015
Next Revision: September 2019
Module Title: **FUNDAMENTALS OF ENGINEERING**

<table>
<thead>
<tr>
<th>Code</th>
<th>TEGT3521</th>
</tr>
</thead>
<tbody>
<tr>
<td>NQF Level</td>
<td>5</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>2L + 1T/week</td>
</tr>
<tr>
<td>Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>None</td>
</tr>
</tbody>
</table>

**Content:**

*Introduction to Engineering:* What is engineering? Historical perspective of engineering, Common traits of good engineers; The Technology team (Scientist, Engineers, Technologist, Technician and Artisans) Difference between Scientific and Engineering Methods, Engineering Job Functions. **Branches of Engineering:** Civil, Electronics and Computer, Electrical, Mechanical, Metallurgical, Mining and others. **Engineering as a Profession:** Engineering Council of Namibia (ECN), Professional engineers – how to become one and significance of having the title. Professional Societies. **Introduction to Engineering Design and Problem Solving:** Types of Problems, Problem Solving Approach and Skills, The Design process, Brainstorming, Criteria and Evaluation, Sustainability, **Engineering Ethics:** Interaction Rules, Ethical decision making, Plagiarism, Settling Conflicts, Moral theories and The Ethical Engineer. **Engineering tools:** Presentation software, Internet as a research tool, Computational tools – Microsoft Excel. **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

**Learning Outcomes:** Upon completion of this module, students will be able to:

- Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
- Describe the various branches of engineering, possible careers, and job prospects
- Describe how to solve basic engineering problems
- Identify general steps involved in engineering design and communication
- Use modern engineering and communication tools and procedures.

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Module Title: **BASIC MATHEMATICS**

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>5</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>4L + 2T/Week</td>
</tr>
<tr>
<td>Credits</td>
<td>16</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50%, Examination 50% (1x3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>None</td>
</tr>
</tbody>
</table>

**Contents:** Sets: notations and diagrams to represent sets, subset, empty set, equality of sets, intersection, union, complement. Algebraic expressions: simplification, expansion, polynomials, reminder and factor theorem, partial fractions. Trigonometry: trigonometric functions, basic trigonometric identities. The absolute value, linear equations, linear inequalities, quadratic equations, the quadratic formula, quadratic inequalities. Functions: domain, co-domain, image, pre-image, even function, odd function. Sequences: the general term, the geometric sequence, the arithmetic sequence.

**Learning Outcomes:** Upon completion of this module the student is expected to be able to:

- represent information using Venn diagrams
- represent information using equations
- find the intersection and the union of two sets as well as the complement of a subset of a set
- decompose a fraction into partial fractions
- simplify and factorize algebraic expressions and solve linear and quadratic equations and inequalities
- find the domain and the range of a function as well as the pre-image of a set
- find the composition of two functions
- apply the factor and the remainder theorem
- able to find partial sums and the sums of geometric and arithmetic sequences
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>ANALYTIC GEOMETRY</th>
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<tbody>
<tr>
<td>Code</td>
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<tr>
<td>NQF level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1 T/Week FOR 14 Weeks</td>
</tr>
<tr>
<td>Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50%, Examination 50% (1x 2 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite</td>
<td>None</td>
</tr>
<tr>
<td>Issue Date:</td>
<td>January 2012</td>
</tr>
<tr>
<td>Next Revision</td>
<td>January 2016</td>
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<table>
<thead>
<tr>
<th>Module Title:</th>
<th>COMPLEX NUMBERS AND MATRICES</th>
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<tbody>
<tr>
<td>Code</td>
<td>SMAT3521</td>
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<tr>
<td>NQF level</td>
<td>5</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>2L + 1T/Week FOR 14 Weeks</td>
</tr>
<tr>
<td>Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50%, Examination 50% (1x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite</td>
<td>None</td>
</tr>
<tr>
<td>Contents:</td>
<td>Vectors in 2-and 3-dimensions: addition of vectors, multiplication by a scalar, norm of a vector, dot product, cross product. Lines and planes in 3D-space. Systems of linear equations: introduction to linear systems, solution by Gaussian elimination and Gauss–Jordan elimination (for up to 3 x 3). Matrices: addition, multiplication, scalar multiplication, transpose (for up to 3 x 3), elementary matrices, diagonal, triangular and symmetric matrices, determinant and inverse (for up to 3 x 3), solutions of systems of linear equations by Cramer’s rule (for up to 3 x 3). Complex Numbers: complex planes, operations on complex numbers, modulus, complex conjugate, division, modulus-argument form, de Moivre’s formula, Euler’s formula, Fundamental Theorem of Algebra</td>
</tr>
<tr>
<td>Issue Date:</td>
<td>January 2012</td>
</tr>
<tr>
<td>Next Revision</td>
<td>January 2016</td>
</tr>
</tbody>
</table>
Module Title: CHEMISTRY 1A

Code SCHM3511
NQF Level 5
Contact Hours 4L + 1 PS/Week
Credits: 16
Assessment Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites None

Content: An Introduction to Chemistry: Classification of Matter; The Three States of Matter; Physical and Chemical Properties of Matter; Measurement; Handling Numbers (scientific notation, significant figures); Factor-Label Method in Solving Problems. Atoms, Molecules and Ions: The Structure of the Atom; Atomic Number, Mass Number, and Isotopes; Molecules and Ions; Chemical Formulas (molecular and empirical); Naming Compounds. Mass Relationships in Chemical Reactions: Atomic Mass; Avogadro’s Number and Molar mass; Molecular Mass; Percent Composition of Compounds; Experimental Determination of Empirical Formulas; Chemical Reactions and Chemical Equations; Stoichiometry (amounts of reactants and products); Limiting and Excess Reagents; Reaction Yield; Concentration of Solutions. Reactions in Aqueous Solutions: General Properties of Aqueous Solutions; Precipitation Reactions; Acid-Base Reactions; Oxidation and Reduction Reactions (assigning oxidation states, writing redox equations, balancing redox reactions). Quantum Theory and the Electronic Structure of Atoms: The Photoelectric Effect; Bohr’s Theory of the Hydrogen Atom; Quantum Numbers; Atomic Orbitals; Electron Configuration; The Building-up Principle. Periodic Relationships Among Elements: Periodic Classification of the Elements; Periodic Variation in Physical Properties (effective nuclear charge, atomic radius, ionic radius); Ionization Energy; Electron Affinity; Variation in Chemical Properties of the Representative Elements (main group elements). Chemical Bonding: Lewis Dot Symbols; Ionic Bonding; Covalent Bonding; Metallic Bonding; Electronegativity; Writing Lewis Structures; Formal Charge; Concept of Resonance; Bond Enthalpy. Basic Molecular Geometry and Hybridization of Atomic Orbitals: Molecular Geometry; Dipole Moments; Valence Bond Theory; Hybridization of Atomic Orbitals; Molecular Orbital Theory; Molecular Orbital Configurations.

Learning Outcomes: Upon completion of this module, the student is expected to:

● Define and classify the three states of matter and solve problems using the factor label method while respecting significant figures.
● Explain the structure of an atom, and distinguish between molecules and ions.
● Discuss mass relationships in chemical reactions.
● Explain reactions in aqueous solutions.
● Describe the quantum theory and use it to determine the electronic structure of atoms.
● Describe and analyse the periodic relationships among elements
● Explain chemical bonding.
● Predict molecular geometry and hybridization of atomic orbitals.

Issue Date: January 2013
Next Revision: January 2017
### Module Title: PHYSICS FOR PHYSICAL SCIENCES I

<table>
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<tr>
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<th>SPHY3511</th>
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<tr>
<td>Contact hours</td>
<td>4L + 2T or 1 PS/Week</td>
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<tr>
<td>Credits</td>
<td>16</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>None</td>
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</table>

**Contents:** Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton’s laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler’s laws; pressure; Archimedes’ principle; laminar flow; Bernoulli’s equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

**Learning Outcomes:** Upon completion of the module, the student is expected to:
- Employ units, do unit conversions and use of significant figures.
- 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.

**Issue Date:** January 2013  
**Next Revision:** January 2017

### SEMESTER 2

### Module Title: ENGLISH FOR ACADEMIC PURPOSES

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<td>Contact hours</td>
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<td>Pre-requisites</td>
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**Module Description:** This module develops a student's understanding and competencies regarding academic conventions such as academic reading, writing, listening and oral presentation skills for academic purposes. Students are required to produce a referenced and researched essay written in formal academic style within the context of their university studies. Students are also required to do oral presentations based on their essays. The reading component of the course deals with academic level texts. This involves students in a detailed critical analysis of such texts. The main aim is therefore, to develop academic literacy in English.

**Learning Outcomes:** Upon completion of this module, the students will be able to:
- Apply academic and formal writing conventions within the context of their studies.
- Integrate advanced reading strategies in reading an academic context.
- Employ oral and presentation skills in an academic context.
- Employ academic listening techniques in an academic context.

**Issue Date:** September 2015  
**Next Revision:** September 2019
Module Title: CONTEMPORARY SOCIAL ISSUES

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<th>Code</th>
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<tr>
<td>Contact Hours</td>
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<tr>
<td>Assessment</td>
<td>Continuous Assessment (100%). variety of assessments which evaluate and test the students’ individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.</td>
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<tr>
<td>Prerequisite</td>
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Module Descriptor: The module, Contemporary Social Issues (CSI3580), is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

Learning Outcomes

By the end of this module students should be able to:

- Contribute to family, community and society;
- Develop social consciousness, thinking skills, self-concepts as well as moral and ethical sensitivity;
- Illustrate key contemporary social issues and challenges experienced within the Namibian society and globally;
- Discuss the role of human conduct, structures, institutions and relations of power in shaping social life in the country;
- Promote ethical and moral reasoning, anticorruption behaviours, human rights, healthy lifestyles, gender equality, productive citizenship, responsible leadership, social media ethics and environmental sustainability; and
- Open their minds to possible meaningful and worthwhile career opportunities.

Issue Date: September 2012
Next Revision: September 2016

Module Title: PRE-CALCULUS

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<td>Pre-requisite</td>
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</table>

Content: Functions: one-to-one and onto functions, horizontal line test, composition of functions, inverse of a function. Introduction to exponential and logarithmic functions. Limit of a function: definition, left and right limits, infinite limits, limits at infinity, continuity in terms of limits. Differentiation: rate of change, derivative of a function, rules of differentiation, increasing and decreasing functions and graph sketching. Integration: anti-derivatives, the definite integral, area under a graph. Trigonometry: further trigonometric identities, area of a sector and segment of a circle, derivatives and integrals of trigonometric functions.

Learning Outcomes: Upon completion of this module the student is expected to be able to:

- check whether a function is injective and to find the inverse function
- find the limit of a function at a point and a limit involving infinity
- find the derivative of exponential and polynomial functions
- solve problems involving rates of change
- sketch a graph of a function using sign tables
- find an area of a region under a graph

Issue Date: January 2013
Next Revision: January 2017
**Module Title:** INTRODUCTION TO STATISTICS  

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<td>Pre-requisite</td>
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**Learning Outcomes:** Upon completion of the module, the student is expected to:

- Demonstrate an understanding of basic concepts in Statistics
- Identify various measures in Statistics
- Demonstrate an understanding of the concepts of sampling
- Carryout descriptive analysis of data

**Issue Date:** September 2015  
**Next Revision:** September 2019

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**Module Title:** CHEMISTRY 1B  

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<td>Assessment</td>
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<tr>
<td>Pre-requisites</td>
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</tbody>
</table>

**Content:** Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature, Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

**Learning Outcomes:** Upon completion of this module, the student is expected to:

- Explain and use the gas laws
- Discuss energy changes in chemical reactions
- Analyse the rates of chemical reactions.
- Explain chemical reactions at equilibrium and predict shift in equilibrium when a stress is applied to the system.
- Distinguish between the three laws of thermodynamics
- Explain acid-base equilibria and solubility equilibria.
- Demonstrate an understanding of how galvanic cells work.

**Issue Date:** January 2013  
**Next Revision:** January 2017
Module Title: PHYSICS FOR PHYSICAL SCIENCES II

Code: SPHY3512
NQF Level: 5
Contact Hours: 4L + 1 PS/Week
Credits: 16
Assessment: Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite: SPHY3511 Physics for Physical Sciences I

Contents: Electric charge; insulators and conductors; Electric force and coulomb’s law; Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm’s law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

Learning Outcomes: Upon completion of this module, the student is expected 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.

Issue Date: January 2013
Next Revision: January 2017

Module Title: COMPUTER LITERACY

Code: UCLC 3509
NQF Level: 5
Contact Hours: 2 lecture periods and 1 practical class per week for 14 weeks
Credits: 8
Assessment: 100% Continuous (2 Practical Tests 50% and 2 Theory Tests 50%)
Pre-requisite: None

Module description: This module aims to introduce basics of computer hardware, operating systems and application software; cover principles of word processing, spread sheet, presentations and databases; equip students with necessary hands on experience to use computers and relevant productivity software applications in both the educational and later at the work environment.

Learning Outcomes: On completing the module students should be able to:
● Distinguish between hardware and software
● Describe and compare computer Performance
● Discuss health, safety and environment impact in computing
● Discuss security and copyright issues
● Use a word processor to create, edit and format documents
● Insert different types of objects on to a word document
● Use the mail merge features
● Use a spread sheet to create, edit and format workbooks
● Use formulae and functions to perform calculations
● Create different types of objects on to a worksheet
● Use a presentation software to create, edit and format a presentation file
● Insert different types of objects on to a presentation
● Manipulate a presentation file
● Use a web browser to navigate the Internet/web
● Use email software to send and receive messages with attachments
● Use social network sites and other communication tools to send/receive messages

Issue Date: September 2012
Next Revision: September 2016
G. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS)

G.1. DEGREE NAME: BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS) 19BCVE

G.2. 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.

G.3. 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. An 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.

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<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
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<tbody>
<tr>
<td>1</td>
<td>Engineering Mathematics I</td>
</tr>
<tr>
<td>1</td>
<td>Engineering Drawing</td>
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<tr>
<td>1</td>
<td>Physics for Physical Sciences I</td>
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<td>Workshop Practice</td>
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<td>1</td>
<td>Materials Science</td>
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<td>1 and 2</td>
<td>Contemporary Social Issues</td>
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<td>Fundamentals of Engineering</td>
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<td>2</td>
<td>Engineering Mathematics II</td>
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<td>2</td>
<td>Fundamentals of Electrical Engineering</td>
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<tr>
<td>2</td>
<td>Physics for Physical Sciences II</td>
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<tr>
<td>2</td>
<td>Engineering Mechanics I</td>
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YEAR 1 OF BSc IN CIVIL ENGINEERING – 164 CREDITS

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<td>Engineering Drawing</td>
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<td>Physics for Physical Sciences I</td>
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<td>Workshop Practice</td>
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<td>1</td>
<td>Fundamentals of Engineering</td>
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<tr>
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<td>Engineering Mathematics II</td>
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<td>2</td>
<td>Fundamentals of Electrical Engineering</td>
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<td>Physics for Physical Sciences II</td>
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<td>Engineering Mechanics I</td>
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<td>Chemistry 1B</td>
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<td>2</td>
<td>English for Academic Purposes</td>
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NB: Students who have done UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512 and SCHM3512 will be exempted from taking them in this year.
### YEAR 2 OF BSc IN CIVIL ENGINEERING – 144 Credits

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<td>6</td>
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### YEAR 3 OF BSc IN CIVIL ENGINEERING – 136 Credits

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<td>TCVI3622</td>
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### YEAR 4 OF BSc IN CIVIL ENGINEERING – 140 CREDITS

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
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<tr>
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<td>Road Pavement and Geometric Design</td>
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<td>8</td>
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<td>Railways and Public Transport Systems</td>
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**TOTAL CREDITS FOR BSc IN CIVIL ENGINEERING (HONOURS)** 584
### G.4. DETAILED COURSE CONTENTS FOR BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS)

#### YEAR 1 OF BSc IN CIVIL ENGINEERING

#### SEMESTER 1

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS I</th>
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<tr>
<td>Code</td>
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<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</tbody>
</table>


**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to engineering
4. Apply trigonometry in solving mathematical and engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
6. Solve mathematical and engineering problems using partial differentiation

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

**Issue Date:** September 2015

**Next Revision:** TBD
Module Title: ENGINEERING DRAWING

<table>
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<th>Code</th>
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<tr>
<td>Contact Hours</td>
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<tr>
<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (minimum of 2 tests and 4 drawing assignments)</td>
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<tr>
<td>Pre-requisite(s)</td>
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</table>

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free-hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: Isometric and oblique representations, sections of cones – interpenetrations, developments.

Learning Outcomes: Upon completion of this 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 drawings and assembly drawings of various engineering components

Contribution to Exit Level Outcome:

5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
6 Professional and Technical Comm (Course Outcomes 2, 3, 4, 5)

Issue Date: September 2015
Next Revision: TBD
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>PHYSICS FOR PHYSICAL SCIENCES I</th>
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<tr>
<td>Code</td>
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<tr>
<td>Contact hours</td>
<td>4L + 2T or 1 PS/Week</td>
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<tr>
<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>

**Contents:** Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton’s laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler’s laws; pressure; Archimedes’ principle; laminar flow; Bernoulli’s equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

**Learning Outcomes:** Upon completion of the module, the student is expected to:

1. Employ units, do unit conversions and use of significant figures.
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.

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4 Investigations, Experiments and Data Analysis (Course Outcome 9)

**Issue Date:** September 2015
**Next Revision:** TBD
Module Title: COMPUTING FUNDAMENTALS

Code: TCME3521
NQF Level: 5
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Pre-requisite(s): None


Learning Outcomes: Upon completion of this module, students should be able to:

1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

CONTRIBUTION to Exit Level Outcome
   5  Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

Issue Date: September 2015
Next Revision: TBD
<table>
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<tr>
<th>Module Title:</th>
<th>WORKSHOP PRACTICE</th>
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<td>Code</td>
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<td>NQF Level</td>
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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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**Content:** Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Turning, Fitting, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components. Refrigeration and Air-conditioning and their installation.

**Learning Outcomes:** Upon completion of this course, students should be able to:

1. Describe general safety procedures applicable to engineering workshops.
2. Describe specific hand tools used in engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of 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.
10. Install air-conditioning and refrigeration systems.

**Contribution to Exit Level Outcome:**

2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

**Issue Date:** September 2015
**Next Revision:** TBD
Module Title: MATERIALS SCIENCE
Code: TEGS3591
NQF Level: 5
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (2 Assignments, 2 Practical Reports and 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s): None


Learning Outcomes: On completing the course students should be able to:
1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
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. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

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

Issue Date: September 2015
Next Revision: TBD
# Module Title

**CONTEMPORARY SOCIAL ISSUES**

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<th>Code</th>
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<td>NQF</td>
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<tr>
<td>Contact Hours</td>
<td>1 Contact hours per week for 28 weeks</td>
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<td>Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous Assessment (100%). variety of assessments which evaluate and test the students’ individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.</td>
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<tr>
<td>Prerequisite</td>
<td>None</td>
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**Module Descriptor:** The module, **Contemporary Social Issues (CSI3580)**, is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

**Learning Outcomes**

By the end of this module students should be able to:

- Contribute to family, community and society;
- Develop social consciousness, thinking skills, self-concepts as well as moral and ethical sensitivity;
- Illustrate key contemporary social issues and challenges experienced within the Namibian society and globally;
- Discuss the role of human conduct, structures, institutions and relations of power in shaping social life in the country;
- Promote ethical and moral reasoning, anticorruption behaviours, human rights, healthy lifestyles, gender equality, productive citizenship, responsible leadership, social media ethics and environmental sustainability; and
- Open their minds to possible meaningful and worthwhile career opportunities.

**Contribution to Exit Level Outcome:**

- Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

**Issue Date:** September 2015

**Next Revision:** TBD
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>FUNDAMENTALS OF ENGINEERING</th>
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<td>Credits</td>
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<td>Assessment</td>
<td>100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>None</td>
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</table>


**Learning Outcomes:** Upon completion of this module, students will be able to:

- Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
- Describe the various branches of engineering, possible careers, and job prospects
- Describe how to solve basic engineering problems
- Identify general steps involved in engineering design and communication
- Use modern engineering and communication tools and procedures.

**Issue Date:** September 2015

**Next Revision:** TBD
**Module Title**: ENGINEERING MATHEMATICS II

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<td>Co-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
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</table>


**Learning Outcomes**: Upon completion of this 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. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and engineering problems

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

**Issue Date**: September 2015
**Next Revision**: TBD
### Module Title: FUNDAMENTALS OF ELECTRICAL ENGINEERING

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<td>Assessment</td>
<td>Continuous Assessment 100% (2 Tests 60%, 2 Quizzes (20%) and 2 Practicals (20%))</td>
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<td>Pre-requisite(s)</td>
<td>None</td>
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**Learning Outcomes:** Upon completion of this 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
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

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** TBD

### Module Title: PHYSICS FOR PHYSICAL SCIENCES II

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<td>NQF Level</td>
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<td>Contact Hours</td>
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<td>NQF Credits</td>
<td>16</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>SPHY3511 Physics for Physical Sciences I</td>
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**Contents:** Electric charge; insulators and conductors; Electric force and coulomb’s law, Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm’s law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

**Learning Outcomes:** Upon completion of this 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.

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** TBD
Module Title: ENGINEERING MECHANICS I

Code: TEGT3592  
NQF Level: 5  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous 50% (At least 2 tests and 4 assignments); Examination 50% (1 x 3 hour paper)  
Co-requisite(s): SPHY3511 Physics for physical Sciences I

Content: 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. Analysis of forces in a truss: Method of joints, method of sections; 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 force and bending moment diagrams, Bending Stress, Shear stress.  
Center of Gravity and Centroid.

Learning Outcomes: Upon completion of this 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

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1-6)  
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)

Issue Date: September 2015  
Next Revision: TBD
Module Title: CHEMISTRY 1B

Code: SCHM3512
NQF Level: 5
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)
Pre-requisite(s): None

Content:
- Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid–Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

Learning Outcomes:
Upon completion of this course, students should be able to:
1. Explain and use the gas laws
2. Discuss energy changes in chemical reactions
3. Analyse the rates of chemical reactions.
4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
5. Distinguish between the three laws of thermodynamics
7. Demonstrate an understanding of how galvanic cells work.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: TBD
<table>
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<tr>
<th>Module Title</th>
<th>ENGLISH FOR ACADEMIC PURPOSES</th>
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<tr>
<td>Code</td>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous: 60% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper) Examination: (40%) made up of 1 x 3 hour examination paper</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE</td>
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</tbody>
</table>

**Content:** Structure of materials: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

**Learning outcomes:** Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

**Contribution to Exit Level Outcome:**
- 6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
- 9 Independent Learning Ability (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** TBD
YEAR 2 OF BSc IN CIVIL ENGINEERING

SEMESTER 1

Module Title: ENGINEERING MATHEMATICS III

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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>Assessment</td>
<td>50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)</td>
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<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
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</table>

Content: Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binormal, torsion, curvature, the gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Functions of Several Variables: limits, continuity derivatives, differentials, the Jacobian matrix and determinants, composite functions, higher order derivatives, extrema with constraints, surfaces, applications in Science and Engineering Integral Transforms: Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.. Power series solutions of second order ordinary differential equations and introduction to Bessel functions. Analytic functions: Cauchy-Riemann equations, Cauchy’s theorem, Cauchy’s integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem, evaluation.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply differential vector calculus to solve mathematical and engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving engineering problems
4. Apply the power series method in approximations of solutions of ordinary differential equations
5. Describe the basis for complex analysis in engineering problem solving
6. Apply the residual theorem to engineering problems

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

Issue Date: September 2015
Next Revision: TBD
Module Title: ENGINEERING MECHANICS II

Code: TEGT3641
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (4 assignments and 2 Tests), Examination 50% (1 x 2 hour paper)
Co-requisite(s): TEGT3592 Engineering Mechanics I


Learning Outcomes: On completing the course students should be able to:
1. 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. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, 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. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

CONTRIBUTION to Exit Level Outcome:
1. Problem Solving (Course Outcomes 3, 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 6, 7)

Issue Date: September 2015
Next Revision: TBD
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<thead>
<tr>
<th>Module Title</th>
<th>COMPUTER SCIENCE FOR ENGINEERS</th>
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<td>Code</td>
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<td>Contact Hours</td>
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<td>Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).</td>
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<td>Preerequisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
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</table>

**Content:** Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. Binary Trees and their applications. Programming using MATLAB. Application of MATLAB programming to actual engineering situations. Programming project. MATLAB Basics: variables and arrays, multidimensional arrays. Branching statements and program: Program design, Top-down, Bottom-up Techniques. Control Statements. **User-defined functions:** Operational arguments, sharing data using global memory. **Pre-defined functions.** Complex Data: Character data and additional plot types. Graphical User Interface, Advantages and Disadvantages of MATLAB. Introduction to C programming language.

**Learning Outcomes:** On completing the course students should be able to:

1. Generate data structures and algorithms
2. Apply binary trees to specific programming environment
3. Demonstrate knowledge of MATLAB programming
4. Create and use user-defined MATLAB functions
5. Apply MATLAB programming for solving engineering problems
6. Write simple C programs

**Contribution to Exit Level Outcome:**

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

**Issue Date:** September 2015
**Next Revision:** TBD

<table>
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<tr>
<th>Module Title</th>
<th>COMPUTER AIDED DRAWING</th>
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<td>NQF Level</td>
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<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous 100% (2 Tests (40%), 1 Mini-project (25%), 4 Assignments (35%))</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3561 Engineering Drawing</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
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</table>

**Content:** Getting started; Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; 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 your drawing; Working in three-dimensional space; Creating three-dimensional objects.

**Learning Outcomes:** Upon completion of this 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

**Contribution to Exit Level Outcome:**

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

**Issue Date:** September 2015
**Next Revision:** TBD
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<th>Module Title:</th>
<th>STATISTICS FOR ENGINEERS</th>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
<td>Continuous 50% (at least 4 assignments (40%) and 2 Tests (60%)), Examination 50% (1 x 3 hour paper)</td>
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<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
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</table>

**Contents:** Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; Sampling Distributions: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; Linear Regression and Correlation: Simple and Multiple Linear Regression, Correlation; Analysis of Variance: Completely Randomized and Randomized Block Designs, Multiple Comparisons;

**Learning Outcomes:** On completing the course students should be able to:

1. Describe the theory of probability
2. Analyse data using probability distribution and densities
3. Use the principles of sampling distribution to analyse data
4. Apply linear regression and correlation to a set of data
5. Apply analysis of variance to solve engineering problems

**Contribution to Exit Level Outcome:**

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

**Issue Date:** September 2015
**Next Revision:** TBD
Module Title: INTRODUCTION TO ENGINEERING GEOLOGY

Code: TMNE3621
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper).
Co-requisite(s): None

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; introductory geo-hydrology. Practical work involving geological map interpretation.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Describe composition and properties of common minerals and rocks
2. Relate the nature of the interior of the earth and the plate tectonic theory
3. Describe weathering processes and soil formation processes
4. Discuss key aspects of geo-hydrology

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD
**Module Title:** STRENGTH OF MATERIALS I  
**Code:** TCVM3621  
**NQF Level:** 6  
**Contact Hours:** 2L + 1T or 1PS/Week  
**NQF Credits:** 8  
**Assessment:** Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 2 hour paper)  
**Co-requisite(s):** TEGT3592 Engineering Mechanics I

**Content:**
*Basic concepts:* Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams.  
*Stress and strain:* Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke’s Law; Modulus of Elasticity; Normal stress and strain; Poisson’s ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson’s ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants.  
*Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems:* Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars.  
*Geometrical characteristics of plane sections:* Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem.  
*Bending:* Shear force and bending moment diagrams.

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Demonstrate the application of Hooke’s Law to normal and shear stresses.  
2. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.  
3. Calculate geometrical characteristics of plane sections.  
4. Draw bending and shear force diagrams in beams.  
5. Employ bending and shear stresses in beams.  
6. Solve problems involving shear stresses and shear flow in beams.  
7. Calculate stresses and strains in circular shafts subjected to torsion.  
8. Relate stresses in thin cylinders and spheres subjected to internal pressure.

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2, 5, 6)  
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 7, 8)  
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5, 6, 7, 8)

**Issue Date:** September 2015  
**Next Revision:** TBD
Module Title: FLUID MECHANICS

Code: TMEM3681
NQF Level: 6
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (assignments, 3 Tests, lab report); Examination 50% (1 x 3 hour paper)
Co-requisite(s): TEGT3592 Engineering Mechanics I

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 (constant acceleration); forces on submerged surfaces; buoyancy. One-dimensional flows with inertia: 1-D mass conservation; 1-D momentum conservation (Bernoulli equation); total head diagrams; free liquid jets; flow measurement. Hydraulic systems: Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram); general loss coefficients.

Learning Outcomes: Upon completion of this 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 Bernoulli’s equation
3. Demonstrate skills for flow measurements
4. Solve general hydraulic systems with respect to energy changes, pipe friction, loss coefficient.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 2, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4)
3. Investigations, Experiments and data Analysis (Course Outcome 3)
4. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 4, 5)

Issue Date: September 2015
Next Revision: TBD
**SEMESTER 2**

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<th>ENGINEERING MATHEMATICS IV</th>
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<tr>
<td>Pre-requisite(s)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
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**Content:** Applications of second order ordinary differential equations with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations:** Classification of PDEs as Elliptic, Parabolic and Hyperbolic, Neumann, Dirichlet boundary conditions of PDEs. Methods of solution of the heat equation and the equation for the vibrating string fixed at both ends, separation of variables, Application of Fourier series to the solution of heat and wave equations, waves in a stretched elastic string. **Multiple Integral.** Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods:** Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations:** Modelling with difference equations, methods of solution to first and second order difference equations.

**Learning Outcomes:** On completing the course students should be able to:

1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green's theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)

**Issue Date:** September 2015

**Next Revision:** TBD
Module Title: BUILDING MATERIALS
Code: TCVI3612
NQF Level: 6
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (assignments, 2 Tests, lab report); Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TEGS3591 Materials Science


Learning Outcomes: Upon completion of this module, students should be able to:
1. Discuss how construction materials relate to the selection and specification of construction methods for civil engineering structures.
2. Describe mechanical properties of building materials, their uses in the design, and effects on structural performance.
3. Interpret the composition and characteristics of aggregate, concrete and masonry
4. Illustrate various concrete testing techniques
5. Categorise the characteristics and uses of carbon steels used in civil engineering

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4. Investigations, Experiments and data Analysis (Course Outcome 4)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: TBD
**Module Title:** SOIL MECHANICS  
**Code:** TCVD3682  
**NQF Level:** 7  
**Contact Hours:** 3L + 2T or 1PS/Week or field trip  
**NQF Credits:** 12  
**Assessment:** Continuous 50% (assignments, 2 Tests, lab report); Examination 50% (1 x 3 hour paper)  
**Co-requisite(s):** TEGT3592 Engineering Mechanics I and TMNE3621 Introduction to Engineering Geology

**Content:** Mineralogy: Properties and composition of rock forming; **Surface processes:** soil formation, erosion, sediment transport. **Soil mechanics concepts, Elasticity:** Effective stresses, volume change behaviour of soils, stress-strain invariants, isotropic/anisotropic moduli. Modeling of drained/undrained behaviour, elasticity in soil mechanics, small strain elasticity theory. **Plasticity:** Theory in sand and clay, volume change and plastic hardening, friction block model. **Elasto-plastic modelling:** critical state and constant volume, stress-dilatancy. **Shear strength:** Mohr and Coulomb failure, peak and residual strength. **Triaxial testing.** Strength anisotropy, strain-rate and viscous effects. **Introduction to groundwater hydraulics.**

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Identify composition and properties of common minerals and rocks  
2. Relate different soils and their strength  
3. Describe soil parameters and frictions  
4. Interpret elasto-plastic phenomena  
5. Explain Mohr and Coulomb approaches  
6. Discuss consolidation, model stresses and anisotropy with respect to soil mechanics  
7. Discuss geo-hydrology and groundwater flow

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2, 4, 5, 6)  
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4, 5, 6)  
4. Investigations, Experiments and data Analysis (Course Outcomes 2, 4)  
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5, 6, 7)

**Issue Date:** September 2015  
**Next Revision:** TBD
Module Title: INFRASTRUCTURE PLANNING AND DESIGN I

Code: TCVI3622  
NQF Level: 6  
Contact Hours: 2L + 1T/Week + field trip  
NQF Credits: 8  
Assessment: Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 2 hour paper)  
Pre-/Co-requisite(s): None

Content: Infrastructure planning: demographics; urbanization/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. Civil engineering standards: Civil engineering drawings, Codes and good practices. The general planning and design process: scenario planning, task scheduling, multi-tasking, forecasting. Presentation of reports with relevant technical specifications; creative thinking techniques, engineering methodology; modelling; system analysis; decision-making. Environmental management: the role of the civil engineers in environmental problem solving; sustainable development; agenda 21 and global environmental issues and problems; our common future growth versus development; population growth dynamics; tragedy of the commons; environmental problems as externalities; government intervention in environmental problem solving; environmental quality criteria and standards; environmental laws and regulations; integrated pollution control. Systems approach: system dynamics and feedback loops; modelling environmental systems through life-cycle assessment, decision making strategies and the environment.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Correlate population growth with development trends
2. Apply the methodology used in infrastructure planning
3. Paraphrase physical infrastructure
4. Interpret civil engineering drawings
5. Elaborate on the role of civil engineers in environmental problem solving
6. Categorise planning and environmental laws and regulations

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 4)  
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)  
3. Eng Design (Course Outcomes 2)  
4. Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)  
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 5)  
6. Professional and Technical Communication (Course Outcome 3, 5)  
7. Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6)  
8. Individual, Team and Multidisciplinary Working (Course Outcomes 5, 6)  
9. Independent Learning Ability (Course Outcome 5)  
10. Engineering Professionalism (Course Outcomes 5, 6)  
11. Engineering Management (Course Outcomes 2, 5, 6)

Issue Date: September 2015  
Next Revision: TBD
Module Title: SURVEYING FOR ENGINEERS I  
Code: TCVE3642  
NQF Level: 6  
Contact Hours: 2L + 1T or 1PS/Week  
NQF Credits: 8  
Assessment: Continuous 100% (2 Tests (60%), 2 Field work reports (20%), 2 assignments (20%))  
Pre-requisite(s): TEGM3591 Engineering Mathematics I

Content: Introduction to surveying: theory of measurement errors; surveying instrumentation; observation and reduction of observations; levelling, taping and electronic distance measurement; setting out; 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: joins, polars; intersections; traverse; resections; triangulation; tri-lateration; tri-hghting; direction sheet; contouring and surface modelling software. Survey camp (1 week during holidays).

Learning Outcomes: Upon completion of this module, students should be able to:
1. Overview surveying and its applications to engineering
2. Distinguish the various techniques and tools used in practical surveying
3. Match GPS survey systems
4. Apply surveying calculations to an engineering problem
5. Interpret contour and surface modelling software in surveying exercises

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

Issue Date: September 2015  
Next Revision: TBD

Module Title: HIV AND AIDS EDUCATION  
Code: TEGT3602  
NQF Level: 5  
Contact Hours: 1L + 1T per week for 14 weeks  
NQF Credits: None  
Assessment: Continuous assessment 100% (3 Assignments and 1 report)  
Pre-requisite(s): None

Content: The Engineer and HIV: Basic facts of HIV and AIDS; Prevention, Counselling and Testing, and Treatment of HIV and AIDS; Drivers of the HIV and AIDS Epidemic in Namibia, The Engineering Sector and HIV and AIDS. Impact of HIV and AIDS: Socio-Economic Impacts on the workforce; Impact Assessment; HIV and AIDS cost benefit analysis. HIV and AIDS Mitigation: The Policy Environment; Design and Implementation of HIV and AIDS workplace programmes

Learning outcomes: Upon completion of the module students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

Issue Date: September 2016  
Next Revision: TBD
**Module Title:** STRENGTH OF MATERIALS II

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<tr>
<td>Assessment</td>
<td>Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 2 hour paper)</td>
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**Pre-requisite(s):** TEGT3592 Engineering Mechanics I

**Co-requisite(s):** TCVM3621 Strength of Materials I

**Content:**
- **Displacement of Beams – Geometric methods:** Double integration and Macaulay's methods; Moment-area method.
- **Displacement of structures – Work-energy methods:** Principle of conservation of energy; Strain energy due to axial force, bending, torsion, and shear; Method of real work; Principle of virtual work; Application of virtual work in the evaluation of displacements in beams, rigid frames, and trusses; Techniques for evaluation of virtual work integrals; Castigliano's theorems and application to the displacement of beams and frames; Maxwell's theorem of reciprocal deflection.
- **Stresses and strains in two and three dimensions:** Analysis of two and three-dimensional state of stress in structural systems; Transformation of stresses and strains; Principal stresses and maximum shear stresses; Analysis of two and three-dimensional state of strain; Mohr's circle.
- **Energy Theories:** Failure theories applied to structural elements.
- **Combined bending and direct stresses in structural members. Unsymmetrical bending and applications:** Shear stress in thin-walled open sections. Shear center. Creep, Fatigue, Fracture and stress concentration problems.

**Learning Outcomes:**
1. Evaluate displacements (deflections and slopes) of beams using geometric methods.
2. Determine displacements of beams, trusses and rigid frames using work-energy methods.
3. Analyse stresses and strains in two and three dimensions with cases of plane stress and plane strain.
4. Distinguish bending stresses in beams under symmetrical and unsymmetrical loading.
5. Solve problems involving shear stresses and shear flow in beams.
6. Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle.

**Contribution to Exit Level Outcome:**
- Problem Solving (Course Outcomes 1, 2, 3, 5, 6)
- Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
- Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 5, 6)

**Issue Date:** September 2015

**Next Revision:** TBD

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**Module Title:** INDUSTRIAL ATTACHMENT I

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<tr>
<td>NQF Level</td>
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<tr>
<td>Total Hours</td>
<td>Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week x 6 weeks = 180 hours.</td>
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<td>NQF Credits</td>
<td>Not assigned.</td>
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<tr>
<td>Assessment</td>
<td>The Module is required to be satisfactorily done before graduation.</td>
</tr>
<tr>
<td>Pre-requisite</td>
<td>Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).</td>
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**Content:**
- During Industrial Attachment I, students will work under company supervision at the level of an Artisan and will undertake at least six weeks of attachment to an appropriate industry for hands-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 workplace twice by their Lecturers.

**Learning Outcomes:**
1. Describe the organisational structure and the operational processes of the company or organisation
2. Describe in detail his/her contribution to the company during the internship

**Issue Date:** September 2015
YEAR 3 OF BSc IN CIVIL ENGINEERING

SEMESTER 1

| Module Title: EXPENDENTIAL AND RESEARCH METHODS |
|---|---|
| Code | TEGR3760 |
| NQF Level | 7 |
| Contact Hours | 2L + 1T or 1PS/Week |
| NQF Credits | 8 |
| Assessment | Continuous 100% (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%)) |
| Pre-requisite(s) | TEGS3661 Statistics for Engineers |

Content: Experimentation planning and execution. **Technical report writing.** Report structure and format. **Literature Review.** Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). **Research methodology.** Formulation and presentation of research proposals. **Statistical data analysis:** Data description: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. **Data modeling:** Experimental data modeling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination $R^2$ and adjusted $R^2$ and the role of adjusted $R^2$ on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

**Research Proposal:** During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

**Learning Outcomes:** On completing the course students should be able to:

1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an engineering research process
7. Propose an engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an engineering audience following specified guidelines

**CONTRIBUTION to Exit Level Outcome:**

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

**Issue Date:** September 2015
**Next Revision:** TBD
Module Title: FUNDAMENTALS OF ECONOMICS

Code: TEGT3761
NQF Level: 7
Contact Hours: 2L + 1T/Week
NQF Credits: 8
Assessment: Continuous 50% (4 assignments, 2 Tests); Examination 50% (1 x 2 hour paper)
Pre-requisite(s): None

Content: Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. Macroeconomics: inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. Financial accounting: nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. Introduction to budgeting, Introduction to marketing. Long and short-term decision making.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: TBD

Module Title: HYDROLOGY FOR ENGINEERS

Code: TCVD3741
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (assignments, 3 Tests); Examination 50% (1 x 2 hours paper)
Pre-requisite(s): TMEM3681 Fluid Mechanics

Content: Hydrological cycle: water resources, rainfall processes and data; the determination and measurement of evaporation and transpiration; Infiltration calculation and modelling; flood frequency determination and analysis, rational method, unit hydrograph analysis; time-area routing, reservoir routing, Muskingum routing, storage draft analysis; soil erosion and sediment production. Flow measurement: stream flow measurement and analysis, hydrological modelling

Learning Outcomes: Upon completion of this module, students should be able to:
1. Summarise the hydrological cycle and describe methods for determination of evaporation and transpiration
2. Distinguish modelling floods and measuring stream flow
3. Discuss the processes that lead to soil erosion and sediment production
4. Discuss methods for flow measurement and hydrological modelling

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcome 1)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 4, 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3, 4)
7 Sustainability and Impact of Eng Activity (Course Outcome 1, 3)

Issue Date: September 2015
Next Revision: TBD
**Module Title:** THEORY OF STRUCTURES  
**Code:** TCVS3791  
**NQF Level:** 7  
**Contact Hours:** 3L + 2T /Week  
**NQF Credits:** 12  
**Assessment:** Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hours paper)  
**Pre-requisite(s):** TCVM3621 Strength of Materials I  

Analysis of two-hinged parabolic arches. **Influence lines for statically determinate structures:** Influence lines for beams and trusses. **Influence lines for statically indeterminate structures:** Beams and frames; Mueller-Breslau’s principle. **Elastic instability:** Determination of critical loads of struts; Stability functions for axially loaded beams and frames. Southwell’s Plot for the determination of critical buckling parameters. **Analysis of plates and simple shells.** Introduction to matrix methods of structural analysis: Flexibility and stiffness methods. **Introduction to structural dynamics:** Dynamic analysis. **Limit state design philosophy:** Ultimate limit states (ULTS) and serviceability limit states (SLS) as applied to structural steelwork and reinforced concrete structures.  

**Learning Outcomes:** Upon completion of this module, students should be able to:  
1. Analyse elastic structures using classical methods  
2. Compare statically determinate and indeterminate structures using influence line diagrams  
3. Demonstrate knowledge of buckling of struts  
4. Use matrix methods of analysis in solving statically determinate and indeterminate structures  
5. Illustrate forces and stresses in beams, arches and trusses  
6. Discuss and compare plates and simple shells  
7. Use ULS and SLS design as applied to structural steelworks and concrete structures.  

**Contribution to Exit Level Outcome:**  
1 Problem Solving (Course Outcomes 1, 4, 7)  
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4, 6, 7)  
3 Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5, 7)  

**Issue Date:** September 2015  
**Next Revision:** TBD
Module Title: INFRASTRUCTURE PLANNING AND DESIGN II

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<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>7</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>2L + 1T/Week plus field trip</td>
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<tr>
<td>NQF Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (2 Tests (60%), 4 assignments (40%))</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TCVI3622 Infrastructure Planning and Design I</td>
</tr>
</tbody>
</table>

**Content:**

The general planning and design process: forecasting and evaluation techniques; system analysis; decision support and decision-making. **Environmental impact assessment:** environmental monitoring and auditing; environmental planning; environmental institutions, sources, characteristics and effects of environmental contaminants; environmental pollution and degradation in Southern Africa. **Computer application:** Introduction to Geographical Information Systems and application to infrastructure planning problems.

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Discuss the principles of forecasting and evaluation techniques
2. Discuss decision support and decision making processes
3. Explain techniques for environmental impact assessment
4. Categorize techniques and tools of remote sensing
5. Appraise computer applications for spatial analysis and evaluation (GIS)

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3. Eng Design (Course Outcome 1, 2, 3)
4. Investigations, Experiments and Data Analysis (Course Outcomes 4, 5)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)
6. Professional and Technical Communication (Course Outcome 1, 2, 3)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 2, 3)
8. Independent Learning Ability (Course Outcome 5)

**Issue Date:** September 2015
**Next Revision:** TBD
Module Title: GEO-TECHNICAL ENGINEERING

Code: TCVG3711
NQF Level: 7
Contact Hours: 4L + 2T or 1PS/Week or field trip
NQF Credits: 16
Assessment: Continuous 50% (assignments, 2 Tests, report); Examination 50% (1 x 3 hours paper)
Pre-requisite(s): TCVD3682 Soil Mechanics
Co- requisite(s): TMNE3621 Introduction to Engineering Geology


Learning Outcomes: On completing the course students should be able to:

1. Discuss properties and classification of soils and rocks
2. Illustrate parameters used to represent shear strength and bearing capacity of soils
3. Discuss the distribution of stresses in soils and rocks using elastic theory
4. Demonstrate design principles for foundations
5. Apply design principles of retaining walls with respect to respective earth pressures on structures

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 2, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 4, 5)
3. Eng Design (Course Outcome 3)
4. Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 4, 5)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 4, 5)

Issue Date: September 2015
Next Revision: TBD
## Module Title
CONSTRUCTION MANAGEMENT

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<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>7</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment:</td>
<td>Continuous 100% (2 Tests (50%); 2 Project reports (25%), 2 assignments (25%))</td>
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<tr>
<td>Pre-requisite(s):</td>
<td>None</td>
</tr>
</tbody>
</table>

**Content:** 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. Programming methods and work control: methods and quantitative tools used to effectively plan, organize, and control construction projects: PERT, CPM, project planning Grant’s diagram. Bill of quantities: Legislation for works contracts, tender document preparation, and tender evaluation. Interpreting Engineering Drawings: ability to convert engineering drawings into bill of quantities. Work safety, Quality control principles.

**Learning Outcomes:** On completing the course students should be able to:

1. Recall principles of construction management and work control
2. Identify basic concepts of construction estimating, planning and scheduling
3. Categorize tender documentation, preparation of bill of quantities, and tender evaluation
4. Integrate safety into project cost schedule and describe measures taken to ensure safety at work
5. Evaluate basic principles of quality control
6. Interpret engineering drawings

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 2, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4, 5, 6)
3. Eng Design (Course Outcome 4)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5, 6)
10. Engineering Professionalism (Course Outcomes 4, 5)
11. Engineering Management (Course Outcomes 1, 2, 3, 4, 5)

**Issue Date:** September 2015

**Next Revision:** TBD
**SEMESTER 2**

**Module Title:** HYDRAULICS AND HYDRO-ENGINEERING  
**Code:** TCVD3712  
**NQF Level:** 7  
**Contact Hours:** 4L + 2T or 1PS/Week  
**NQF Credits:** 16  
**Assessment:** Continuous 50% (assignments, 3 Tests), Examination 50% (1 x 3 hour paper)  
**Pre-requisite(s):** TEGT3641 Engineering Mechanics II and TMEM3681 Fluid Mechanics


**Learning Outcomes:** On completing the course students should be able to:

1. Illustrate fluid properties and applications of Bernoulli equation to fluids  
2. Distinguish the characteristics of laminar flow and turbulent flow in fluids  
3. Compare the flow characteristics in pipes and channels  
4. Analyse basic fluid machinery including systems with pumps and pipe networks  
5. Discuss basic features of pipeline network design  
6. Discuss basic principles of pump design  
7. Explain characteristics of flows over free surfaces, including flows in spillways and stilling basins  
8. Discuss the characteristics of flows under bridges and culverts  
9. Design common hydraulic structures such as culverts, dams, canals etc.

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)  
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 5, 6, 7, 8, 9)  
3. Eng Design (Course Outcome 5, 6, 9)  
4. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3, 4, 5, 6, 7, 9)

**Issue Date:** September 2015  
**Next Revision:** TBD
Module Title: URBAN WATER SYSTEMS

Code: TCVD3782
NQF Level: 7
Contact Hours: 3L + 2T or 1PS/Week or field trip
NQF Credits: 12
Assessment: Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TCVI3622 Infrastructure Planning I
Co-requisite: TVD3741 Hydrology for Engineers


Learning Outcomes: Upon completing the course students should be able to:

1. Outline water supply systems and codes pertaining to water supply.
2. Classify design and construction of water distribution networks.
4. Determining techniques and instrumentation for water quality control.
5. Summarise water quality control, quality assurance systems and leakage control.
6. Discuss design and analysis of urban drainage systems and networks
7. Outline computer simulations of water and wastewater networks

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3. Eng Design (Course Outcome 4, 5, 6, 7)
4. Investigations, Experiments and Data Analysis (Course Outcome 6, 7)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 5, 6, 7)
6. Sustainability and Impact of Eng Activity (Course Outcomes 3, 4, 5, 6)

Issue Date: September 2015
Next Revision: TBD
Module Title: REINFORCED AND PRE-STRESSED CONCRETE DESIGN

Code: TCVD3792  
NQF Level: 7  
Contact Hours: 3L + 2T/Week  
NQF Credits: 12  
Assessment: Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)  
Pre-requisite(s): TCVM3662 Strength of Materials II  
Co-requisite: TCVS3791 Theory of Structures


Introduction to pre-stressed concrete design, serviceability maximum stresses on pre-stressed steel bars, Loss of pre-stress force.

Learning Outcomes: On completing the course students should be able to:

1. Carry out stress analysis of steel-reinforced concrete elements
2. Apply design codes for steel-reinforced concrete structures
3. Apply limit state philosophy to the design of reinforced concrete structures
4. Formulate characteristic and design features of common structural members
5. Use computational software packages in the analysis and design of reinforced concrete elements
6. Solve general principles of design of pre-stressed concrete 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 2, 3, 4, 5, 6)
3. Eng Design (Course Outcomes 2, 3, 4, 5, 6)
4. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5, 6)

Issue Date: September 2015  
Next Revision: TBD

Module Title: DESIGN OF STEEL AND TIMBER STRUCTURES

Code: TCVS3762  
NQF Level: 7  
Contact Hours: 2L + 1T/Week  
NQF Credits: 8  
Assessment: Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 2 hours paper)  
Pre-requisite(s): TCVM3662 Strength of Materials II  
Co-requisite: TCVS3791 Theory of Structures


Learning Outcomes: On completing the course students should be able to:

1. Recognize design features for steel structures and timber structures
2. Discuss the limit-state design of structural steel members
3. Design structural steel and timber elements, and their connections and joints

Contribution to Exit Level Outcome:

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

Issue Date: September 2015  
Next Revision: TBD
Module Title: TRANSPORT PLANNING AND TRAFFIC ENGINEERING

Code: TCVT3792  
NQF Level: 7  
Contact Hours: 3L + 2T/Week + field trip  
NQF Credits: 12  
Assessment: Continuous 50% (Project assignments with report, 2 Tests); Examination 50% (1 x 3 hours paper)  
Co-requisite(s): TCVI3622 Infrastructure Planning and Design I

Contents: Transportation and Network Planning: Transport planning process and transport modelling. Road Safety Management: Black spots management, Road safety inspection, Road safety audits. Traffic Engineering: traffic flow theory and traffic data collection. Transport policy and the decision maker. Capacity of junctions, planning of traffic lights; computer applications for traffic simulation. Transport Economy. Supply and demand; measuring and estimating demand; social and environmental impacts; planning of transportation systems; characteristics of transportation modes; interaction between modes; mode interfaces; transportation technology; economics; public policy, implementation and management

Learning Outcomes: On completing the course students should be able to:

1. Apply transportation engineering principles for streets and highways with emphasis on the safe and efficient operation of roadway intersections
2. Discuss road traffic and transport planning
3. Correlate road safety management with traffic engineering
4. Discuss main features of transport economy.
5. Illustrate quantitative and computerized techniques for planning, designing, and operating transportation systems.

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 2, 3, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4)
3. Eng Design (Course Outcomes 1, 3, 5)
4. Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 5)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3, 5)
6. Sustainability and Impact of Eng Activity (Course Outcomes 2, 4)

Issue Date: September 2015  
Next Revision: TBD
Module Title: ENTREPRENEURSHIP

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<th>Code</th>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T/Week</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% [2 Tests (50%); 2 Reports (25%); At least 2 Assignments (25%)]</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3761 Fundamentals of Economics</td>
</tr>
</tbody>
</table>


Learning Outcomes: On completing the course students should be able to:

1. Discuss the concept of entrepreneurship and important parameters that characterize a good entrepreneur
2. Distinguish the methods used to carry out feasibility studies
3. Separate the concepts of motivation, competencies, innovation and product marketing
4. Relate the procedure used when starting a new venture including conceptualization, planning, financing, operations, accounting and marketing strategies
5. Differentiate between the various business management functions within an organisation

Contribution to Exit Level Outcome:

7    Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11   Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: TBD
Module Title: INDUSTRIAL ATTACHMENT II

<table>
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<th>Code</th>
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<td>NQF Level</td>
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<tr>
<td>Total Hours</td>
<td>Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.</td>
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<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).</td>
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<tr>
<td>Co-requisite</td>
<td>TEGT3600 Industrial Attachment I</td>
</tr>
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Module Description: During Industrial Attachment II, students will work under company supervision at the level of Technologist Trainee and will undertake at least six weeks of attachment at an appropriate industry for hands-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. 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 technologists and technicians in an industrial setting and identify the associated reporting channels.
2. Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
3. Describe the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: TBD
YEAR 4 OF BSc IN CIVIL ENGINEERING

SEMESTER 1

<table>
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<th>Module Title:</th>
<th>SOCIETY AND THE ENGINEER</th>
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<tr>
<td>Code</td>
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<tr>
<td>NQF Level</td>
<td>8</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T/Week plus field trip</td>
</tr>
<tr>
<td>Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3742 Entrepreneurship</td>
</tr>
</tbody>
</table>

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:

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 constitute 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.

Issue Date: September 2015
Next Revision: TBD
Module Title: PROJECT MANAGEMENT

<table>
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<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>8</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 1T/Week</td>
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<tr>
<td>NQF Credits</td>
<td>12</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (1 Group project plus presentation, 2 Tests, 4 assignments/case studies)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3761 Fundamentals of Economics</td>
</tr>
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</table>

**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:**

<table>
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<tr>
<th>Course Outcome</th>
<th>Description</th>
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<tr>
<td>5</td>
<td>Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)</td>
</tr>
<tr>
<td>8</td>
<td>Individual, Team and multi-discipline Working (Course Outcomes 7)</td>
</tr>
<tr>
<td>11</td>
<td>Engineering Management (Course Outcomes 1, 3, 4, 5, 7)</td>
</tr>
</tbody>
</table>

**ECN Exit Level Outcomes Assessed:**

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING</td>
</tr>
<tr>
<td></td>
<td>Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments</td>
</tr>
<tr>
<td>11</td>
<td>ENGINEERING MANAGEMENT</td>
</tr>
<tr>
<td></td>
<td>Demonstrate knowledge and understanding of engineering management principles and economic decision-making</td>
</tr>
</tbody>
</table>

**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 work 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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: TBD
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>STRUCTURAL ENGINEERING</th>
</tr>
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<tbody>
<tr>
<td>Code</td>
<td>TCVS3811</td>
</tr>
<tr>
<td>NQF Level</td>
<td>8</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>4L + 1T/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>16</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50% (assignments, 2 Tests) making 30%, presentation (10%) and report (10%); Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TCVS3761 Design of Steel and Timber Structures and TCVC3792 Reinforced and Pre-stressed Concrete Design</td>
</tr>
</tbody>
</table>


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)
4. 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 constitute 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 Knowledge” 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)

Issue Date: September 2015
Next Revision: TBD
Module Title: RAILWAYS AND PUBLIC TRANSPORT SYSTEMS

Code TCVD3881
NQF Level 8
Contact Hours 3L + 1T or 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


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 understanding of 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)

Issue Date: September 2015
Next Revision: TBD
Module title: WASTE WATER AND SOLID WASTE MANAGEMENT

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>8</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>12</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (assignments, 2 Tests) making 30%, presentation (10%) and report (10%); Examination 50% (1 x 3 hours paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TCVI3622 Infrastructure Planning and Design I</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TCVD3782 Urban Water Systems</td>
</tr>
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</table>

**Content:**


**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.
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)
4. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 4, 5, 6)
5. 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**

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 wastewater (10%), all together 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 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 constitute 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.

Issue date: September 2015
Next Revision: TBD
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 a 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 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.

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 constitute 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 constitute 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 constitute 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?**

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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.

**Issue Date:** September 2015  
**Next Revision:** TBD

<table>
<thead>
<tr>
<th>Module Title:</th>
<th>CIVIL ENGINEERING DESIGN PROJECT</th>
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<tbody>
<tr>
<td>Code</td>
<td>TCVD3890</td>
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<tr>
<td>NQF Level</td>
<td>8</td>
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<tr>
<td>Contact Hours</td>
<td>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</td>
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<tr>
<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>All third year modules</td>
</tr>
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</table>

**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:

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 solution(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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: TBD
## Module Title:
**INDUSTRIAL ATTACHMENT III**

<table>
<thead>
<tr>
<th>Code</th>
<th>TEGT3800</th>
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<tbody>
<tr>
<td>NQF Level</td>
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<tr>
<td>Total Hours</td>
<td>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.</td>
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<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
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<tr>
<td>Assessment</td>
<td>100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3700 Industrial Attachment II</td>
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**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 hands-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.

**Issue Date:** September 2015

**Next Revision:** TBD
G.7. 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, Complementary Studies and design and analysis.

G.8. CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Electronics Computer 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 BSc IN ELECTRONICS AND COMPUTER ENGINEERING – 160 Credits

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
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<th>NQF CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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<tr>
<td>1</td>
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<td>TEGM3591</td>
<td>5</td>
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<td>1</td>
<td>Engineering Drawing</td>
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<tr>
<td>1</td>
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<td>SPHY3511</td>
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<td>16</td>
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<tr>
<td>1</td>
<td>Computing Fundamentals</td>
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<td>5</td>
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<td>1</td>
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<td>1</td>
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Total Credits Semester I 80

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<tr>
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<td>Fundamentals of Electrical Engineering</td>
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Total Credit Semester II 84

NB: Students who have done UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512 and SCHM3512 will be exempted from taking them in this year.
### YEAR 2 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 144 Credits

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<tr>
<th>SEMESTER</th>
<th>MODULE</th>
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<tr>
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<tr>
<td>1</td>
<td>Statistics for Engineers</td>
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<tr>
<td>1</td>
<td>Electric Circuit Analysis I</td>
<td>TECE3691</td>
<td>6</td>
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<tr>
<td>1</td>
<td>Analogue Electronics I</td>
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<td>Measurements and Instrumentation</td>
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YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

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<tr>
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<td>Telecommunication Principles</td>
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YEAR 4 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

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<tr>
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<td>Society and the Engineer</td>
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YEAR 4 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

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<tr>
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<td>Research Project</td>
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<td>All 3rd Year Modules</td>
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TOTAL CREDITS FOR THE BSc IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS) 584
G.9. DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

YEAR 1 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS I</th>
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<tr>
<td>Code</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous (Quiz (30%), 2 Tests (70%) ) 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</tbody>
</table>


Learning Outcomes: Upon completion of this module, students should be able to:
1. Solve basic mathematics and engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to engineering
4. Apply trigonometry in solving mathematical and engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
6. Solve mathematical and engineering problems using partial differentiation

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2 and 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING DRAWING

Code: TEGT3561
NQF Level: 5
Contact Hours: 2L + 2T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 100% (minimum of 2 tests and 4 drawing assignments)
Pre-requisite(s): None


Learning Outcomes: Upon completion of this 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 drawings and assembly drawings of various engineering components

Contribution to Exit Level Outcome:
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
6 Professional and Technical Comm (Course Outcomes 2, 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title: PHYSICS FOR PHYSICAL SCIENCES I

Code: SPHY3511
NQF level: 5
Contact hours: 4L + 2T or 1 PS/Week
NQF Credits: 16
Assessment: Continuous assessment 50% (minimum 2 tests and 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper).
Pre-requisite(s): None

Contents: Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton’s laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler’s laws; pressure; Archimedes’ principle; laminar flow; Bernoulli’s equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

Learning Outcomes: Upon completion of the module, the student is expected to:
1. Employ units, do unit conversions and use of significant figures.
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.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4 Investigations, Experiments and Data Analysis (Course Outcome 9)

Issue Date: September 2015
Next Revision: September 2019
Module Title: COMPUTING FUNDAMENTALS

<table>
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<th>Code</th>
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<tbody>
<tr>
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<tr>
<td>Contact Hours</td>
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<tr>
<td>Assessment</td>
<td>Continuous assessment (At least 2 Tests, 4 Assignments and 2 Practicals Reports) 50%, written examination (1x2 hour paper) 50%</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</tbody>
</table>


Learning Outcomes: Upon completion of this module, students should be able to:
1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

CONTRIBUTION to Exit Level Outcome
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title: WORKSHOP PRACTICE

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<tr>
<td>Assessment</td>
<td>Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>


Learning Outcomes: Upon completion of this course, students should be able to:
1. Describe general safety procedures applicable to engineering workshops.
2. Describe specific hand tools used in engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of 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.
10. Install air-conditioning and refrigeration systems

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

Issue Date: September 2015
Next Revision: September 2019
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. **Behaviour of Materials in Service:** Fatigue, Creep and Corrosion.

**Learning Outcomes:** On completing the course students should be able to:
1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
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. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

**Contribution to Exit Level Outcome:**
1. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
4. Investigations, Experiments and Data Analysis (Course Outcomes 6)
Module Title: Contemporary Social Issues

Module Code: UCSI3580
NQF Level: 5
Contact Hours: 1 Contact hour per week for 28 weeks
Credits: 8
Assessment: Continuous Assessment (100%). A variety of assessments which evaluate and test the students’ individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.

Prerequisite: None

Module Descriptor: The module, Contemporary Social Issues (CSI3580), is designed to encourage behavioral change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well-rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional, and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning, and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real-life situations of case studies and practical exercises that draw attention to social issues that attract ongoing political, public, and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions, and class participation.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Identify social issues affecting the Namibian society
2. Describe the characteristics of these issues and design a plan of action
3. Assess the challenges facing the society in a multi-cultural, multi-faith, and secular setting
4. Develop respect for humanity, nature, and cosmos
5. Describe the physical-medical aspects of HIV/AIDS
6. Demonstrate knowledge of social factors that can contribute towards the spread of HIV/AIDS
7. HIV/AIDS relationships; Social conditions; Attitudes; Cultural influences; Myths about HIV/AIDS
8. Explain behavior change towards HIV/AIDS
9. Construct HIV/AIDS prevention strategies, continuum of care and support among students
10. Identify with, and use gender concepts with ease
11. Utilize gender-sensitive language and live a life that reflects gender exposure
12. Reflect on gender relations between women and men in society, and the impact on society
13. Reduce gender stereotypes in their home and community at large
14. Examine the impact of gender unequal relations on the spread of HIV/AIDS, gender-based violence, myths, stereotypes and believes about males and females, resource distribution, the education system and many other issues that affect society and community at large

Contribution to Exit Level Outcome:

10 Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

Issue Date: September 2015
Next Revision: September 2019

Module Title: Fundamentals of Engineering

Module Code: TEGT3521
NQF Level: 5
Contact Hours: 2L + 1T or 1 PS/Week
NQF Credits: 8
Assessment: Continuous assessment 100% (Quizzes - 10%, Assignments - 20%, course project and presentation - 30%, Test - 40%)

Co-requisite(s): None

Plagiarism, Settling Conflicts, Moral theories and The Ethical Engineer. **Engineering tools:** Presentation software, Internet as a research tool, Computational tools – Microsoft Excel. **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.

**Learning Outcomes:** On completing the course students should be able to:
1. Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
2. Describe the various branches of engineering, possible careers, and job prospects
3. Describe how to solve basic engineering problems
4. Identify general steps involved in engineering design and communication
5. Use modern engineering and communication tools and procedures.

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

**Issue Date:** September 2015
**Next Revision:** September 2019
SEMESTER 2

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS II</th>
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<tbody>
<tr>
<td>Code</td>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous (Quiz (30%), 2 Tests (70%) ) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
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</table>


Learning Outcomes: Upon completion of this 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. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and engineering problems

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6)

Issue Date: September 2015
Next Revision: September 2019

<table>
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<tr>
<th>Module Title</th>
<th>FUNDAMENTALS OF ELECTRICAL ENGINEERING</th>
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<tbody>
<tr>
<td>Code</td>
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<td>Contact Hours</td>
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<tr>
<td>Assessment</td>
<td>Continuous Assessment 100% (at least 2 tests - 60%, 2 quizzes - 20%) and 2 practical labs – 20%</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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Learning Outcomes: Upon completion of this 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 Ohm’s law, Kirchhoff’s current and voltage laws, current and voltage division laws, superposition theorem, Norton’s and Thevenin’s theorems for problem solving
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

Contribution to Exit Level Outcome:
Module Title: PHYSICS FOR PHYSICAL SCIENCES II

Code: SPHY3512
NQF Level: 5
Contact Hours: 4L + 2T or 1 PS/Week
NQF Credits: 16
Assessment: Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)
Co-requisite(s): SPHY3511 Physics for Physical Sciences I

Contents: Electric charge; insulators and conductors; Electric force and coulomb’s law, Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm’s law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

Learning Outcomes: Upon completion of this 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.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcome 4)

Module Title: ENGINEERING MECHANICS I

Code: TEGT3592
NQF Level: 5
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous (4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 3 hour paper) 50%
Co-requisite(s): SPHY3511 Physics for physical Sciences I


Learning Outcomes: Upon completion of this 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

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1-6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)
Module Title: CHEMISTRY 1B

Code SCHM3512
NQF Level 5
Contact Hours 4L + 2T or 1PS/Week
NQF Credits 16
Assessment Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports). Examination 50% (1 x 3 hour paper)

Pre-requisite(s) None

Content: Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid–Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Explain and use the gas laws
2. Discuss energy changes in chemical reactions
3. Analyse the rates of chemical reactions.
4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
5. Distinguish between the three laws of thermodynamics
7. Demonstrate an understanding of how galvanic cells work.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019
<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGLISH FOR ACADEMIC PURPOSES</th>
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<tbody>
<tr>
<td>Code</td>
<td>ULEA 3519</td>
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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Continuous: 60% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper) Examination: (40%) made up of 1 x 3 hour examination paper</td>
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<td>Pre-requisite(s)</td>
<td>ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE</td>
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</tbody>
</table>

**Content:** Structure of materials: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

**Learning outcomes:** Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

**Contribution to Exit Level Outcome:**
6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
9 Independent Learning Ability (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
YEAR 2 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

SEMESTER 1

<table>
<thead>
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<th>Module Title:</th>
<th>ENGINEERING MATHEMATICS III</th>
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<tr>
<td>Code</td>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)</td>
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<td>Co-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3951 Engineering Mathematics I</td>
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</table>


Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply differential vector calculus to solve mathematical and engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving engineering problems
4. Apply the power series method in approximation of solutions of ordinary differential equations
5. Describe the basis for complex analysis in engineering problem solving
6. Apply the residual theorem to engineering problems.

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, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 6)

Module Title: COMPUTER SCIENCE FOR ENGINEERS

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<th>Code</th>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
</tbody>
</table>


Learning Outcomes: On completing the course students should be able to:
1. Develop algorithms and apply data structures in computer programs.
2. Apply binary trees to specific programming environment
3. Write programs in MATLAB or equivalent software employing user defined and built in functions.
4. Apply MATLAB (or equivalent software) programming in solving engineering problems
5. Write simple C programs

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING MECHANICS II

Code: TEGT3641
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous (4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 2 hour paper) 50%
Co-requisite(s): TEGT3592 Engineering Mechanics I


Learning Outcomes: On completing the course 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. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, 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. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 3, 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 6, 7)

Issue Date: September 2015
Next Revision: September 2019

Module Title: STATISTICS FOR ENGINEERS

Code: TEGS3661
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous (at least 4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 2 hour paper) 50%
Pre-requisite(s): TEGM3591 Engineering Mathematics I

Contents: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; Sampling Distributions: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; Linear Regression and Correlation: Simple and Multiple Linear Regression, Correlation; Analysis of Variance: Completely Randomized and Randomized Block Designs, Multiple Comparisons;

Learning Outcomes: On completing the course students should be able to:
1. Describe the theory of probability
2. Analyse data using probability distribution and densities
3. Use the principles of sampling distribution to analyse data
4. Apply linear regression and correlation to a set of data
5. Apply analysis of variance to solve engineering problems

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

Issue Date: September 2015
Next Revision: September 2019
Module Title: ELECTRIC CIRCUIT ANALYSIS I

Code: TECE3691
NQF Level: 6
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (Assignments, At least 2 Tests), Examination 50% (1 x 3 hour paper)
Co-requisite(s): TEGT3542 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin's and Nortons theorems, superposition theorem, concept of input and output resistance of network, single port networks, two-port networks, KCL, KVL, electric power, energy sources, sources transformations, power transfer, maximum power transfer, current and voltage divider theorems, Mesh and Node analysis; D.C. power supplies and their industrial use. Sinusoidal Steady State Analysis: AC. behavior in R, L and C elements. Phasor analysis with complex algebra, two terminal networks - impedance, admitance susceptance and their real and imaginary parts. Resonance: series and parallel resonance, half power points, bandwidth, Power: instantaneous, average, power factor, active, reactive, complex, apparent power, Power triangle and power factor correction. A.C. Circuit Analysis of Simple Networks: Circuit theorems under a.c. conditions; Thevenin, Norton, and superposition theorems; KVL, KCL, loop/mesh and node analysis, maximum power transfer. Transient Analysis: Analysis of first order LR and RC circuits subjected to excitation of D.C., square pulse, sinusoidal sources and exponential sources. Interpretation of complementary function and particular integral. Analysis of second order RLC circuit subjected to step input and sinusoidal input. Frequency Response Curves: Resonance, series and parallel resonance, the concept of Q-factor, tuned circuits’ frequency selective networks mutually-couple circuits. Computer simulation tools. Three Phase Circuits: Concept of three-phase supply, phase diagrams for 3-phase circuits, balanced 3-phase supply, star and delta circuits, analysis of simple balance 3-phase circuits, power in three-phase circuits power measurement in three phase circuits. Computer circuit analysis and simulation

Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply circuit
2. Apply circuit theorems to simplify and find solutions to electrical circuits.
3. Interpret, develop and design electrical engineering circuits
4. Use computer simulation tools for electric circuit analysis and design
5. Perform DC and AC power calculations including power factor correction;
6. Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
7. Analyze, simulate, and experimentally validate DC and AC circuits;

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)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3)

Issue Date: September 2015
Next Revision: September 2019
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<tr>
<th>Module Title</th>
<th>ANALOGUE ELECTRONICS I</th>
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<tbody>
<tr>
<td>Code</td>
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<td>Assessment</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3542, Fundamentals of Electrical Engineering</td>
</tr>
</tbody>
</table>

**Content:** Semiconductor theory, Diodes: construction, diode applications (including power supplies), Bipolar Junction Transistors (BJTs): structure, operation, biasing and ac modelling, Field Effect Transistors (FET): structure, operation, biasing and introduction to amplification and switching. OP-Amps: internal structure, ideal and practical op-amps, specifications, and basic applications. Analysis of electronic circuits using Electronic Design Automation (EDA) software.

**Learning Outcomes:** On completing the course 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 BJT transistors
5. Analyse and design BJT transistor amplifier and switching circuits
6. Discuss the construction of FET transistors
7. Analyse and design FET biasing circuits
8. Discuss the internal circuitry for op-amps
9. Discuss the operation of op-amps
10. Analyse and design basic op-amp circuits
11. Use EDA software to analyse electronic circuits.

**Contribution to Exit Level Outcome:**
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 6, 8, 9)
3 Engineering Design (Course Outcomes 3, 5, 7, 10)
4 Investigations, Experiments and Data Analysis (Course Outcomes 10)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 11)

**Issue Date:** September 2015
**Next Revision:** September 2019
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<th>Module Title</th>
<th>SOFTWARE ENGINEERING</th>
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<tr>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (at least 2 Assignments – 20%, at least 2 Tests 50 %, mini project - 30%)</td>
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<tr>
<td>Prerequisite(s)</td>
<td>TCME3621 Computer Science for Engineers</td>
</tr>
</tbody>
</table>

Content: Preliminaries: Software- Problems and prospects; Tasks of software development; Feasibility study; Requirements engineering. Design: User interface design; Modularity; Structured programming; Functional decomposition; Data flow design; Data structure design; Object-oriented design; design patterns; Refactoring. Programming Languages: Basics of Programming; Basic understanding of object-oriented programming; Programming in the large; Software robustness; Scripting Process Models: The waterfall model; The spiral model; Prototyping; Incremental development; Open source software development; Agile methods and extreme programming; The unified process. Project Management: Teams; Software metrics and quality assurance; Project management.

Learning Outcomes: On completing the course students should be able to:
1. Apply appropriate techniques in software design.
2. Plan and deliver an effective software engineering process.
3. Capture, document and analyse requirements.
4. Translate requirements into an implementable design, following a structured and organized process.
5. Make effective use of UML, along with design strategies such as defining software architecture.
6. Work on a mini project within a group.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 2)
2. Engineering Design (Course Outcomes 1, 4)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 5)
4. Professional and Technical Communication (Course Outcomes 3)
5. Individual, Team and Multidisciplinary Working (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019
### SEMESTER 2

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<th>Module Title:</th>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
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<td>Co-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
</tr>
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<td>Pre-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
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**Learning Outcomes:** On completing the course students should be able to:

1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green’s theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications.

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
<table>
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<th>Module Title</th>
<th>APPLIED ELECTROMAGNETICS</th>
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<td>Assessment</td>
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<td>Pre-requisite(s)</td>
<td>SPHY3512 Physics for Physical Sciences II</td>
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<tr>
<td>Learning Outcomes:</td>
<td>On completing the course students should be able to:</td>
</tr>
<tr>
<td>1. Perform calculations involving electric and magnetic fields</td>
<td></td>
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<tr>
<td>2. Describe how energy is stored in electric and magnetic fields</td>
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<tr>
<td>3. Explain the theories and applications of electromagnetic fields and waves in material space</td>
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<tr>
<td>4. Explain the physical meaning and significance of Maxwell’s equations;</td>
<td></td>
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<tr>
<td>5. Describe electromagnetic time varying fields and waves, and their implications in modern communication systems</td>
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<tr>
<td>6. Derive and apply equations related to static electromagnetic fields in material space</td>
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<tr>
<td>Contribution to Exit Level Outcome:</td>
<td>2 Application of Scientific and Engineering Knowledge (Course Outcomes 6, 7)</td>
</tr>
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| Issue Date:       | September 2015 |
| Next Revision:   | September 2019 |

<table>
<thead>
<tr>
<th>Module Title</th>
<th>SIGNALS AND SYSTEMS</th>
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<tbody>
<tr>
<td>Code</td>
<td>TTCE3692</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
</tr>
<tr>
<td>Content: Classification of signals, Representation of signals, Signal Parameters, Signal operations, Fourier series, Fourier transforms, Laplace transforms. Classification of systems, System description and parameters. Convolution, Filter design (FIR and IIR Filters). Computer simulation software (e.g. MATLAB or equivalent).</td>
<td></td>
</tr>
<tr>
<td>Learning Outcomes:</td>
<td>On completing the course students should be able to:</td>
</tr>
<tr>
<td>1. Describe the characteristics of common signals types and systems</td>
<td></td>
</tr>
<tr>
<td>2. Discuss the operation and application of linear systems.</td>
<td></td>
</tr>
<tr>
<td>3. Apply transformation techniques and various analysis approaches to work out the response of a linear system to any input signal.</td>
<td></td>
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<tr>
<td>4. Design filters.</td>
<td></td>
</tr>
<tr>
<td>5. Carry out computer based simulations related to signals and systems.</td>
<td></td>
</tr>
<tr>
<td>Contribution to Exit Level Outcome:</td>
<td>2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)</td>
</tr>
<tr>
<td></td>
<td>5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 5)</td>
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| Issue Date:       | September 2015 |
| Next Revision:   | September 2019 |
Module Title: MEASUREMENTS AND INSTRUMENTATION

<table>
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<td>NQF Level</td>
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<td>Contact Hours</td>
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<tr>
<td>Assessment</td>
<td>Continuous (at least 2 Assignments – 20%, at least 2 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 2 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3542 Fundamentals of Electrical Engineering</td>
</tr>
</tbody>
</table>

Contents: Systems of Units and Standards of Measurement, Elements of generalized measurement system, Functional elements of an instrument, Static characteristics (Accuracy, Precision, Error, Sensitivity, Reproducibility, and Tolerance) Dynamic characteristics (Speed of response, Fidelity, Lag, dynamic error). Instrument classification, Methods of Measurement, Calibration, Noise, interference and grounding, Sources of Errors and types of Errors, Digital and analogue Instruments, Bridge measurement (Wheatstone, Kelvin, Maxwell etc.), Measurements of electrical and non-electrical quantities (including high frequency signals), Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Introduction to Programmable Logic Controllers (PLCs).

Learning Outcomes: On completing the course students should be able to:
1. Explain different types and methods of measurements.
2. Describe static and dynamic characteristics of an instrument.
3. Explain the importance of signal generators and signal analysers in measurements.
4. Classify, calculate errors and reduce them in measurements.
5. Describe the concept of instrument calibration.
6. Explain the use of sensors and transducers.
7. Practically measure different quantities (including high frequency signals), analyse and interpret the measurement results.
8. Describe the architecture and operation of PLCs.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 7)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019
<table>
<thead>
<tr>
<th>Module Title</th>
<th>DIGITAL ELECTRONICS</th>
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<tr>
<td><strong>Contact Hours</strong></td>
<td>3L + 2T or 1PS/Week</td>
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<tr>
<td><strong>NQF Credits</strong></td>
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<td><strong>Assessment</strong></td>
<td>Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td><strong>Co-requisite(s)</strong></td>
<td>TETE3691 Analogue Electronics I</td>
</tr>
</tbody>
</table>

**Content:** 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). Sequential Logic: latches flip-flops, counters, shift registers. Design of Digital Systems. Logic gate circuitry: TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

**Learning Outcomes:** On completing the course 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 logic circuits
6. Analyse and design sequential logic circuits
7. Compare the performance of different logic family devices
8. Discuss and analyse the internal circuitry of different logic family technologies.
9. Design interfaces between circuits of different logic families.

**Contribution to Exit Level Outcome:**
1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 8)
2. Engineering Design (Course Outcomes 5, 6, 9)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
**Module Title**: COMPUTER PROGRAMMING

**Code**: TCMS3692

**NQF Level**: 6

**Contact Hours**: 3L + 2T or 1PS/Week

**NQF Credits**: 12

**Assessment**: Continuous 100% (At least 2 Tests 50%, At least 4 Labs and Assignments 20%, Mini Project 30%)

**Co-requisite(s)**: TCME3621 Computer Science for Engineers

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**Content: Problem Solution and Software Development**: Top-down stepwise refinement approach. **Structured Programming**: variables and constants; comments, input and output and file management. Elements of data structures. **C Declarations, Expressions and Operators**: Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Enums and Structs. **Selection Structures**. Using if statements; the Nested if; the switch statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Structures**. The while loop; Writing typical Loops; The for Loop; Nested Loops; Using Loops with Structure Fields. **Arrays, Strings, and Pointers**. Arrays; Storing Values in Arrays; Accessing and Using Array Values; Creating Arrays of Structure Objects; Using Strings; Pointers in C. The **C Functions**. Functions definition; Functions declaration; Functions calling; Functions arguments; Recursion and Recursive Functions to Sort a List. **Object Oriented Programming: Classes**. Creating Classes; Encapsulating Class Components; Implementing Class Functions; Using Static Class Members; Polymorphism. **Advanced Topics**: Class Features and Design Issues; Friends and Overloading Operators; Overloading Functions; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; Using Enumerators.

**Learning Outcomes**: On completing the course students should be able to:

1. Apply problem solving techniques to computational and engineering problems.
2. Design and present algorithms for solving given problems using flowchart or pseudo code.
3. Develop structured programs in C programming language.
4. Use pointers effectively.
5. Describe concept of object-oriented programming.
6. Work with object oriented concepts and terminologies such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
7. Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6, 7)
3. Engineering Design (Course Outcomes 2, 3)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 3, 4, 7)
5. Professional and Technical Communication (Course Outcomes 7)

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**Issue Date**: September 2015

**Next Revision**: September 2019
Module Title: HIV AND AIDS EDUCATION

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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
<td>Continuous assessment 100% (3 Assignments and 1 report)</td>
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<td>Co-requisite(s)</td>
<td>None</td>
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</table>


Learning Outcomes: On completing the course students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

New: September 2016
Next Revision: September 2020

Module Title: INDUSTRIAL ATTACHMENT I

<table>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Total Hours</td>
<td>Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week x 6 weeks = 180 hours.</td>
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<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).</td>
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<tr>
<td>Pre-requisite</td>
<td>TEGW3590 Workshop Practice</td>
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Module Description: During Industrial Attachment I, students will work under company supervision at the level of Technician 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 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. Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
2. Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
3. Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Issue Date: September 2015
Next Revision: September 2019
YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

Module Title: EXPERIMENTAL AND RESEARCH METHODS

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<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%))</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>EGS3661 Statistics for Engineers</td>
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</table>

Content: Experimentation planning and execution. Technical report writing. Report structure and format. Literature Review: Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). Research methodology. Formulation and presentation of research proposals. Statistical data analysis: Data description: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. Data modeling: Experimental data modeling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination $R^2$ and adjusted $R^2$ and the role of adjusted $R^2$ on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

Research Proposal: During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

Learning Outcomes: On completing the course students should be able to:
1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an engineering research process
7. Propose an engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an engineering audience following specified guidelines

Contribution to Exit Level Outcome:
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

Issue Date: September 2015
Next Revision: September 2019
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>FUNDAMENTALS OF ECONOMICS</th>
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<tr>
<td>Code</td>
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<td>Contact Hours</td>
<td>2L + 1T/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (4 Assignments, 2 Tests); Examination 50% (1 x 2 hour paper)</td>
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<td>Pre-requisite(s)</td>
<td>None</td>
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</table>

Content: Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. Macroeconomics: inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. Financial accounting: nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. Introduction to budgeting, Introduction to marketing. Long and short-term decision making.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ELECTRIC CIRCUIT ANALYSIS II

<table>
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<th>Code</th>
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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
<td>Continuous (2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)</td>
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<td>Co-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TECE3691 Electric Circuit Analysis I</td>
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Learning Outcomes: On completing the course students should be able to:
1. Use principles and methods of analysis and modelling of electric circuits in the steady state.
2. Use of Laplace transformation and bode plots in circuit analysis
3. Apply the concepts of frequency response, resonance, and network functions.
4. Analyse and solve two port networks using different parameters
5. Synthesise network circuits to meet specifications

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title: ANALOGUE ELECTRONICS II

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<td>NQF Credits</td>
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<td>Assessment</td>
<td>Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TETE3691 Analogue Electronics I</td>
</tr>
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</table>

Contents: FET ac modelling, Frequency response of transistor circuits. Op-Amp Applications (including summing amplifiers, controlled sources, differential amplifiers, active filters etc). Power Amplifiers, ADC and DAC circuits, Oscillator Circuits (including VCOs, PLL, 555 timer based circuits, feedback transistor based oscillator circuits including high frequency circuits design principles), Power Supplies, Power electronics devices and applications.

Learning Outcomes: On completing the course students should be able to:
1. Model and analyse FETs based circuits
2. Determine the frequency response of transistor based circuits
3. Analyse and design op-amp and circuits
4. Analyse and design different op-amp based circuits
5. Analyse and design power amplifiers
6. Analyse and design filter circuits
7. Analyse and design oscillator circuits
8. Analyse and design ADC and DAC circuits
9. Analyse and design switching circuits employing basic power electronics components

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcome 1)
3 Engineering Design (Course Outcomes 3 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2)

Issue Date: September 2015
Next Revision: September 2019
**Module Title**: TELECOMMUNICATION PRINCIPLES

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<tr>
<td>Assessment</td>
<td>Continuous (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TTCE3692 Signals and Systems</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3542 Fundamentals of Electrical Engineering</td>
</tr>
</tbody>
</table>

**Content**: Review of signal models and analysis: Periodic and non-periodic signals; transform theorems and power spectra. Basic notions and definitions: Bandwidth, Baseband, Broadband, Narrowband and Wideband, Full vs. Half Duplex, Analogue vs. Digital transmission, Connection Oriented vs. Connectionless Communication, Circuit Switching vs. Packet Switching, Switching vs. Routing, Local Area vs. Wide Area Networks, The PSTN vs. the Internet; Radio Spectrum. Noise: Noise sources, noise figure and noise temperature; noise models.

**Components of a Communication System**: communication channels and their characteristics such as bandwidth, channel capacity, distortion, noise and other impairments. Standards Organizations. Analog modulation Technique: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; comparison of angle and linear modulation systems. Introduction to Analogue Pulse modulation Techniques: Amplitude shift keying, phase-shift keying and frequency-shift keying. Multiplexing techniques: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM), PCM, WDM. Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication.

**Learning Outcomes**: On completing the course students should be able to:
1. Explain the principles involved in the transmission and reception of information in a communication system.
2. Discuss the architecture of a generic communication system
3. Discuss and Analyze the effect of different types of noise in communication systems
4. Differentiate between different types of analogue modulation
5. Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication.

**Contribution to Exit Level Outcome**:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3)
4 Investigations, Experiments and Data Analysis (Course Outcomes 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5)
6 Professional and Technical Communication (Course Outcomes 6)

**Issue Date**: September 2015
**Next Revision**: September 2019
<table>
<thead>
<tr>
<th>Module Title</th>
<th>PROGRAMMABLE ELECTRONICS DESIGN</th>
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<tr>
<td>Code</td>
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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (at least 4 labs 20%, at least 2 assignments 10%, 2 tests 40%, mini project 30%)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TETD3692 Digital Electronics</td>
</tr>
</tbody>
</table>

**Contents:** Programmable Electronics Design Cycle, Structure of the development board. **VHDL:** VHDL structure, data types, operators, concurrent statements (including selected and conditional statements), and structural description. **Sequential Logic Modelling:** process statement, sequential statements, signals and variables, state machines. **System Design:** packages, components, functions and procedures.

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss and apply the programmable electronics design cycle.
2. Design, test and implement concurrent statement based logic circuit descriptions.
3. Design, test and implement logic circuits using structural VHDL descriptions.
4. Design, test and implement sequential circuits VHDL descriptions.
5. Create VHDL packages, functions and procedures.

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1)
3 Engineering Design (Course Outcomes 2, 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 3, 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: MICROPROCESSOR SYSTEMS

Code: TCEE3791
NQF Level: 7
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TETD3692 Digital Electronics

Content: 

**Computer Architecture:** The basics of modern processor and system architectures, advanced use of tools such as assemblers, compilers and debuggers in embedded systems, as well as the methods for peripherals interfacing and networking, elements and organisation of a computer system; Memory Devices: RAM (SRAM, DRAM, DRAM cell arrays), ROM (EPROM, EEPROM), flash memory, memory addressing, address multiplexing, bus contention; Instruction set architecture. Microprocessors: 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. 

**Program execution time calculation.** Translation of mnemonics to machine codes.

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss the organization and design principles behind modern microprocessor-based systems
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 programs.

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1)
3 Engineering Design (Course Outcomes 2, 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENTREPRENEURSHIP

<table>
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<td>NQF Level</td>
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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3761 Fundamentals of Economics</td>
</tr>
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</table>


Learning Outcomes: On completing the course students should be able to:

1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Discuss the methods used to carry out feasibility studies
3. Develop a business plan relating to an engineering endeavor
4. Discuss the concepts of motivation, competencies, innovation and product marketing
5. Describe the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11 Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: Embedded Systems Design I

Code: TETD3792
NQF Level: 7
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 100% (at least 4 labs 20%, at least 2 tests 40%, mini project 40%)
Co-requisite(s): TCEE3791 Microprocessor Systems
Pre-requisite(s): TETD3692 Digital Electronics

Contents: Microcontrollers Architectures: von Neumann, Harvard, (including differences) architectural differences between popular microcontroller types (e.g. PIC, ARM and Atmel AVR etc); Specific Microcontroller IC (AVR or PIC) detailed architecture: bus structure, registers, timers, ADC, serial communication, memories and ports; Development board details; Assembly Language: Instruction set, language structure, header files, port initialisation, loops, branching, interrupts, delay implementation, timers, look-up tables; Microcontroller Applications using Assembly language: ADC, LCD, motor control, keypad, seven segment displays, UART, etc.

Learning Outcomes: On completing the course students should be able to:
1. Differentiate between microcomputers, microprocessors and microcontrollers.
2. Discuss different types of microcontroller architectures.
3. Design, implement and analyse assembly programs for Atmel AVR and/or PIC microcontrollers.
4. Develop microcontroller based applications employing digital electronics, analogue electronics and assembly language.
5. Execute a micro-controller based group project.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2)
3 Engineering Design (Course Outcomes 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 5)

Issue Date: September 2015
Next Revision: September 2019
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<tr>
<th>Module Title</th>
<th>COMPUTER NETWORKS</th>
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<tr>
<td>Pre-requisite</td>
<td>TCME3521 Computing Fundamentals</td>
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**Content:** Data communications, network architectures, communication protocols, data link control, medium access control; introduction to local area networks metropolitan area networks and wide area networks; introduction to Internet and TCP/IP. **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:** Threats, secret-key crypto, public key Algorithms, intrusion detection, authentication systems, Kerberos, email security (PGP, S/MIME), firewalls, WWW security.

**Learning Outcomes:** On completing the course students should be able to:
1. Discuss computer network layers
2. Compare the OSI model and the TCP/IP model
3. Understand the issues related to addressing between networks
4. Identify common security risks for Internet-connected computers.
5. Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
6. Distinguish between the different threats to wireless network security and different types of security threats.
7. Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.
8. Independently study and make a presentation on one emerging network technology.

**Contribution to Exit Level Outcome:**
2 Application of Scientific and Engineering Knowledge (Course Outcomes 4, 5, 6, 7)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 7)
9 Independent Learning Ability (Course Outcomes 8)

**Issue Date:** September 2015
**Next Revision:** September 2019
**Module Title** | **ELECTRONIC PRODUCTS DEVELOPMENT**
---|---
**Code** | TCEE3782
**NQF Level** | 7
**Contact Hours** | 2L + 1T or 1PS/Week
**NQF Credits** | 8
**Assessment** | Continuous 100% (at least 3 assignments 20%, at least 2 Test 50%, mini project 30%)
**Co-requisite(s)** | (TETD3692 Digital Electronics), (TETA3791 Analogue Electronics II)

**Content:** The students will develop (synthesize) an electronic product/prototype or a part of a product/prototype to meet set requirements through a mini project. The aim is to introduce the students to the process of electronic product development through a project based learning method. The emphasis will not be on product complexity but on the development process. Each project will be carried out by one person or by a team of two persons. Support lectures will be given with topics which will include: Electronic products development cycle, Design methods, feasibility, Requirements, Design specifications, prototyping, verification and testing, pcb design issues including EMI reduction methods, product packaging, failure analysis, heat sink design, product documentation, Intellectual property and patents.

**Learning Outcomes:** On completing the course students should be able to:
1. Carry out need analysis and feasibility studies for electronic products.
2. Develop design specifications for electronics products to meet user, functional and system requirements as well as industrial standards.
3. Develop a product/prototype following a clear and standard electronic product development cycle.
4. Formulate testing methods for an electronics product.
5. Test and troubleshoot the electronic circuit product.
6. Produce a technical document of the product.

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2)
3. Engineering Design (Course Outcomes 2, 3)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6. Professional and Technical Communication (Course Outcomes 6)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 1)
8. Individual, Team and Multidisciplinary Working (Course Outcomes 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
## Module Title
DIGITAL COMMUNICATION

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<td>EGS3661 Statistics for Engineers</td>
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### Contents:
**Digital communications concepts and terminology:** Definition and elements of a digital communications system, comparison of analogue and digital communication systems. **Source Formatting:** The digital representation of data, sampling, quantization, pulse code modulation. Quantization noise, companding, standards for companding. Voice codecs and codec standards. **Multiplexing and multiple access schemes:** Frequency division, time division, and code division multiplexing. Comparison of frequency division and time division multiplexing. **Baseband Communication:** Basic lines codes, comparison and spectral estimation of line codes, coding standards for LAN and telecommunications networks. Baseband detection, error rate calculation. Intersymbol interference and equalization. Eye diagrams. Signal transmission, comparison of repeaters and regenerators. **Information Theory:** Definition of Information, entropy, conditional entropy and redundancy, entropy rate, channel capacity. **Source and Channel Coding:** Symbol source encoding, Speech coding, representation and analysis of codes, types of errors, 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. **Data Transmission:** Baseband data transmission through a channel, intersymbol interference, baseband error probabilities, M-ary coding, channel capacity. **Receiver design:** General binary and M-ary signaling; Maximum-likelihood receivers; Performance in an AWGN channel.

### Learning Outcomes
On completing the course students should be able to:
1. Discuss the difference between analogue and digital communication systems
2. Describe source formatting, in particular, sampling, quantization, signal to quantization noise ratio
3. Analyse and Design error correction codes and decoding techniques.
4. Analyze and select digital communication techniques for band limited channels.
5. Use simulation packages (e.g. MATLAB or equivalent) to evaluate the performance of various digital communications systems

### Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5)

### Issue Date:
September 2015

### Next Revision:
September 2019
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<tr>
<th>Module Title</th>
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<td>Co-requisite(s)</td>
<td>TCEE3791 Microprocessor Systems</td>
</tr>
</tbody>
</table>


Learning Outcomes: On completing the course students should be able to:
1. Discuss the core functionality of modern operating systems such as Windows and Unix based systems
2. Discuss key concepts and algorithms in operating system implementations
3. Investigate the kernel interface, files, processes, and inter-process communication for modern operating systems.
4. Implement simple concepts of Operating Systems
5. Write programs that interface to the operating system at the system-call level.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019

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<tr>
<th>Module Title</th>
<th>DATABASE SYSTEMS</th>
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<td>Assessment</td>
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<td>Co-requisite(s)</td>
<td>TCEE3521 Computing Fundamentals</td>
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</table>

Content: This module covers material necessary to provide the students with the required skills for working with a variety of database systems. The module will cover the following topics: - types of databases; Evolution of Database technologies; Database technology versus conventional file-processing systems; The Systems Development Life Cycle (SDLC); The prototyping methodology; The enterprise data model; Conceptual Data Modelling; Types of entities; ER diagrams; Business rules; Integrity Control Statements; Writing SQL statements; ER Diagram to relation transformation; Functional Dependencies; Normalization and de-normalization

Learning Outcomes: On completing the course students should be able to:
1. Differentiate the variety of database systems.
2. Plan and implement database technologies versus conventional file-processing systems.
3. Apply software development life cycle in database systems development.
4. Develop prototyping methodology and enterprise data models.
5. Effectively apply conceptual data modelling.
6. Apply integrity control systems

Contribution to Exit Level Outcome:
3 Engineering Design (Course Outcomes 2, 4)
Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5, 6, 7)

Module Title: INDUSTRIAL ATTACHMENT II

Code: TEGT3700
NQF Level: 7
Total Hours: Six (6) weeks preferably during the June/July break in Year 3 or 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: TEGT3600 Industrial Attachment I

Content: During Industrial Attachment II, 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 hands-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 workplace 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 detail his/her contribution to the company during the internship

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<th>Module Title:</th>
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<td>Assessment</td>
<td>Continuous 100% (at least 2 Assignments 20%, at least 3 Tests (covering the aspects: Law, Professionalism, Health and Safety) 80%).</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3742 Entrepreneurship</td>
</tr>
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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.


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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019

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:
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 constitute 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 constitute 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.

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<th>Module Title</th>
<th>CONTROL ENGINEERING</th>
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<td>Assessment</td>
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<td>Pre-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
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**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:**

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. Analyze 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)

**Issue Date:** September 2015
**Next Revision:** September 2019
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;


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
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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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 programs for embedded systems.
5. Optmise 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)

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Next Revision: September 2019
Module Title: WIRELESS COMMUNICATION

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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>12</td>
</tr>
<tr>
<td>Assessment</td>
<td>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%</td>
</tr>
<tr>
<td>Co-requisites</td>
<td>TTCD3792 Digital Communication</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>TTCE3741 Telecommunication Principles</td>
</tr>
</tbody>
</table>


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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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) TCER3792 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. 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 constitute 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 constitute 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.

**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 constitute 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.

**Issue Date:** September 2015  
**Next Revision:** September 2019
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 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, 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 an 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 constitute 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 constitute 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 constitute 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.

**Issue Date:** September 2015

**Next Revision:** September 2019
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>INDUSTRIAL ATTACHMENT III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>TEGT3800</td>
</tr>
<tr>
<td>NQF Level</td>
<td>8</td>
</tr>
<tr>
<td>Total Hours</td>
<td>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.</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous assessment 100% (Logbook record 20%, Lecturer/Employer Evaluation 20%, Final report 60%)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3700 Industrial Attachment II</td>
</tr>
</tbody>
</table>

**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

**Issue Date:** September 2015  
**Next Revision:** September 2019
A. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

A.1. DEGREE NAME: BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS) 19BECE

A.2. 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.

A.3. 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 BSc IN ELECTRICAL ENGINEERING - 160 Credits

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>NQF LEVEL</th>
<th>NQF CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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<tbody>
<tr>
<td>1</td>
<td>Engineering Mathematics I</td>
<td>TEGM3591</td>
<td>5</td>
<td>12</td>
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<tr>
<td>1</td>
<td>Engineering Drawing</td>
<td>TEGT3561</td>
<td>5</td>
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<tr>
<td>1</td>
<td>Physics for Physical Sciences I</td>
<td>SPHY3511</td>
<td>5</td>
<td>16</td>
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<tr>
<td>1</td>
<td>Computing Fundamentals</td>
<td>TCME3521</td>
<td>5</td>
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<tr>
<td>1</td>
<td>Workshop Practice</td>
<td>TEGW3590</td>
<td>5</td>
<td>8</td>
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<tr>
<td>1</td>
<td>Materials Science</td>
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<td>5</td>
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<td>1 and 2</td>
<td>Contemporary Social Issues</td>
<td>UCSI3580</td>
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<tr>
<td>1</td>
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<td><strong>Total Credits Semester I</strong></td>
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<tr>
<th>SEMESTER</th>
<th>MODULE</th>
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<th>NQF LEVEL</th>
<th>NQF CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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<tbody>
<tr>
<td>2</td>
<td>Engineering Mathematics II</td>
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<td>16</td>
<td>TEGM3591</td>
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<tr>
<td>2</td>
<td>Fundamentals of Electrical Engineering</td>
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<td>2</td>
<td>Physics for Physical Sciences II</td>
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<td>SPHY3511</td>
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<tr>
<td>2</td>
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<td>5</td>
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<td>SPHY3511</td>
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<tr>
<td>2</td>
<td>Chemistry 1B</td>
<td>SCHM3512</td>
<td>5</td>
<td>16</td>
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<td>2</td>
<td>English for Academic Purposes</td>
<td>ULEA3519</td>
<td>5</td>
<td>16</td>
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<td><strong>Total Credit Semester II</strong></td>
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</table>

NB: Students who have done UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512 and SCHM3512 will be exempted from taking them in this year.
### Year 2 of BSc in Electrical Engineering - 152 Credits

<table>
<thead>
<tr>
<th>Semester</th>
<th>Module</th>
<th>Code</th>
<th>NQF Level</th>
<th>NQF Credits</th>
<th>Pre &amp; Co-Requisite</th>
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<tr>
<td>1</td>
<td>Engineering Mathematics III</td>
<td>TEGT3671</td>
<td>6</td>
<td>16</td>
<td>TEGM3591, TEGM3512</td>
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<tr>
<td>1</td>
<td>Computer Science for Engineers</td>
<td>TCEM3621</td>
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<td>1</td>
<td>Engineering Mechanics II</td>
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<td>6</td>
<td>8</td>
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<tr>
<td>1</td>
<td>Statistics for Engineers</td>
<td>TEGS3661</td>
<td>6</td>
<td>8</td>
<td>TEGM3591</td>
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<tr>
<td>1</td>
<td>Electric Circuit Analysis I</td>
<td>TECCE3691</td>
<td>6</td>
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<td>1</td>
<td>Analogue Electronics I</td>
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<td>8</td>
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<td>1</td>
<td>Computer Aided Drawing</td>
<td>TEGT3661</td>
<td>6</td>
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<td>TCEM3521, TEGT3591</td>
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Total Credits Semester III: 72

<table>
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<tr>
<th>Semester</th>
<th>Module</th>
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<td>2</td>
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<td>2</td>
<td>Applied Electromagnetics</td>
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<td>6</td>
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<td>2</td>
<td>Signals and Systems</td>
<td>TTCE3692</td>
<td>6</td>
<td>12</td>
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<tr>
<td>2</td>
<td>Measurements and Instrumentation</td>
<td>TETA3622</td>
<td>6</td>
<td>8</td>
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<td>Digital Electronics</td>
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<td>2</td>
<td>Electrical Machines</td>
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<td>2</td>
<td>HIV and AIDS Education</td>
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<tr>
<td>2</td>
<td>Industrial Attachment I</td>
<td>TEGT3600</td>
<td>6</td>
<td>-</td>
<td>TEGT3590</td>
</tr>
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</table>

Total Credits Semester IV: 76

### Year 3 of BSc in Electrical Engineering - 132 Credits

<table>
<thead>
<tr>
<th>Semester</th>
<th>Module</th>
<th>Code</th>
<th>NQF Level</th>
<th>NQF Credits</th>
<th>Pre &amp; Co-Requisite</th>
</tr>
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<tbody>
<tr>
<td>1 and 2</td>
<td>Experimental and Research Methods</td>
<td>TEGR3760</td>
<td>7</td>
<td>8</td>
<td>TEGS3661</td>
</tr>
<tr>
<td>1</td>
<td>Fundamentals of Economics</td>
<td>TEGT3761</td>
<td>7</td>
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<tr>
<td>1</td>
<td>Electric Circuit Analysis II</td>
<td>TECE3791</td>
<td>7</td>
<td>12</td>
<td>TECE3691, TEGT3671</td>
</tr>
<tr>
<td>1</td>
<td>Fundamentals of Power Systems</td>
<td>TECE3731</td>
<td>7</td>
<td>16</td>
<td>TECE3691, TECE3791</td>
</tr>
<tr>
<td>1</td>
<td>Electrical Machines Analysis and Design</td>
<td>TECE3711</td>
<td>7</td>
<td>16</td>
<td>TECP3622</td>
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<tr>
<td>1</td>
<td>Power Electronics</td>
<td>TECC3791</td>
<td>7</td>
<td>12</td>
<td>TETE3691</td>
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Total Credits Semester V: 72

<table>
<thead>
<tr>
<th>Semester</th>
<th>Module</th>
<th>Code</th>
<th>NQF Level</th>
<th>NQF Credits</th>
<th>Pre &amp; Co-Requisite</th>
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<tbody>
<tr>
<td>2</td>
<td>Entrepreneurship</td>
<td>TEGT3742</td>
<td>7</td>
<td>8</td>
<td>TEGT3761</td>
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<tr>
<td>2</td>
<td>High Voltage Engineering</td>
<td>TECM3792</td>
<td>7</td>
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<td>2</td>
<td>Computer Networks</td>
<td>TCMH3722</td>
<td>7</td>
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<td>2</td>
<td>Power Transmission and Distribution</td>
<td>TECT3792</td>
<td>7</td>
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<td>TECE3731, TECP3622</td>
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<td>2</td>
<td>Electrical Engineering Design</td>
<td>TECE3762</td>
<td>7</td>
<td>8</td>
<td>TECE3731, TECE3711</td>
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<tr>
<td>2</td>
<td>Renewable Energy Technologies</td>
<td>TECC3792</td>
<td>7</td>
<td>12</td>
<td>TEGT3541</td>
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<td>2</td>
<td>Industrial Attachment II</td>
<td>TEGT3700</td>
<td>7</td>
<td>-</td>
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Total Credits Semester VI: 60
### YEAR 4 OF BSc IN ELECTRICAL ENGINEERING - 140 Credits

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>NQF LEVEL</th>
<th>NQF CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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<tbody>
<tr>
<td>1</td>
<td>Society and the Engineer</td>
<td>TEGT3821</td>
<td>8</td>
<td>8</td>
<td>TEGT3742</td>
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<tr>
<td>1</td>
<td>Project Management</td>
<td>EGM3881</td>
<td>8</td>
<td>12</td>
<td>TEGT3761</td>
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<tr>
<td>1</td>
<td>Control Engineering</td>
<td>TECP3891</td>
<td>8</td>
<td>12</td>
<td>TEGT3671</td>
</tr>
<tr>
<td>1</td>
<td>Computation Methods in Power Engineering</td>
<td>TECE3891</td>
<td>8</td>
<td>12</td>
<td>TECP3831, TEC3731</td>
</tr>
<tr>
<td>1</td>
<td>Power Systems Protection</td>
<td>TEC3831</td>
<td>8</td>
<td>16</td>
<td>TECE3791</td>
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<tr>
<td>1</td>
<td>Microprocessor and Programmable Logic Controllers</td>
<td>TEC3851</td>
<td>8</td>
<td>16</td>
<td>TETD3692</td>
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**Total Credits Semester VII**

76

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>NQF LEVEL</th>
<th>NQF CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>Research Project</td>
<td>TECR3892</td>
<td>8</td>
<td>30</td>
<td>All 3rd Year Modules</td>
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<tr>
<td>2</td>
<td>Electrical Design Project</td>
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<td>8</td>
<td>34</td>
<td>All 3rd Year Modules</td>
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<tr>
<td>2</td>
<td>Industrial Attachment III</td>
<td>TEGT3800</td>
<td>8</td>
<td>-</td>
<td>TEGT3700</td>
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</table>

**Total Credits Semester VIII**

64

**TOTAL CREDITS FOR THE DEGREE OF BSc IN ELECTRICAL ENGINEERING (HONOURS)**

584
A.4. DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

YEAR 1 OF BSc IN ELECTRICAL ENGINEERING

SEMESTER 1

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>TEGM3591</td>
</tr>
<tr>
<td>NQF Level</td>
<td>5</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>12</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous (Quiz (30%), 2 Tests (70%) ) 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
</tr>
</tbody>
</table>


Learning Outcomes: Upon completion of this module, students should be able to:
1. Solve basic mathematics and engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to engineering
4. Apply trigonometry in solving mathematical and engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
6. Solve mathematical and engineering problems using partial differentiation

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING DRAWING</th>
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<tbody>
<tr>
<td>Code</td>
<td>TEGT3561</td>
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<tr>
<td>NQF Level</td>
<td>5</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>2L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (minimum of 2 tests and 4 drawing assignments)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
</tr>
</tbody>
</table>


Learning Outcomes: Upon completion of this 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 drawings and assembly drawings of various engineering components
Contribution to Exit Level Outcome:
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
6 Professional and Technical Communication (Course Outcomes 2, 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title: PHYSICS FOR PHYSICAL SCIENCES I
Code SPHY3511
NQF level 5
Contact hours 4L + 2T or 1 PS/Week
NQF Credits 16
Assessment Continuous assessment 50% (minimum 2 tests and 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper).
Pre-requisite(s) None

Contents: Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton’s laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler’s laws; pressure; Archimedes’ principle; laminar flow; Bernoulli’s equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

Learning Outcomes: Upon completion of the module, the student is expected to:
1. Employ units, do unit conversions and use of significant figures.
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.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4 Investigations, Experiments and Data Analysis (Course Outcome 9)

Module Title: COMPUTING FUNDAMENTALS
Code TCME3521
NQF Level 5
Contact Hours 2L + 1T or 1PS/Week
NQF Credits 8
Assessment Continuous assessment (At least 2 Tests, 4 Assignments and 2 Practicals Reports) 50%, written examination (1x2 hour paper) 50%
Pre-requisite(s) None


Learning Outcomes: Upon completion of this module, students should be able to:
1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

**CONTRIBUTION to Exit Level Outcome**
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

<table>
<thead>
<tr>
<th>Module Title:</th>
<th>WORKSHOP PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>TEGW3590</td>
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<tr>
<td>NQF Level</td>
<td>5</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>2L + 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>

**Content:** Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Turning, Fitting, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components. Refrigeration and Air-conditioning and their installation.

**Learning Outcomes:** Upon completion of this course, students should be able to:
1. Describe general safety procedures applicable to engineering workshops.
2. Describe specific hand tools used in engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of 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.
10. Install air-conditioning and refrigeration systems Describe the general operation of air-conditioning and refrigeration systems.

**Contribution to Exit Level Outcome:**
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)
<table>
<thead>
<tr>
<th><strong>Module Title:</strong></th>
<th>MATERIALS SCIENCE</th>
</tr>
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<tbody>
<tr>
<td><strong>Code</strong></td>
<td>TEGS3591</td>
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<tr>
<td><strong>NQF Level</strong></td>
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</tr>
<tr>
<td><strong>Contact Hours</strong></td>
<td>3L + 2T or 1PS/Week</td>
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<tr>
<td><strong>NQF Credits</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td>Continuous (2 assignments, 2 practicals reports and 2 Tests) 50%, Examination (1 x 3 hour paper) 50%</td>
</tr>
<tr>
<td><strong>Co-requisite(s)</strong></td>
<td>None</td>
</tr>
</tbody>
</table>


**Learning Outcomes:** On completing the course students should be able to:
1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
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. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

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

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: CONTEMPORARY SOCIAL ISSUES

Code: UCSI3580
NQF: 5
Contact Hours: 1 Contact hours per week for 28 weeks
Credits: 8
Assessment: Continuous Assessment (100%). variety of assessments which evaluate and test the students’ individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.
Prerequisite: None

Module Descriptor: The module, Contemporary Social Issues (CSI3580), is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Identify social issues affecting the Namibian society
2. Describe the characteristics of these issues and to design a plan of action
3. Assess the challenges facing the society in a multi-cultural, multi-faith and secular setting
4. Develop respect for humanity, nature and cosmos
5. Describe the physical-medical aspects of HIV/AIDS
6. Demonstrate knowledge of social factors that can contribute towards the spread of HIV/AIDS
7. HIV/AIDS; Relationships; Social conditions; Attitudes; Cultural influences; Myths about HIV/AIDS
8. Explain behaviour change towards HIV/AIDS
9. Construct HIV/AIDS prevention strategies, continuum of care and support among students
10. Identify with, and use gender concepts with ease
11. Utilize gender-sensitive language and live a life that reflects gender exposure
12. Reflect on gender relations between women and men in society, and the impact on society
13. Reduce gender stereotypes in their home and community at large
14. Examine the impact of gender unequal relations on the spread of HIV/AIDS, gender based violence, myths, stereotypes and believes about males and females, resource distribution, the education system and many other issues that affect society and community at large

Contribution to Exit Level Outcome:
10 Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

Issue Date: September 2015
Next Revision: September 2019

Module Title: Fundamentals of Engineering

Code: TEGT3521
NQF Level: 5
Contact Hours: 2L + 1T or 1 PS/Week
NQF Credits: 8
Assessment: Continuous assessment 100% (Quizzes - 10%, Assignments - 20%, course project and presentation - 30%, Test - 40%)
Co-requisite(s): None


**Learning Outcomes:** On completing the course students should be able to:
1. Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
2. Describe the various branches of engineering, possible careers, and job prospects
3. Describe how to solve basic engineering problems
4. Identify general steps involved in engineering design and communication
5. Use modern engineering and communication tools and procedures.

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

**Issue Date:** September 2015
**Next Revision:** September 2019

### SEMESTER 2

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS II</th>
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<tbody>
<tr>
<td><strong>Code</strong></td>
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<td><strong>NQF Level</strong></td>
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<tr>
<td><strong>Contact Hours</strong></td>
<td>3L + 2T or 1PS/Week</td>
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<tr>
<td><strong>NQF Credits</strong></td>
<td>16</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td>Continuous (Quiz (30%), 2 Tests (70%) ) 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td><strong>Co-requisite(s)</strong></td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
</tbody>
</table>


**Learning Outcomes:** Upon completion of this 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. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and engineering problems

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 1, 2, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6)

**Issue Date:** September 2015
**Next Revision:** September 2019

| Module Title                      | FUNDAMENTALS OF ELECTRICAL ENGINEERING |

146
Code: TEGT3542
NQF Level: 5
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous Assessment 100% (2 tests - 60%, 2 quizzes - 20%) and 2 practical labs - 20%
Pre-requisite(s): None


Learning Outcomes: Upon completion of this 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 Thévenin’s theorems for problem solving
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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title: PHYSICS FOR PHYSICAL SCIENCES II
Code: SPHY3512
NQF Level: 5
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)
Co-requisite(s): SPHY3511 Physics for Physical Sciences I

Contents: Electric charge; insulators and conductors; Electric force and coulomb’s law, Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm’s law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

Learning Outcomes: Upon completion of this 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.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019

147
Module Title: ENGINEERING MECHANICS I
Code: TEGT3592
NQF Level: 5
Contact Hours: 3L + 2T or 1P/Week
NQF Credits: 12
Assessment: Continuous (4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 3 hour paper) 50%
Co-requisite(s): SPHY3511 Physics for physical Sciences I


Learning Outcomes: Upon completion of this 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

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1-6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: CHEMISTRY 1B
Code: SCHM3512
NQF Level: 5
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)

Pre-requisite(s): None

Content: Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Explain and use the gas laws
2. Discuss energy changes in chemical reactions
3. Analyse the rates of chemical reactions.
4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
5. Distinguish between the three laws of thermodynamics
7. Demonstrate an understanding of how galvanic cells work.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGLISH FOR ACADEMIC PURPOSES

Code: ULEA 3519
NQF Level: 5
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment:
- Continuous: 60% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)
- Examination: (40%) made up of 1 x 3 hour examination paper

Pre-requisite(s): ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE


Learning outcomes: Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

Contribution to Exit Level Outcome:
- 6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
- 9 Independent Learning Ability (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019
YEAR 2 OF BSc IN ELECTRICAL ENGINEERING (HONOURS)

SEMESTER 1

Module Title: ENGINEERING MATHEMATICS III

<table>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
</tbody>
</table>


Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply differential vector calculus to solve mathematical and engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving engineering problems
4. Apply the power series method in approximation of solutions of ordinary differential equations
5. Describe the basis for complex analysis in engineering problem solving
6. Apply the residual theorem to engineering problems.

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, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title: COMPUTER SCIENCE FOR ENGINEERS

<table>
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<th>Code</th>
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<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).</td>
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<td>Pre-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
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</table>


Learning Outcomes: On completing the course students should be able to:
1. Develop algorithms and apply data structures in computer programs.
2. Apply binary trees to specific programming environment
3. Write programs in MATLAB or equivalent software employing user defined and built in functions.
4. Apply MATLAB (or equivalent software) programming in solving engineering problems
5. Write simple C programs

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)
Module Title: ENGINEERING MECHANICS II
Code: TEGT3641
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous (4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 2 hour paper) 50%
Co-requisite(s): TEGT3592 Engineering Mechanics I


Learning Outcomes: On completing the course 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. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, 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. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 3, 4, 5, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 6, 7)
Module Title: ELECTRIC CIRCUIT ANALYSIS I

Code: TECE3691
NQF Level: 6
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (Assignments, At least 2 Tests), Examination 50% (1 x 3 hour paper)
Co-requisite(s): TEGT3542 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin’s and Nortons theorems, superposition theorem, concept of input and output resistance of network, single port networks, two-port networks, KCL, KVL, electric power, energy sources, sources transformations, power transfer, maximum power transfer, current and voltage divider theorems, Mesh and Node analysis; D.C. power supplies and their industrial use. Sinusoidal Steady State Analysis: AC. behavior in R, L and C elements. Phasor analysis with complex algebra, two terminal networks - impedance, admittance, susceptance and their real and imaginary parts. Resonance: series and parallel resonance, half power points, bandwidth, Power: instantaneous, average, power factor, active, reactive, complex, apparent power, Power triangle and power factor correction. A.C. Circuit Analysis of Simple Networks: Circuit theorems under a.c. conditions; Thevenin, Norton, and superposition theorems; KVL, KCL, loop/mesh and node analysis, maximum power transfer. Transient Analysis: Analysis of first order LR and RC circuits subjected to excitation of D.C., square pulse, sinusoidal sources and exponential sources. Interpretation of complementary function and particular integral. Analysis of second order RLC circuit subjected to step input and sinusoidal input. Frequency Response Curves: Resonance, series and parallel resonance, the concept of Q-factor, tuned circuits’ frequency selective networks mutually-couple circuits. Computer simulation tools. Three Phase Circuits: Concept of three-phase supply, phase diagrams for 3-phase circuits, balanced 3-phase supply, star and delta circuits, analysis of simple balance 3-phase circuits, power in three-phase circuits power measurement in three phase circuits.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply circuit On completing the course students should be able to:
2. Apply circuit theorems to simplify and find solutions to electrical circuits.
3. Interpret, develop and design electrical engineering circuits
4. Use computer simulation tools for electric circuit analysis and design
5. Perform DC and AC power calculations including power factor correction;
6. Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
7. Analyze, simulate, and experimentally validate DC and AC circuits;

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)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 5)
Module Title: ANALOGUE ELECTRONICS I  
Code: TETE3691  
NQF Level: 6  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)  
Pre-requisite(s): TEGT3542, Fundamentals of Electrical Engineering  


Learning Outcomes: On completing the course 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 BJT transistors  
5. Analyse and design BJT transistor amplifier and switching circuits  
6. Discuss the construction of FET transistors  
7. Analyse and design FET biasing circuits  
8. Discuss the internal circuitry for op-amps  
9. Discuss the operation of op-amps  
10. Analyse and design basic op-amp circuits  
11. Use EDA software to analyse electronic circuits.  

Contribution to Exit Level Outcome:  
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 6, 8, 9)  
3 Engineering Design (Course Outcomes 3, 5, 7, 10)  
4 Investigations, Experiments and Data Analysis (Course Outcomes 10)  
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 11)  

Issue Date: September 2015  
Next Revision: September 2019

Module Title: COMPUTER AIDED DRAWING  
Code: TEGT3661  
NQF Level: 6  
Contact Hours: 2L + 1T or 1PS/Week  
NQF Credits: 8  
Assessment: Continuous 100%  
Pre-requisite(s): TEGT3561 Engineering Drawing  
Co-requisite(s): TCME3521 Computing Fundamentals  

Content: Getting started; Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; 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 your drawing; Working in three-dimensional space; Creating three-dimensional objects.  

Learning Outcomes: Upon completion of this 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  

Contribution to Exit Level Outcome:  
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 4)  
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4)
SEMESTER 2

Module Title: ENGINEERING MATHEMATICS IV
Code TEGT3672
NQF Level 6
Contact Hours 4L + 2T or 1PS/Week
NQF Credits 16
Assessment Continuous (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s) TEGT3671 Engineering Mathematics III
Pre-requisite(s) TEGM3512 Engineering Mathematics II


Learning Outcomes: On completing the course students should be able to:
1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green's theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)
Module Title: APPLIED ELECTROMAGNETICS

Code: TTCE3622
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/week
Credits: 8
Assessment: Continuous (at least 3 Assignments – 30%, at least 2 Tests 70) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): SPHY3512 Physics for Physical Sciences II

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 Torque and Movement; Magnetization in Materials. Magnetic Boundary Conditions. Inductor and Inductance; Magnetic Energy.

Learning Outcomes: On completing the course students should be able to:
1. Perform calculations involving electric and magnetic fields
2. Describe how energy is stored in electric and magnetic fields
3. Explain the theories and applications of electromagnetic fields and waves in material space
4. Explain the physical meaning and significance of Maxwell’s equations;
5. Describe electromagnetic time varying fields and waves, and their implications in modern communication systems
6. Derive and apply equations related to static electromagnetic fields in material space

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 6, 7)

Issue Date: September 2015
Next Revision: September 2019

Module Title: SIGNALS AND SYSTEMS

Code: TTCE3692
NQF Level: 6
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s): TEGT3671 Engineering Mathematics III

Content: Classification of signals, Representation of signals, Signal Parameters, Signal operations, Fourier series, Fourier transforms, Laplace transforms. Classification of systems, System description and parameters. Convolution, Filter design (FIR and IIR Filters). Computer simulation software (e.g. MATLAB or equivalent).

Learning Outcomes: On completing the course students should be able to:
1. Describe the characteristics of common signals types and systems
2. Discuss the operation and application of linear systems.
3. Apply transformation techniques and various analysis approaches to work out the response of a linear system to any input signal.
4. Design filters.
5. Carry out computer based simulations related to signals and systems.

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 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MEASUREMENTS AND INSTRUMENTATION

Code: TETA3622
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous (at least 2 Assignments – 20%, at least 2 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s): TEGT3542 Fundamentals of Electrical Engineering

Contents: Systems of Units and Standards of Measurement, Elements of generalized measurement system, Functional elements of an instrument, Static characteristics (Accuracy, Precision, Error, Sensitivity, Reproducibility, and Tolerance) Dynamic characteristics (Speed of response, Fidelity, Lag, dynamic error). Instrument classification, Methods of Measurement, Calibration, Noise, interference and grounding, Sources of Errors and types of Errors, Digital and analogue Instruments, Bridge measurement (Wheatstone, Kelvin, Maxwell etc.) Measurements of electrical and non-electrical quantities (including high frequency signals), Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Introduction to Programmable Logic Controllers (PLCs).

Learning Outcomes: On completing the course students should be able to:
1. Explain different types and methods of measurements.
2. Describe static and dynamic characteristics of an instrument.
3. Explain the importance of signal generators and signal analysers in measurements.
4. Classify, calculate errors and reduce them in measurements.
5. Describe the concept of instrument calibration.
6. Explain the use of sensors and transducers.
7. Practically measure different quantities (including high frequency signals), analyse and interpret the measurement results.
8. Describe the architecture and operation of PLCs

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 7)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: DIGITAL ELECTRONICS  
Code: TETD3692  
NQF Level: 6  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)  
Co-requisite(s): TETE3691 Analogue Electronics I  

Content: 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). Sequential Logic: latches flip-flops, counters, shift registers. Design of Digital Systems. Logic gate circuitry: TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

Learning Outcomes: On completing the course 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 logic circuits  
6. Analyse and design sequential logic circuits  
7. Compare the performance of different logic family devices  
8. Discuss and analyse the internal circuitry of different logic family technologies.  
9. Design interfaces between circuits of different logic families.

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, 8)  
3 Engineering Design (Course Outcomes 5, 6, 9)  
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4)

Module Title: ELECTRICAL MACHINES  
Code: TECP3622  
NQF Level: 6  
Contact Hours: 2L + 1T or 1PS/Week  
NQF Credits: 8  
Assessment: Continuous 100% ( 2 assignments, 2 Practical Labs, 2 Tests)  
Pre-requisite(s): TEGT3541 Fundamentals of Electrical Engineering  


Learning Outcomes: On completing the course students should be able to:  
1. Demonstrate an understanding of the principle of operation of electrical machinery  
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.  
3. Describe the principle of operation and applications of transformers and AC windings  
4. Describe the principle of operation and applications of three-phase induction machines

Contribution to Exit Level Outcome:  
1 Problem Solving (Course Outcomes 1, 2, 3, 4)
Module Title: COMPUTER PROGRAMMING  
Code: TCMS3692  
NQF Level: 6  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous 100% (At least 2 Tests 50%, At least 4 Labs and Assignments 20%, Mini Project 30%)  
Co-requisite(s): TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development: Top-down stepwise refinement approach. Structured Programming: variables and constants; comments, input and output and file management. Elements of data structures. C Declarations, Expressions and Operators: Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Enums and Structures. Selection Structures. Using if statements; the Nested if; the switch statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. Repetition Structures. The while loop; Writing typical Loops; The for Loop; Nested Loops; Using Loops with Structure Fields. Arrays, Strings, and Pointers: Arrays; Storing Values in Arrays; Accessing and Using Array Values; Creating Arrays of Structure Objects; Using Strings; Pointers in C. The C Functions: Functions definition; Functions declaration; Functions calling; Functions arguments; Recursion and Recursive Functions to Sort a List. Object Oriented Programming: Classes. Creating Classes; Encapsulating Class Components; Implementing Class Functions; Using Static Class Members; Polymorphism. Advanced Topics: Class Features and Design Issues; Friends and Overloading Operators; Overloading Functions; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; Using Enumerators.

Learning Outcomes: On completing the course students should be able to:
1. Apply problem solving techniques to computational and engineering problems.
2. Design and present algorithms for solving given problems using flowchart or pseudo code.
3. Develop structured programs in C programming language.
4. Use pointers effectively.
5. Describe concept of object-oriented programming.
6. Work with object oriented concepts and terminologies such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
7. Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6, 7)
3. Engineering Design (Course Outcomes 2, 3)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 3, 4, 7)
5. Professional and Technical Communication (Course Outcomes 7)
Module Title: HIV AND AIDS EDUCATION

Code: TEGT3602
NQF Level: 6
Contact Hours: 1L + 1T per week for 14 weeks
NQF Credits: None
Assessment: Continuous assessment 100% (3 Assignments and 1 report)
Co-requisite(s): None

Content:
The Engineer and HIV:
Basic facts of HIV and AIDS; Prevention, Counselling and Testing, and Treatment of HIV and AIDS; Drivers of the HIV and AIDS Epidemic in Namibia, The Engineering Sector and HIV and AIDS. Impact of HIV and AIDS:
Socio-Economic Impacts on the workforce; Impact Assessment; HIV and AIDS cost benefit analysis. HIV and AIDS Mitigation:
The Policy Environment; Design and Implementation of HIV and AIDS workplace programmes

Learning Outcomes: On completing the course students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

New: September 2016
Next Revision: September 2020

Module Title: INDUSTRIAL ATTACHMENT I

Code: TEGT3600
NQF Level: 6
Total Hours: Six (6) weeks preferably during the June/July break in Year 2 or Year 3 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%).
Pre-requisite: TEGW3590 Workshop Practice

Module Description: During Industrial Attachment I, students will work under company supervision at the level of Technician 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 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. Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
2. Discuss the major industrial processes involved in a typical engineering activity associated with the students’ discipline.
3. Describe the major tools, equipment and machinery used in industry associated with activities in the students’ discipline.

Issue Date: September 2015
Next Revision: September 2019
## YEAR 3 OF BSc IN ELECTRICAL ENGINEERING
### SEMESTER 1

<table>
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<tr>
<td>Assessment</td>
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<tr>
<td>Pre-requisite(s)</td>
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</table>

**Content:** Experimentation planning and execution. **Technical report writing.** Report structure and format. **Literature Review:** Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). **Research methodology.** Formulation and presentation of research proposals. **Statistical data analysis:** Data description: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. **Data modeling:** Experimental data modeling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination $R^2$ and adjusted $R^2$ and the role of adjusted $R^2$ on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

**Research Proposal:** During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

**Learning Outcomes:** On completing the course students should be able to:
1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an engineering research process
7. Propose an engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an engineering audience following specified guidelines

**Contribution to Exit Level Outcome:**
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

**Issue Date:** September 2015
**Next Revision:** September 2019
### Module Title: FUNDAMENTALS OF ECONOMICS

<table>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (4 Assignments, 2 Tests); Examination 50% (1 x 2 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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**Content:** Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. Macroeconomics: inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. Financial accounting: nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. **Introduction to budgeting**, **Introduction to marketing**. Long and short-term decision making.

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

**Contribution to Exit Level Outcome:**

7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

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### Module Title: ELECTRIC CIRCUIT ANALYSIS II

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<th>Code</th>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
<td>12</td>
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<tr>
<td>Assessment</td>
<td>Continuous (At least 2 assignments - 30%, At least 2 Tests - 70%) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TECE3691 Electric Circuit Analysis I</td>
</tr>
</tbody>
</table>


**Learning Outcomes:** On completing the course students should be able to:

1. Use principles and methods of analysis and modelling of electric circuits in the steady state.
2. Use of Laplace, Fourier transformation and bode plots in circuit analysis
3. Apply the concepts of frequency response, resonance, and network functions.
4. Analyse and solve two-port networks using different parameters
5. Synthesise network circuits to meet specifications

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 5)
Module Title: FUNDAMENTALS OF POWER SYSTEMS

Code: TECE3731

NQF Level: 7

Contact Hours: 4L + 2T or 1PS/Week

NQF Credits: 16

Assessment: Continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%) 50%, Exam 50% (1 x 3 hour paper)

Co-requisite(s): TECE3791 Electric Circuit Analysis II

Pre-requisite(s): TECE3691 Electric Circuit Analysis I


Learning Outcomes: On completing the course 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.

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)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
4. Independent Learning Ability (Course Outcomes 5, 8)

Issue Date: September 2015

Next Revision: September 2019
Module title: ELECTRICAL MACHINES ANALYSIS AND DESIGN

Code: TECE3711
NQF Level: 7
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite(s): TECP3622 Electrical Machines

Content: Basic Machine Theory: Emf generation in machines; distribution, coil span and winding factors; emf developed by distributed windings; development of rotating fields; torque developed; simple AC windings, the per unit (pu) notation in power systems Single and Three Phase Transformers: Three Phase Transformer connections and phase shift; equivalent circuit; per unit notation and transformers in parallel.


Learning Outcomes: On completing the course students should be able to:
1. Design and conduct experiments, as well as to analyse and interpret data.
2. Design and implement practical product-oriented systems
3. Apply theoretical engineering knowledge to practical designs.
4. Demonstrate an understanding of 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 meet desired specifications within realistic constraints
7. Communicate the logic and detailed approach to problem solving.
8. Design a system component of various electrical machines or process to meet desired needs within realistic constraints
9. Demonstrate an ability to effectively communicate design concepts in a written report.
10. Demonstrate an understanding of the operation of electrical machines in a power system network
11. Apply Software Design tools

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 6, 7, 8)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6, 10)
3. Engineering Design (Course Outcomes 1, 2, 3, 6, 8)
4. Investigations, Experiments and Data Analysis (Course Outcomes 1)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 11)
6. Professional and Technical Communication (Course Outcomes 7, 9)
7. Independent Learning Ability (Course Outcomes 9)

Issue Date: September 2015
Next Revision: September 2019
Module Title: POWER ELECTRONICS

Code: TECC3791
NQF Level: 7
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TETE3691 Analogue Electronics I

Content: Applications and the Role of Power Electronics in Sustainable Energy. **Power Electronic Devices:** Power electronics circuits. Construction and principles of operation (Diodes, BJTs, MOSFETS, IGBTs, SCRs, TRAICs, GTOs, and IGCTs). **Power Converter Analysis:** DC-DC Converters, AC-DC Converters, AC-AC Converters and DC-AC Converters. **Application of Power Converters in:** Linear Power Supplies, Switch Mode Power Supplies (SMPs), DC Motor Adjustable Speed Drives (ASDs), AC Motor Adjustable Speed Drives (ASDs) and Electrical Power Transmission. **Industrial applications:** UPS, HVDC/HVAC systems configurations. Design and simulation of simple converter circuits. Practical issues in the design and operation of converters.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Describe the operation of diode and SCR based power electronic circuits
2. Demonstrate an understanding of the basic concepts of switched-mode power supplies and control principles
3. Analyze the steady state operating Characteristics of switching converters
4. Illustrate the operation and apply power electronic devices in Linear dc power supplies
5. Analyze 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

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)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 7)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENTREPRENEURSHIP

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<tr>
<td>Contact Hours</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3761 Fundamentals of Economics</td>
</tr>
</tbody>
</table>


Learning Outcomes: On completing the course students should be able to:

1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Discuss the methods used to carry out feasibility studies
3. Develop a business plan relating to an engineering endeavor
4. Discuss the concepts of motivation, competencies, innovation and product marketing
5. Describe the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Contribution to Exit Level Outcome:

7  Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11 Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
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<table>
<thead>
<tr>
<th>Module Title</th>
<th>HIGH VOLTAGE ENGINEERING</th>
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<tr>
<td>Code</td>
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<td>NQF Level</td>
<td>7</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TECE3731 Fundamentals of Power Systems</td>
</tr>
</tbody>
</table>

**Content:**

**Fields:** Field Concepts, electrostatic and magnetic fields. **Conduction and Breakdown:** Conduction and breakdown processes in gases, liquids and solids. **Generation of High Voltages and Currents:** HVDC, HVAC, Impulse Voltages and Currents. **Measurement and Testing of HV and High Currents:** Measurement of High DC, High AC and Impulse Voltages, Measurement of High DC, AC and Impulse Currents. **Overvoltage and Insulation Coordination:** Overvoltages and their causes, principles of insulation.

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Demonstrate an understanding of the generation of HV and high currents.
2. Describe HV and high current measurement methods.
3. Conduct selected HV and high current measurements.
4. Describe the standard HV tests, and design the test generator circuits for ac, dc and impulse voltages (and currents).
5. Demonstrate an understanding of overvoltage; types and causes where necessary

**Contribution to Exit Level Outcome:**

2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 5)
3. Engineering Design (Course Outcomes 4)

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<thead>
<tr>
<th>Module Title</th>
<th>COMPUTER NETWORKS</th>
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<td>Contact Hours</td>
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<tr>
<td>Assessment</td>
<td>Continuous (at least 2 Assignments – 20%, at least 2 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 2 hour paper)</td>
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<td>Pre-requisite</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
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</table>

**Content:** 

**Data communications,** network architectures, communication protocols, data link control, medium access control; introduction to local area networks metropolitan area networks and wide area networks; introduction to Internet and TCP/IP. **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:** Threats, secret-key crypto, public key Algorithms, intrusion detection, authentication systems, Kerberos, email security (PGP, SMIME), firewalls, WWW security.

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss computer network layers
2. Compare the OSI model and the TCP/IP model
3. Understand the issues related to addressing between networks
4. Identify common security risks for Internet-connected computers.
5. Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
6. Distinguish between the different threats to wireless network security and different types of security threats.
7. Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.
8. Independently study and make a presentation on one emerging network technology.

**Contribution to Exit Level Outcome:**

2. Application of Scientific and Engineering Knowledge (Course Outcomes 4, 5, 6, 7)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 7)
9. Independent Learning Ability (Course Outcomes 8)

**Issue Date:** September 2015  
**Next Revision:** September 2019
<table>
<thead>
<tr>
<th>Module Title</th>
<th>POWER TRANSMISSION AND DISTRIBUTION</th>
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<tr>
<td>Code</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<tr>
<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>50% continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%) Examinations 50% (1 x 3 hour paper).</td>
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<td>Pre-requisite(s)</td>
<td>TECP3622 Electrical Machines</td>
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<tr>
<td>Co-requisite(s)</td>
<td>(TECE3731 Fundamentals of Power systems)</td>
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</table>

**Content:** Power generation, transmission and distribution network architecture and composition, network equations and solutions; symmetrical components; parameters and equivalent circuits in symmetrical components for overhead and underground lines, transformers, generators and loads; substations; industrial networks; network steady-state analysis; faults; voltage and power static control; power system stability and methods of improving stability. Symmetrical components and fault calculations.

**Learning Outcomes:** On completing the course students should be able to:
1. Demonstrate an understanding of electric power generation methods, distribution systems and equipment.
2. Demonstrate an understanding of the principles of operation and applied design of bulk power distribution and transmission systems and substations.
3. Discuss the main issues concerning the design and performance of a large power networks.
4. Develop models and analytical techniques used in the calculation of the characteristics and specification of the main items of equipment involved in the generation, transmission and distribution and protection of electrical power.
5. Develop and demonstrate the use of system models for unsymmetrical fault analysis and load flow studies.
6. Analyse the stability of power systems using appropriate software and tools

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)
9. Independent Learning Ability (Course Outcomes 5, 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: ELECTRICAL ENGINEERING DESIGN

Code: TECE3762
NQF Level: 7
Contact Hours: 2L +1T or 1PS/Week
NQF Credits: 8
Assessment: 100% continuous (at least 2 tests - 50%, at least 2 labs - 10%, at least 2 assignments -10%, Mini Project 30%).
Co-requisite(s): TECE3711 Electrical Engineering machines Analysis and Design
TECE3731 Fundamentals of Power Systems

Content: The purpose of the course is to provide students a major design experience in power systems that prepare them for engineering practice. Major design experience in electric power systems. Application of power system fundamentals to the design of a system incorporating engineering standards and realistic constraints. Use of computational tools for the design and analysis of power electronics systems. Provide an insight into the main issues concerning the design and performance of a large power network, to develop models and analytical techniques used in the calculation of the characteristics and specification of the main items of equipment involved in the generation, transmission and distribution of electrical power. Use of modern CAD software for design, modelling and simulation of power systems.

Learning Outcomes: On completing the course students should be able to:
1. Use both basic circuit theorems as well as more advanced circuit analysis methods
2. Discuss basic concepts related to energy utilization, generation planning, tariff, power quality, energy efficiency, and demand side management.
3. Perform component modeling and power system analysis using per unit system.
4. Analyse and design Electrical circuits
5. Use computer based software for electrical circuits design, power system analysis software and simulation
6. Apply methods and tools used in the design process to analyse and test an electrical circuit system
7. Make a presentation on electrical engineering design to demonstrate independent learning abilities

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2)
3. Engineering Design (Course Outcomes 4, 6)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5, 6)
6. Professional and Technical Communication (Course Outcomes 7)
9. Independent Learning Ability (Course Outcomes 7)

Issue Date: September 2015
Next Revision: September 2019
Module Title: RENEWABLE ENERGY TECHNOLOGIES

Code: TECC3792

NQF Level: 7

Contact Hours: 3L + 2T or 1PS/Week

NQF Credits: 12

Assessment: Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)

Pre-requisite(s): TEGT3542 Fundamentals of Electrical Engineering

Content: Fundamentals of various sources of renewable energy and their applications: Solar (thermal and photovoltaic), fuel cells, hydroelectric, bio-energy, wind energy, tidal power, wave energy, geothermal energy, ocean thermal, heat pump systems. Wind Power generation. Aspects of performance analysis and system design/sizing of renewable energy systems for building integration. The course provides opportunities to gain experience in issues of technology selection, system design, installation and performance analysis of a range of renewable energy systems. The module will emphasize on solar energy technologies (photovoltaic and solar thermal systems) and small scale wind turbines.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Analyze and design energy systems to supply the electricity/heat/cooling requirements using wind energy, bio-energy and/or solar energy.
2. Describe in detail the fundamentals and main characteristics of wind energy, bio-energy and solar energy and their differences compared to fossil fuels.
3. Describe in detail the main components of these 3 different renewable energy systems.
4. Explain the technological basis for harnessing these renewable energy sources.
5. Recognize the effects that current energy systems based on fossil fuels have over the environment and the society.
6. Compare different renewable energy technologies and choose the most appropriate based on local conditions.
7. Design and dimension technological solutions based on wind energy, bio-energy or solar energy that meet specific energy demands, are economically feasible and have a minimal impact on the environment.

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)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 7)
5. Sustainability and Impact of Engineering Activity (Course Outcomes 4, 5, 6, 7)

ECN Exit Level Outcomes Assessed:

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 constitute the following:

At least 2 Assignments and at least 2 Tests making 30%, Presentation (10%) and Report on selected topics in renewable energy technologies 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 7 assessed in the presentation and the submitted report as follows:

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. This exit level outcome will be assessed through a 3 hour exam paper concentrating on sustainability and impact of engineering activity on the social, industrial and physical environment and how these aspects are considered in the engineering analysis and design.

What constitute 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.

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:** INDUSTRIAL ATTACHMENT II  
**Code:** TEGT3700  
**NQF Level:** 7  
**Total Hours:** Six (6) weeks preferably during the June/July break in Year 3 or 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:** TEGT3600 Industrial Attachment I  

**Content:** During Industrial Attachment II, 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. Distinguish the roles of technologists and technicians in an industrial setting and identify the associated reporting channels.
2. Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
3. Describe the main technical activities undertaken during the attachment.
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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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

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 work 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 constitute 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 constitute 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.

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<tr>
<th>Module Title</th>
<th>CONTROL ENGINEERING</th>
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<td>Code</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 1PSWeek</td>
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<tr>
<td>NQF Credits</td>
<td>12</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 1 Assignment, At least 2 Tests and a mini-project), Examination 50% (1 x 3 hour paper)</td>
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<td>Pre-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
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**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. Analyze 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)

**Issue Date:** September 2015
**Next Revision:** September 2019
<table>
<thead>
<tr>
<th>Module Title</th>
<th>COMPUTATIONAL METHODS IN POWER ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>TECE 3891</td>
</tr>
<tr>
<td>NQF Level</td>
<td>8</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>12</td>
</tr>
<tr>
<td>Assessment</td>
<td>100% continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TECE3731 Fundamental of Power Systems</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>(TECP3831 Protection of Power Systems)</td>
</tr>
</tbody>
</table>

**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 modeling 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)
3. 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 constitute 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.

**Issue Date:** September 2015
**Next Revision:** September 2019
<table>
<thead>
<tr>
<th>Module Title</th>
<th>POWER SYSTEMS PROTECTION</th>
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<tbody>
<tr>
<td>Code</td>
<td>TECP3831</td>
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<tr>
<td>NQF Level</td>
<td>8</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
<td>16</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 Assignments - 30%, At least 2 Tests - 70%), Exam 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TECE3791 Electric Circuit Analysis II</td>
</tr>
</tbody>
</table>

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. Analyze 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)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MICROPROCESSORS 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


PLCs: Definition of PLCs, need for the PLC and principles of operation, Ladder diagrams and the PLC, advantages of PLC based 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 programing 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 programs.
6. Describe the architecture and principles of operation of PLCs
7. Demonstrate an understanding of IEC standard and languages
8. Describe the PLC programing techniques and languages
9. Design PLC Programs for PLC based control applications
10. Program 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)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 10)

Issue Date: September 2015
Next Revision: September 2019
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 conduct 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 analyze, interpret and derive information from data.

What constitute 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, modeling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

*What constitute 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 constitute 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.

**Issue Date:** September 2015  
**Next Revision:** September 2019
Module Title: ELECTRICAL DESIGN PROJECT

Code: TECO3890

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, 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.

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, analyze and solve complex engineering problems creatively and innovatively. The final design report should show evidence of the student’s ability to identify, analyze 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 constitute 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 modeling and optimization.

What constitute 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 constitute 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.

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<thead>
<tr>
<th>Issue Date:</th>
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<tbody>
<tr>
<td>Next Revision:</td>
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**Module Title:** INDUSTRIAL ATTACHMENT III

<table>
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<tr>
<th>Code</th>
<th>TEGT3800</th>
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<tr>
<td>NQF Level</td>
<td>8</td>
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<tr>
<td>Total Hours</td>
<td>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.</td>
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<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (Daily Logbook Record 20%, Lecturer/Employer Evaluation 20% and Final Report 60%).</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3700 Industrial Attachment II</td>
</tr>
</tbody>
</table>

**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 hands-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.

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<thead>
<tr>
<th>Issue Date:</th>
<th>September 2015</th>
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<tbody>
<tr>
<td>Next Revision:</td>
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</table>
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.

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) semesters. A semester consists of 14 weeks of lectures plus 2 weeks of university examinations. Year 1 of study (semesters 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.

<table>
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<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>NQF LEVEL</th>
<th>NQF CREDITS</th>
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<td>1</td>
<td>Engineering Mathematics I</td>
<td>TEGM3591</td>
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<tr>
<td>1</td>
<td>Engineering Drawing</td>
<td>TEGT3561</td>
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<tr>
<td>1</td>
<td>Physics for Physical Sciences I</td>
<td>SPHY3511</td>
<td>5</td>
<td>16</td>
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<td>1</td>
<td>Computing Fundamentals</td>
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<td>Workshop Practice</td>
<td>TEGW3590</td>
<td>5</td>
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<td>1</td>
<td>Materials Science</td>
<td>TEGS3591</td>
<td>5</td>
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<td>1 and 2</td>
<td>Contemporary Social Issues</td>
<td>UCSI3580</td>
<td>5</td>
<td>8</td>
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<td>1</td>
<td>Fundamentals of Engineering</td>
<td>TEGT3521</td>
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Total Credits Semester I: 80

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<th>SEMESTER</th>
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<td>5</td>
<td>16</td>
<td>TEGM3591</td>
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<tr>
<td>2</td>
<td>Fundamentals of Electrical Engineering</td>
<td>TEGT3542</td>
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<td>8</td>
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<td>Physics for Physical Sciences II</td>
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<td>16</td>
<td>SPHY3511</td>
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<tr>
<td>2</td>
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<td>2</td>
<td>English for Academic Purposes</td>
<td>ULEA3519</td>
<td>5</td>
<td>16</td>
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</table>

Total Credit Semester II: 84

NB: Students who have done UCSI3529, ULEA3519, SPHY3511, SPHY3512 and SCHM3512 will be exempted from taking them in this year.
### YEAR 2 OF BSc IN MECHANICAL ENGINEERING – 140 Credits

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
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<th>NQF CREDITS</th>
<th>PRE &amp; CO-REQUISITE</th>
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Total Credits Semester III: 68

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Total Credits Semester IV: 68

### YEAR 3 OF BSc IN MECHANICAL ENGINEERING – 144 Credits

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<td>Modelling and Analysis of Dynamic Systems</td>
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Total Credits Semester V: 72

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Total Credits Semester VI: 72
### YEAR 4 OF BSc IN MECHANICAL ENGINEERING – 140 CREDITS

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**Total Credits Semester VII** 76

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**Total Credits Semester VIII** 64

**TOTAL CREDITS FOR THE DEGREE OF BSc IN MECHANICAL ENGINEERING (HONOURS)** 584
G.13.  DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

YEAR 1 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 1

Module Title: ENGINEERING MATHEMATICS I

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<tr>
<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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Learning Outcomes: Upon completion of this module, students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to engineering
4. Apply trigonometry in solving mathematical and engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
6. Solve mathematical and engineering problems using partial differentiation

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 2 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING DRAWING

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<td>Assessment</td>
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<td>Pre-requisite(s)</td>
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Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free-hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: Isometric and oblique representations, sections of cones – interpenetrations, developments.

Learning Outcomes: Upon completion of this 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 drawings and assembly drawings of various engineering components

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019
Module Title: PHYSICS FOR PHYSICAL SCIENCES I

Code: SPHY3511  
NQF level: 5  
Contact hours: 4L + 2T or 1 PS/Week  
NQF Credits: 16  
Assessment: Continuous 50%, Examination 50% (1 x 3 hour paper)  
Pre-requisite(s): None

Contents: Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton's laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler’s laws; pressure; Archimedes’ principle; laminar flow; Bernoulli’s equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

Learning Outcomes: Upon completion of the module, the student is expected to:
1. Employ units, do unit conversions and use of significant figures.
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.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4 Investigations, Experiments and Data Analysis (Course Outcome 9)

Issue Date: September 2015  
Next Revision: September 2019
Module Title: COMPUTING FUNDAMENTALS

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<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)</td>
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<td>Pre-requisite(s)</td>
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Learning Outcomes: Upon completion of this module, students should be able to:

1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

CONTRIBUTION to Exit Level Outcome

5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

Issue Date: September 2015
Next Revision: September 2019
Module Title: WORKSHOP PRACTICE

Code: TEGW3590
NQF Level: 5
Contact Hours: 2L + 1PS/Week
NQF Credits: 8
Assessment: Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.

Pre-requisite(s): None


Learning Outcomes: Upon completion of this course, students should be able to:

1. Describe general safety procedures applicable to engineering workshops.
2. Describe specific hand tools used in engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of 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.
10. Install air-conditioning and refrigeration systems
11. Describe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MATERIALS SCIENCE

Code: TEGS3591
NQF Level: 5
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s): None


Learning Outcomes: On completing the course students should be able to:
1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
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. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

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

Issue Date: September 2015
Next Revision: September 2019
Module Title: CONTEMPORARY SOCIAL ISSUES

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<tr>
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<td>Continuous Assessment (100%). variety of assessments which evaluate and test the students’ individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.</td>
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<tr>
<td>Prerequisite</td>
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Module Descriptor: The module, Contemporary Social Issues (CSI3580), is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

Learning Outcomes

By the end of this module students should be able to:

- Contribute to family, community and society;
- Develop social consciousness, thinking skills, self-concepts as well as moral and ethical sensitivity;
- Illustrate key contemporary social issues and challenges experienced within the Namibian society and globally;
- Discuss the role of human conduct, structures, institutions and relations of power in shaping social life in the country;
- Promote ethical and moral reasoning, anticorruption behaviours, human rights, healthy lifestyles, gender equality, productive citizenship, responsible leadership, social media ethics and environmental sustainability; and
- Open their minds to possible meaningful and worthwhile career opportunities.

Contribution to Exit Level Outcome:

10 Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

Issue Date: September 2015
Next Revision: September 2019
### Module Title: FUNDAMENTALS OF ENGINEERING

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<td>Assessment</td>
<td>100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)</td>
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<td>Pre-requisites</td>
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**Content:** Introduction to Engineering: What is engineering? Historical perspective of engineering, Common traits of good engineers; The Technology team (Scientist, Engineers, Technologist, Technician and Artisans) Difference between Scientific and Engineering Methods, Engineering Job Functions. **Branches of Engineering:** Civil, Electronics and Computer, Electrical, Mechanical, Metallurgical, Mining and others. **Engineering as a Profession:** Engineering Council of Namibia (ECN), Professional engineers – how to become one and significance of having the title. Professional Societies. **Introduction to Engineering Design and Problem Solving:** Types of Problems, Problem Solving Approach and Skills, The Design process, Brainstorming, Criteria and Evaluation, Sustainability. **Engineering Ethics:** Interaction Rules, Ethical decision making, Plagiarism, Settling Conflicts, Moral theories and The Ethical Engineer. **Engineering tools:** Presentation software, Internet as a research tool, Computational tools – Microsoft Excel. **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

**Learning Outcomes:** Upon completion of this module, students will be able to:

- Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
- Describe the various branches of engineering, possible careers, and job prospects
- Describe how to solve basic engineering problems
- Identify general steps involved in engineering design and communication
- Use modern engineering and communication tools and procedures.

**Issue Date:** September 2015  
**Next Revision:** September 2019
SEMESTER 2

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<th>ENGINEERING MATHEMATICS II</th>
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**Learning Outcomes:** Upon completion of this 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. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and engineering problems

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 1, 2, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
### Module Title: FUNDAMENTALS OF ELECTRICAL ENGINEERING

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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous Assessment 100% (2 tests - 60%, 2 quizzes - 20%) and 2 practical labs - 20%)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>


**Learning Outcomes:** Upon completion of this 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
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

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** September 2019

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### Module Title: PHYSICS FOR PHYSICAL SCIENCES II

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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports) , Examination 50% (1 x 3 hour paper)</td>
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<td>Co-requisite(s)</td>
<td>SPHY3511 Physics for Physical Sciences I</td>
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</tbody>
</table>

**Contents:** Electric charge; insulators and conductors; Electric force and coulomb’s law, Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm’s law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

**Learning Outcomes:** Upon completion of this 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.

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: ENGINEERING MECHANICS I

Code: TEGT3592
NQF Level: 5
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 tests and 4 assignments); Examination 50% (1 x 3 hour paper)
Co-requisite(s): SPHY3511 Physics for physical Sciences I


Learning Outcomes: Upon completion of this 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

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1-6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: CHEMISTRY 1B

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<td>NQF Credits</td>
<td>16</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)</td>
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</table>

Pre-requisite(s): None

Content: Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria. The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Explain and use the gas laws
2. Discuss energy changes in chemical reactions
3. Analyse the rates of chemical reactions.
4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
5. Distinguish between the three laws of thermodynamics
7. Demonstrate an understanding of how galvanic cells work.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGLISH FOR ACADEMIC PURPOSES

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<td>Continuous: 60% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper) Examination: (40%) made up of 1 x 3 hour examination paper</td>
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<td>ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE</td>
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Learning outcomes: Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

Contribution to Exit Level Outcome:
   6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
   9 Independent Learning Ability (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING MATHEMATICS III

Code: TEGT3671
NQF Level: 6
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: 50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s): TEGM3512 Engineering Mathematics II
Co-requisite(s): TEGM3512 Engineering Mathematics I

Content: Vector Calculus: Vector functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binormal, torsion, curvature, the gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Functions of Several Variables: Functions of several variables, limits, continuity derivatives, differentials, the Jacobian matrix and determinants, composite functions, higher order derivatives, extrema with constraints, surfaces, applications in Science and Engineering Integral Transforms: Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems. Power series solutions of second order ordinary differential equations and introduction to Bessel functions. Analytic functions: Cauchy-Riemann equations, Cauchy’s theorem, Cauchy’s integral formulæ, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem, evaluation.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply differential vector calculus to solve mathematical and engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving engineering problems
4. Apply the power series method in approximation of solutions of ordinary differential equations
5. Describe the basis for complex analysis in engineering problem solving
6. Apply the residual theorem to engineering problems.

CONTRIBUTION to ECN 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 and 6)
5. Engineering Methods, Skills, and Tools including Technology (Course Outcomes 1, 2, 3, 4 and 6)

Issue Date: September 2015
Next Revision: September 2019
## Module Title
COMPUTER SCIENCE FOR ENGINEERS

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<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).</td>
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<td>Pre-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
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**Content:** Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. Binary Trees and their applications. Programming using MATLAB. Application of MATLAB programming to actual engineering situations. Programming project. MATLAB Basics: variables and arrays, multidimensional arrays. Branching statements and program: Program design, Top-down, Bottom-up Techniques. Control Statements. **User-defined functions:** Operational arguments, sharing data using global memory. **Pre-defined functions.** Complex Data: Character data and additional plot types. Graphical User Interface, Advantages and Disadvantages of MATLAB. Introduction to C programming language.

**Learning Outcomes:** On completing the course students should be able to:

1. Generate data structures and algorithms
2. Apply binary trees to specific programming environment
3. Demonstrate knowledge of MATLAB programming
4. Create and use user-defined MATLAB functions
5. Apply MATLAB programming for solving engineering problems
6. Write simple C programs

**CONTRIBUTION to ECN Exit Level Outcome:**

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

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: ENGINEERING MECHANICS II

Code: TEGT3641
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Co-requisite(s): TEGT3592 Engineering Mechanics I


Learning Outcomes: On completing the course 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. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, 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. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

CONTRIBUTION to ECN Exit Level Outcome:
1. Problem Solving (Course Outcomes 3, 4, 5 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5 and 6)
5. Engineering Methods, Skills, and Tools including Technology (Course Outcomes 3, 4, 6 and 7)

Issue Date: September 2015
Next Revision: September 2019
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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
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</table>

**Contents:** Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; Sampling Distributions: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; Linear Regression and Correlation: Simple and Multiple Linear Regression, Correlation; Analysis of Variance: Completely Randomized and Randomized Block Designs, Multiple Comparisons;

**Learning Outcomes:** On completing the course students should be able to:

1. Describe the theory of probability
2. Analyse data using probability distribution and densities
3. Use the principles of sampling distribution to analyse data
4. Apply linear regression and correlation to a set of data
5. Apply analysis of variance to solve engineering problems

**Contribution to Exit Level Outcome:**

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

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: STRENGTH OF MATERIALS I

Code: TCVM3621
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Pre-requisite(s): TEGT3592 Engineering Mechanics I

Content: Basic concepts: Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams. Stress and strain: Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke’s Law; Modulus of Elasticity; Normal stress and strain; Poisson’s ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson’s ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants. Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems: Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars. Geometrical characteristics of plane sections: Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem. Bending: Shear force and bending moment diagrams. Bending and shear stresses in beams: Theory of beam bending; Section modulus; Composite beams; Shear stress distribution due to bending. 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 and longitudinal stress.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Demonstrate the application of Hooke’s Law to normal and shear stresses.
2. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
3. Calculate geometrical characteristics of plane sections.
4. Draw bending and shear force diagrams in beams.
5. Analyse bending and shear stresses in beams.
6. Solve problems involving shear stresses and shear flow in beams.
7. Analyse stresses and strains in circular shafts subjected to torsion.
8. Analyse stresses in thin cylinders and spheres subjected to internal pressure. Analyse stresses in thin cylinders and spheres subjected to internal pressure.

CONTRIBUTION to ECN Exit Level Outcome:
1. Problem Solving (Course Outcomes 2 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 5, 7 and 8)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FLUID MECHANICS

Code: TMEM3681
NQF Level: 6
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s): TEGT3592 Engineering Mechanics I

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 (constant acceleration); forces on submerged surfaces; buoyancy. One-dimensional flows with inertia: 1-D mass conservation; 1-D momentum conservation (Bernoulli equation); total head diagrams; free liquid jets; flow measurement. Hydraulic systems: Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram); general loss coefficients.

Learning Outcomes: Upon completion of this 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 Bernoulli’s equation
3. Demonstrate skills for flow measurements
4. Solve general hydraulic systems with respect to energy changes, pipe friction, loss coefficient.

CONTRIBUTION to ECN Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4 and 5)

Issue Date: September 2015
Next Revision: September 2019
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<th>Module Title:</th>
<th>COMPUTER AIDED DRAWING</th>
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<td>Assessment</td>
<td>Continuous 100% (2 tests 40%, 4 assignments 35%, mini-project 25%)</td>
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<td>Co-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3561 Engineering Drawing</td>
</tr>
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</table>

**Content:** Getting started; Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; 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 your drawing; Working in three-dimensional space; Creating three-dimensional objects.

**Learning Outcomes:** Upon completion of this 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

**CONTRIBUTION to ECN Exit Level Outcome:**
3 Engineering Design (Course Outcomes 1, 2, 3 and 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: ENGINEERING MATHEMATICS IV

Code: TEGT3672
NQF Level: 6
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TEGM3512 Engineering Mathematics II
Co-requisite(s): TEGT3671 Engineering Mathematics III


Learning Outcomes: On completing the course students should be able to:

1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green's theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications.

CONTRIBUTION to ECN Exit Level Outcome:

1. Problem Solving (Course Outcome 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3 and 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING THERMODYNAMICS

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<td>Assessment</td>
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<td>Pre-requisite(s)</td>
<td>SCHM3512 Chemistry 1B</td>
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Contents: 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.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Discuss the first law of thermodynamics and its applications to non-flow and flow processes.
2. Discuss and quantify the properties of working fluids.
3. Interpret and use thermodynamic property diagrams.
4. Apply the equation of state of a perfect gas.
5. Discuss the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.

**CONTRIBUTION to ECN Exit Level Outcome:**
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4 and 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title: HIV AND THE ORGANIZATION

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<tr>
<td>Contact Hours</td>
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<td>Pre-requisite(s)</td>
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Content: The Engineer and HIV: Basic facts of HIV and AIDS; Prevention, Counselling and Testing, and Treatment of HIV and AIDS; Drivers of the HIV and AIDS Epidemic in Namibia, The Engineering Sector and HIV and AIDS. **Impact of HIV and AIDS:** Socio-Economic Impacts on the workforce; Impact Assessment; HIV and AIDS cost benefit analysis. **HIV and AIDS Mitigation:** The Policy Environment; Design and Implementation of HIV and AIDS workplace programmes

Learning outcomes: Upon completion of the module students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

Issue Date: September 2016
Next Revision: September 2020
Module Title: MECHANICAL ENGINEERING DESIGN I

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<td>Assessment:</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3592 Engineering Mechanics I</td>
</tr>
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**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Discuss the methodology for engineering design
2. Discuss key features in the design of machine elements
3. Use codes of practice for mechanical engineering and Mechanical engineering drawing
4. Use Auto-CAD software in mechanical engineering drawing and design
5. Discuss basic mechanisms used in machine design
6. Discuss the fundamentals of different methods of mechanism design, analysis and synthesis

**CONTRIBUTION to ECN Exit Level Outcome:**

3 Engineering Design (Course Outcomes 1, 2, 3, 4, 5 and 6)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: ENGINEERING MATERIALS

Code: TMEM3622
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Co-requisite(s): TEGS3591 Materials Science


Learning Outcomes: Upon completion of this 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.

CONTRIBUTION to ECN Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3 and 4)

Issue Date: September 2015
Next Revision: September 2019
## Module Title
COMPUTER PROGRAMMING

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<td>Assessment</td>
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</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TCME3621 Computer Science for Engineers</td>
</tr>
</tbody>
</table>

### Content: Problem Solution and Software Development
- Top-down stepwise refinement approach.
- Structured Programming: variables and constants; comments, input and output and file management. Elements of data structures.
- C Declarations, Expressions and Operators: Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Enums and Structs.
- Selection Structures. Using if statements; the Nested if; the switch statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields.
- Repetition Structures. The while loop; Writing typical Loops; The for Loop; Nested Loops; Using Loops with Structure Fields.
- Arrays, Strings, and Pointers: Arrays; Storing Values in Arrays; Accessing and Using Array Values; Creating Arrays of Structure Objects; Using Strings; Pointers in C. The C Functions: Functions definition; Functions declaration; Functions calling; Functions arguments; Recursion and Recursive Functions to Sort a List.
- Object Oriented Programming: Classes. Creating Classes; Encapsulating Class Components; Implementing Class Functions; Using Static Class Members; Polymorphism.
- Advanced Topics: Class Features and Design Issues; Friends and Overloading Operators; Overloading Functions; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; Using Enumerators;

### Learning Outcomes:
- Apply problem solving techniques to computational and engineering problems.
- Design and present algorithms for solving given problems using flowchart or pseudo code.
- Develop structured programs in C programming language.
- Use pointers effectively.
- Describe concept of object-oriented programming.
- Work with object oriented concepts and terminologies such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
- Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++

### CONTRIBUTION to ECN Exit Level Outcome:
1. Problem Solving (Course Outcomes 1 and 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 6 and 7)
3. Engineering Design (Course Outcomes 2 and 3)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 3, 4 and 7)
5. Professional and Technical Communication (Course Outcomes 7)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ELECTRICAL MACHINES

Code: TECP3622  
NQF Level: 6  
Contact Hours: 2L + 1T or 1PS/Week  
NQF Credits: 8  
Assessment: Continuous 100%  
Pre-requisite(s): TEGT3542 Fundamentals of Electrical Engineering

Content: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines**: Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers**: Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine)**: generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine**: introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, special cage motors, induction regulators, energy recovery techniques. **Drives Applications**.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Demonstrate an understanding of the principle of operation of electrical machinery
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.
3. Describe the principle of operation and applications of transformers and AC windings
4. Describe the principle of operation and applications of three-phase induction machines
5. Demonstrate an understanding of special-purpose motors and VSDs.

**CONTRIBUTION to ECN Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3 and 4)

Issue Date: September 2015  
Next Revision: September 2019
Module Title  |  MEASUREMENTS AND INSTRUMENTATION
---|---
Code  |  TETA3622
NQF Level  |  6
Contact Hours  |  2L + 1T or 1PS/Week
NQF Credits  |  8
Assessment  |  Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite(s)  |  TEGT3542 Fundamentals of Electrical Engineering

Contents: Systems of Units and Standards of Measurement, Elements of generalized measurement system, Functional elements of an instrument, Static characteristics (Accuracy, Precision, Error, Sensitivity, Reproducibility, and Tolerance) Dynamic characteristics (Speed of response, Fidelity, Lag, dynamic error). Instrument classification, Methods of Measurement, Calibration, Noise, interference and grounding, Sources of Errors and types of Errors, Digital and analogue Instruments, Bridge measurement (Wheatstone, Kelvin, Maxwell etc.), Measurements of electrical and non-electrical quantities (including high frequency signals), Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Introduction to Programmable Logic Controllers (PLCs).

Learning Outcomes: On completing the course students should be able to:
1. Explain different types and methods of measurements.
2. Describe static and dynamic characteristics of an instrument.
3. Explain the importance of signal generators and signal analyzers in measurements.
4. Classify, calculate errors and reduce them in measurements.
5. Describe the concept of instrument calibration.
6. Explain the use of sensors and transducers.
7. Practically measure different quantities (including high frequency signals), analyse and interpret the measurement results.
8. Describe the architecture and operation of PLCs

Contribution to Exit Level Outcome:
2  Application of Scientific and Engineering Knowledge (Course Outcomes 4 and 6)
4  Investigations, Experiments and Data Analysis (Course Outcomes 7)
5  Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4)

Issue Date:  |  September 2015
Next Revision:  |  September 2019
Module Title: INDUSTRIAL ATTACHMENT I

Code: TEGT3600
NQF Level: 6
Total Hours: Six (6) weeks preferably during the June/July break in Year 2 or Year 3 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%).
Pre-requisite: TEGW3590 Workshop Practice

Content: During Industrial Attachment I, students will work under company supervision at the level of an Artisan and will undertake at least six 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. Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
2. Discuss the major industrial processes involved in a typical engineering activity associated with the students’ discipline.
3. Describe the major tools, equipment and machinery used in industry associated with activities in the students’ discipline.

Revision: 2 September 2015
Next Revision: September 2019
YEAR 3 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 1

Module Title: MANUFACTURING TECHNOLOGY

<table>
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<tr>
<th>Code</th>
<th>TMEM3731</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>7</td>
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<tr>
<td>Contact Hours</td>
<td>4L + 2Tor 1PS/Week</td>
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<tr>
<td>Credits</td>
<td>16</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TMEM3622 Engineering Materials</td>
</tr>
</tbody>
</table>


Learning Outcomes: Upon completion of this module, students will be able to:

1. Apply the knowledge of elastic and plastic behaviour of materials to metal forming, forging, extrusion, wire drawing and printing
2. Describe the processes of annealing and recrystallization
3. Describe the principles of metal cutting
4. Describe metal casting processes and basic foundry operations for ferrous and non-ferrous metals
5. Describe the various casting defects and how to control them.
6. Describe the principles of various welding processes used in engineering and associated welding parameters
7. Describe the principles of non-conventional cutting techniques used in engineering
8. Apply the knowledge of powder metallurgy to composite materials and to surface engineering
9. Discuss the various techniques used in the processing and forming of plastics and rubber

CONTRIBUTION to ECN Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1 and 8)
5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 5, 6, 7 and 9)

Revision: 2 September 2015
Next Revision: September 2019
Module Title: FUNDAMENTALS OF ECONOMICS

Code: TEGT3761
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (4 assignments, 2 Tests); Examination 50% (1 x 2 hour paper)
Pre-requisite(s): None

Content: Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. Macroeconomics: inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. Financial accounting: nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. Introduction to budgeting, Introduction to marketing. Long and short-term decision making.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4 and 5)

Issue Date: September 2015
Next Revision: September 2019
**Module Title:** MODELLING AND ANALYSIS OF DYNAMIC SYSTEMS

<table>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
<td>12</td>
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<tr>
<td>Assessment</td>
<td>Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper). To pass this module a student should obtain a minimum final mark of 50%</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
</tr>
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</table>

**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 dynamic systems (thermos-fluid systems, dynamic systems, machines) 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:** Upon completion of this module, students should be able to:

1. Discuss different control theory terminologies.
2. Model basic mechanical systems as a control systems or part of parts of control systems.
3. Analyse given mechanical 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. 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)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: ADVANCED FLUID MECHANICS

Code: TMER3721  
NQF Level: 7  
Contact Hours: 2L + 1T or 1PS/Week  
NQF Credits: 8  
Assessment: Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)  
Pre-requisite(s): TME3611 Fluid Mechanics

Contents: Thermodynamic and dynamic principles applied to fluid behaviour, stream function and velocity potential, ideal, viscous and compressible fluids under internal and external flow conditions. Inviscid flow, boundary layer, vorticity and rotation of fluid particles. Navier-Stokes equations, flow through pipes and ducts. High and low Reynolds number flows. Two-dimensional potential flow. Shocks and aerofoil theory.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Analyse boundary layer in fluid particles for internal and external flow conditions.
2. Analyse general two-dimensional potential flow.
3. Analyse and describe flow over aerofoil profile.

CONTRIBUTION to ECN Exit Level Outcome:
1. Problem Solving (Course Outcomes 1 and 2)  
5. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2 and 3)

Issue Date: September 2015  
Next Revision: September 2019

Module Title: MECHANICAL ENGINEERING DESIGN II

Code: TMER3781  
NQF Level: 7  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous assessment 100% (2 tests, 4 assignments and 1 mini - Design Project)  
Co-requisite(s): TMEM3642 Mechanical Engineering Design I


Learning Outcomes: Upon completion of this module, students should be able to:
1. Design a range of machine elements as applicable to mechanical engineering and present them as drawings and technical reports.
2. Apply the knowledge of tolerances, fits dynamic loading and power transmission in the design of assemblies.

CONTRIBUTION to ECN Exit Level Outcome:
2. Application of Scientific and Engineering Knowledge (Course Outcome 2)  
3. Engineering Design (Course Outcome 1)  
6. Professional and Technical Communication (Course Outcome 1)

Issue Date: September 2015  
Next Revision: September 2019
Module Title: EXPERIMENTAL AND RESEARCH METHODS

Code: TEGR3760
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 100% (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%)
Pre-requisite(s): TEGS3661 Statistics for Engineers

Content: Experimentation planning and execution. Technical report writing. Report structure and format. Literature Review. Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). Research methodology. Formulation and presentation of research proposals. Statistical data analysis: Data description: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. Data modeling: Experimental data modeling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination $R^2$ and adjusted $R^2$ and the role of adjusted $R^2$ on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

Research Proposal: During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

Learning Outcomes: On completing the course students should be able to:

1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an engineering research process
7. Propose an engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an engineering audience following specified guidelines

CONTRIBUTION to Exit Level Outcome:

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

Issue Date: September 2015
Next Revision: September 2019
# Module Title: MACHINE TOOLS

<table>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous assessment 100% (2 tests, 4 assignments and 1 mini - Design Project)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3592 Engineering Mechanics I</td>
</tr>
</tbody>
</table>

**Contents:** Principal methods of metal cutting. Types of machine tools. Basic operations of the Lathe, shaping machine, milling machine, drilling machine, boring machine. Metal cutting. **Design features of cutting tools.** Economics of cutting. Calculations of feeds, cutting speeds and other parameters. Conventional and unconventional machining. **Computer numerical controlled (CNC) machines.** Automation in machine tools.

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Describe the principles of the various methods used in metal cutting
2. Illustrate the features of various cutting tools and perform calculations on machining parameters
3. Differentiate between conventional and non-conventional machining operations
4. Apply the principle of computer numerical controlled machines

**CONTRIBUTION to ECN Exit Level Outcome:**

1. Problem Solving (Course Outcome 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2 and 4)

**Issue Date:** September 2015  
**Next Revision:** September 2019

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# Module Title: ENTREPRENEURSHIP

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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T/Week</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3761 Fundamentals of Economics</td>
</tr>
</tbody>
</table>

**Contents:** Entrepreneurial perspective: types of entrepreneurs, characteristics of entrepreneurs, examples of successful ventures for national development. Carrying out feasibility studies, writing business plans. Government policies on small business ventures. **Enterprising opportunities:** business motivation, competencies and skills, innovative ideas, product concept and description, market assessment. **Starting new business ventures:** the calculated risk, business planning and organization, management planning, financial projections, possible sources of finance, resource management, projected levels of growth and operations. **Change Management theory.** Group dynamics. Management accounting. **Marketing strategies.**

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Distinguish the methods used to carry out feasibility studies
3. Develop a business plan relating to an engineering endeavor
4. Separate the concepts of motivation, competencies, innovation and product marketing
5. Relate the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

**Contribution to Exit Level Outcome:**

1. Sustainability and Impact of Engineering Activity (Course Outcomes 2)
2. Engineering Management (Course Outcomes 4 and 5)

**Issue Date:** September 2015  
**Next Revision:** September 2019
Module Title: THERMODYNAMICS AND HEAT TRANSFER

Code: TMET3782  
NQF Level: 7  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous 50% (3 tests, 3 assignments and 2 practical reports), written examination 50% (1x3 hour paper)  
Co-requisite(s): TMED3642 Engineering Thermodynamics


Learning Outcomes: Upon completion of this module, students should be able to:

1. Analyse vapour systems and perform calculations on steam, refrigeration and air conditioning
2. Analyse and perform calculations on heat pump systems
3. Illustrate the principles of forced and natural convection and perform calculations on the same
4. Illustrate the principles of heat radiation, heat insulation and appropriate insulation materials

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015  
Next Revision: September 2019

Module Title: COMPUTER AIDED ENGINEERING AND MANUFACTURING

Code: TMER3782  
NQF Level: 7  
Contact Hours: 3L + 2T or 1PS/Week  
NQF Credits: 12  
Assessment: Continuous assessment 100% (2 tests, 4 assignments and 1 mini - Design Project)  
Pre-requisite(s): TEGT3661 Computer Aided Drawing


Learning Outcomes: Upon completion of this module, students should be able to:

1. Differentiate various techniques of 3-D automated modelling
2. Outline the principles of computer aided design
3. Explain the main features of computer integrated manufacturing

CONTRIBUTION to ECN Exit Level Outcome:

1. Engineering Design (Course Outcome 2)
2. Engineering Methods, Skills, Tools and Technology (Course Outcomes 1 and 3)

Issue Date: September 2015  
Next Revision: September 2019
Module Title: SOLID MECHANICS

Code: TMEM3772
NQF Level: 7
Contact Hours: 4L + 2T or 1PS/Week
NQF Credits: 16
Assessment: Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)

Pre-requisite(s): TEGT3592 Engineering Mechanics I


Learning Outcomes: Upon completion of this 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, frames and machines.
2. Apply the method of virtual work for equilibrium and stability analysis.
3. Analyse and solve statically indeterminate problems.
4. Calculate area moments and products of inertia and apply them to mechanics problems.
5. Analyse thermal and assembly stresses
6. Analyse deflection of beams using integration, discontinuity functions and method of superposition.
7. Apply energy methods in stress and strain analysis, deflection and impact loading.
8. Describe and apply Castigliano’s theorem to determine deflection of beams.
9. Analyse composite bodies using the principles of engineering mechanics.
10. Describe design features of composite structures.
11. Analyse stresses in asymmetric solids including cylinders and rotating discs.
12. Describe general theories of failure and demonstrate an understanding of linear elastic fracture mechanics and failure criteria

CONTRIBUTION to ECN Exit Level Outcome:
1. Problem Solving (Course Outcome 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 11)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FUNDAMENTALS OF MECHATRONICS

Code: TMEM3742
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50 (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s): TETA3622 Measurements and Instrumentation


Learning Outcomes: Upon completion of this module, students should be able to:
1. Apply knowledge of mechanisms, electronics and computer technology to model mechatronic systems
2. Illustrate the principles of hydraulic servo systems
3. Outline the application of digital control in mechatronic systems
4. Design simple mechatronic systems or machines

CONTRIBUTION to ECN Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcome 1)
3 Engineering Design Course Outcomes 1 and 3)
5 Engineering Methods, Skills, Tools and including Technology (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: OPERATIONS MANAGEMENT

Code: TEGT3722
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)

Pre-requisite(s): TEGS3691 Statistics for Engineers

Contents: Techniques of Operations Management: Production planning and control systems; material requirements planning; manufacturing resource planning (MRP); measure of performance; techniques for process planning; inventory control. Statistical methods for process control. 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.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Describe the various techniques of operation management
2. Apply knowledge of quality assurance and reliability measures in engineering projects
3. Illustrate the key features of Total Quality Management

CONTRIBUTION to ECN Exit Level Outcome:
1. Engineering Management (Course Outcomes 2 and 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title: RIGID BODY DYNAMICS

Code: TMED3762
NQF Level: 7
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)

Pre-requisite(s): TEGT3641 Engineering Mechanics II


Learning Outcomes: Upon completion of this module, students should be able to:

1. Illustrate the kinematic principles of rigid bodies and perform calculations on the motion of rigid bodies
2. Illustrate the kinetic principles of rigid bodies and perform calculations on plane kinetics
3. Apply the work-energy principle to describe the dynamics of rigid bodies

CONTRIBUTION to ECN Exit Level Outcome:
1. Problem Solving (Course outcome 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2 and 3)

Issue Date: September 2015
Next Revision: September 2019
Module Title: INDUSTRIAL ATTACHMENT II

<table>
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<th>Code</th>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Total Hours</td>
<td>Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.</td>
</tr>
<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).</td>
</tr>
<tr>
<td>Co-requisite</td>
<td>TEGT3600 Industrial Attachment I</td>
</tr>
</tbody>
</table>

**Module Description:** During Industrial Attachment II, students will work under company supervision at the level of Technologist Trainee and will undertake at least six weeks of attachment at an appropriate industry for hands-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. 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 technologists and technicians in an industrial setting and identify the associated reporting channels.
2. Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
3. Describe the main technical activities undertaken during the attachment.

**Issue Date:** September 2015
**Next Revision:** September 2019
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)

Issue Date: September 2015
Next Revision: September 2019
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>MECHANICAL VIBRATIONS</th>
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<tr>
<td>Code</td>
<td>TMER3861</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (2 tests, 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3641 Engineering Mechanics II</td>
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**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) |

**Issue Date:** September 2015

**Next Revision:** September 2019
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:**

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 works 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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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


Learning Outcomes: Upon completion of this 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: THERMAL MACHINES

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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
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<td>Pre-requisite(s)</td>
<td>TMED3642 Engineering Thermodynamics I</td>
</tr>
</tbody>
</table>


**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)

**Issue Date:** September 2015
**Next Revision:** September 2019
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


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)

Issue Date: September 2015  
Next Revision: September 2019
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


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)
4. Professional and Technical Communication (Course Outcomes 7)
5. Sustainability and Impact of Engineering Activity (Course Outcomes 3 and 5)
6. Individual, Team and Multidisciplinary Working (Course Outcomes 4 and 6)
7. Independent Learning Ability (Course Outcomes 2 and 6)
8. Engineering Professionalism (Course Outcomes 4 and 7)

Issue Date: September 2015
Next Revision: September 2019
YEAR 4 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 2

<table>
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<th>Module Title:</th>
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<td>Code</td>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>Assessment</td>
<td>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).</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TMER3792 Research Proposal, All third year modules</td>
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</table>

**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 ANALYSIS**
   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:
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 constitute 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.

ECN Exit Level Outcome 2 – 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 constitute 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 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 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 constitute 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.
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 constitute 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.
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. 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.
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:
ECN exit level outcome 3 – 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.

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 constitute 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.

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. 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 constitute 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.

ECN Exit Level Outcome 10 – 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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.

Issue Date: September 2015
Next Revision: September 2019
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.

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. 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 Year 2, 3 and 4 (semesters III to VII), all students in this degree programme take the same discipline-specific modules and a few common modules. 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 BSc IN METALLURGICAL ENGINEERING – 164 Credits

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>MODULE</th>
<th>CODE</th>
<th>NQF LEVEL</th>
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<tr>
<td>1</td>
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Total Credits Semester I: 80

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Total Credit Semester II: 84

NB: Students who have done UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512 and SCHM3512 will be exempted from taking them in this year.
### YEAR 2 OF BSc IN METALLURGICAL ENGINEERING – 136 Credits

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<tr>
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<th>MODULE</th>
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### YEAR 3 OF BSc IN METALLURGICAL ENGINEERING – 144 Credits

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## YEAR 4 OF BSc IN METALLURGICAL ENGINEERING – 140 CREDITS

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<tr>
<td>1</td>
<td>Society and the Engineer</td>
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**Total Credits Semester VII** 76

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**Total Credits Semester VIII** 64

Total credits for the Degree of BSc in Metallurgical Engineering (Honours) 584
**DETAILED COURSE CONTENT FOR BSC IN METALLURGICAL ENGINEERING (HONOURS)**

**YEAR 1 OF BSc IN METALLURGICAL ENGINEERING**

**SEMESTER 1**

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS I</th>
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<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)</td>
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<td>Pre-requisite(s)</td>
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**Content:**
- **Lines and planes:** Vector equation of a line, Cartesian and parametric equation of a plane, intersections 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.
- **Sequences and number series:** the limit of a sequence, tests for convergence, absolutely convergent series.
- **Functions:** Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, 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, Partial differentiation, Chain rule. Differentiation of algebraic functions.
- **Integration:** anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions.
- **Introduction to complex numbers:** definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to engineering
4. Apply trigonometry in solving mathematical and engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
6. Solve mathematical and engineering problems using partial differentiation

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: ENGINEERING DRAWING

Code: TEGT3561
NQF Level: 5
Contact Hours: 2L + 2T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 100% (minimum of 2 tests and 4 drawing assignments)
Pre-requisite(s): None

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free-hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: Isometric and oblique representations, sections of cones – interpenetrations, developments.

Learning Outcomes: Upon completion of this 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 drawings and assembly drawings of various engineering components

Contribution to Exit Level Outcome:
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
6 Professional and Technical Comm (Course Outcomes 2, 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: PHYSICS FOR PHYSICAL SCIENCES I

Code  SPHY3511
NQF level  5
Contact hours  4L + 2T or 1 PS/Week
NQF Credits  16
Assessment  Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)  None

Contents: Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton's laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

Learning Outcomes: Upon completion of the module, the student is expected to:
1. Employ units, do unit conversions and use of significant figures.
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.

Contribution to Exit Level Outcome:
2  Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4  Investigations, Experiments and Data Analysis (Course Outcome 9)

Issue Date:  September 2015
Next Revision:  September 2019
### Module Title: COMPUTING FUNDAMENTALS

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<td>Contact Hours</td>
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<td>NQF Credits</td>
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<td>Assessment</td>
<td>Continuous 50 % (minimum 2 tests and 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)</td>
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<td>Pre-requisite(s)</td>
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**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

**CONTRIBUTION to Exit Level Outcome**

5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: WORKSHOP PRACTICE

Code: TEGW3590
NQF Level: 5
Contact Hours: 2L + 1PS/Week
NQF Credits: 8
Assessment: Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s): None


Learning Outcomes: Upon completion of this course, students should be able to:

1. Describe general safety procedures applicable to engineering workshops.
2. Describe specific hand tools used in engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of 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.
10. Install air-conditioning and refrigeration systems.
11. Describe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MATERIALS SCIENCE

<table>
<thead>
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<th>Code</th>
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<tr>
<td>NQF Level</td>
<td>5</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
<td>12</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 50% (2 assignments, 2 practical reports and 2 Tests); Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>None</td>
</tr>
</tbody>
</table>

Content:  
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.  

Learning Outcomes: On completing the course students should be able to:

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
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. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019
Module Title: CONTEMPORARY SOCIAL ISSUES

Code: UCSI3580
NQF: 5
Contact Hours: 1 Contact hours per week for 28 weeks
Credits: 8
Assessment: Continuous Assessment (100%). Variety of assessments which evaluate and test the students' individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.
Prerequisite: None

Content: The module, Contemporary Social Issues (CSI3580), is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

Learning Outcomes: Upon completion of this module, students should be able to:

- Contribute to family, community and society;
- Develop social consciousness, thinking skills, self-concepts as well as moral and ethical sensitivity;
- Illustrate key contemporary social issues and challenges experienced within the Namibian society and globally;
- Discuss the role of human conduct, structures, institutions and relations of power in shaping social life in the country;
- Promote ethical and moral reasoning, anticorruption behaviours, human rights, healthy lifestyles, gender equality, productive citizenship, responsible leadership, social media ethics and environmental sustainability; and
- Open their minds to possible meaningful and worthwhile career opportunities.

Contribution to Exit Level Outcome:

10 Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FUNDAMENTALS OF ENGINEERING

Code: TEGT3521
NQF Level: 5
Contact Hours: 2L + 1T or 1PS /week
Credits: 8
Assessment: 100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)
Pre-requisites: None


Learning Outcomes: Upon completion of this module, students will be able to:

1. Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
2. Describe the various branches of engineering, possible careers, and job prospects
3. Describe how to solve basic engineering problems
4. Identify general steps involved in engineering design and communication
5. Use modern engineering and communication tools and procedures.

Issue Date: September 2015
Next Revision: September 2019
SEMESTER 2

Module Title: ENGINEERING MATHEMATICS II

<table>
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<tr>
<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
</tbody>
</table>


Learning Outcomes: Upon completion of this 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. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and engineering problems

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FUNDAMENTALS OF ELECTRICAL ENGINEERING

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<td>Assessment</td>
<td>Continuous Assessment 100% (2 Tests 60%, 2 Quizzes (20%) and 2 Practical Reports (20%))</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</tbody>
</table>


Learning Outcomes: Upon completion of this 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
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

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>PHYSICS FOR PHYSICAL SCIENCES II</th>
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<tr>
<td>Code</td>
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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1 PS/Week</td>
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<td>NQF Credits</td>
<td>16</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Co-requisite(s)</td>
<td>SPHY3511 Physics for Physical Sciences I</td>
</tr>
</tbody>
</table>

**Contents:** Electric charge; insulators and conductors; Electric force and coulomb's law, Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm's law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

**Learning Outcomes:** Upon completion of this 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.

**Contribution to Exit Level Outcome:**

- Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
- Investigations, Experiments and Data Analysis (Course Outcome 4)
- Individual, Team and multi-discipline Working (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
<table>
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<tr>
<th>Module Title:</th>
<th>ENGINEERING MECHANICS I</th>
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<tbody>
<tr>
<td>Code</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 tests and 4 assignments); Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>SPHY3511 Physics for physical Sciences I</td>
</tr>
</tbody>
</table>

**Content:** 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. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces, buoyancy. Distributed forces: centroids and centre of gravity; Pappu’s second moment. **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams:** shear force and bending moment diagrams, Bending Stress, Shear stress. **Centre of Gravity and Centroid.**

**Learning Outcomes:** Upon completion of this 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

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1-6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)

**Issue Date:** September 2015
**Next Revision:** September 2019
### Module Title: CHEMISTRY 1B

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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</tbody>
</table>

**Content:**
- **Gases:** Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour.
- **Basic Thermochemistry:** The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution.
- **Introductory Chemical Kinetics:** Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis.
- **Introduction to Chemical Equilibrium:** The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems.
- **Introduction to Electrochemistry:** Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis.
- **Introduction to Organic Chemistry:** Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

**Learning Outcomes:**
- Upon completion of this course, students should be able to:
  1. Explain and use the gas laws.
  2. Discuss energy changes in chemical reactions.
  3. Analyse the rates of chemical reactions.
  4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
  5. Distinguish between the three laws of thermodynamics.
  7. Demonstrate an understanding of how galvanic cells work.

**Contribution to Exit Level Outcome:**
- Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: ENGLISH FOR ACADEMIC PURPOSES

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<td>Contact Hours</td>
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<td>NQF Credits</td>
<td>16</td>
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</table>
| Assessment    | Continuous: 60% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)  
               | Examination: (40%) made up of 1 x 3 hour examination paper |
| Pre-requisite(s) | ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE |


Learning outcomes: Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

Contribution to Exit Level Outcome:
6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
9 Independent Learning Ability (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019
YEAR 2 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title: ENGINEERING MATHEMATICS III

<table>
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<th>Code</th>
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<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<tr>
<td>Assessment</td>
<td>50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
</tr>
</tbody>
</table>


**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Apply vector calculus to solve mathematical and engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Describe the basis for complex analysis in engineering problem solving
4. Apply the residual theorem to engineering problems

**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, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 6)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: Computer Science for Engineers

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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
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</table>


Learning Outcomes: On completing the course students should be able to:
1. Generate data structures and algorithms
2. Apply binary trees to specific programming environment
3. Demonstrate knowledge of MATLAB programming
4. Create and use user-defined MATLAB functions
5. Apply MATLAB programming for solving engineering problems
6. Write simple C programs

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING MECHANICS II

Code: TEGT3641
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (4 assignments and 2 Tests), Examination 50% (1 x 2 hour paper)
Co-requisite(s): TEGT3592 Engineering Mechanics I


Learning Outcomes: On completing the course 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. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, 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. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 3, 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 6, 7)

Issue Date: September 2015
Next Revision: September 2019
Module Title: STATISTICS FOR ENGINEERS

Code: TEGS3661
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (at least 4 assignments (40%) and 2 Tests (60%)), Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TEGM3591 Engineering Mathematics I

Contents: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; Sampling Distributions: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; Linear Regression and Correlation: Simple and Multiple Linear Regression, Correlation; Analysis of Variance: Completely Randomized and Randomized Block Designs, Multiple Comparisons;

Learning Outcomes: On completing the course students should be able to:
1. Describe the theory of probability
2. Analyse data using probability distribution and densities
3. Use the principles of sampling distribution to analyse data
4. Apply linear regression and correlation to a set of data
5. Apply analysis of variance to solve engineering problems

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

September 2015: September 2015
Next Revision: September 2019
<table>
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<tr>
<th>Module Title:</th>
<th>COMPUTER AIDED DRAWING</th>
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<td>Assessment</td>
<td>Continuous 100%(2 Tests (40%), 1 Mini-project (25%), 4 Assignments (35%))</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3561 Engineering Drawing</td>
</tr>
</tbody>
</table>

**Content:** Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; 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 your drawing; Working in three-dimensional space; Creating three-dimensional objects.

**Learning Outcomes:** Upon completion of this 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

**Contribution to Exit Level Outcome:**
2  Application of Scientific and Engineering Knowledge (Course Outcomes 1, 4)
5  Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: METALLURGICAL THERMODYNAMICS I

Code: TMLX3691
NQF Level: 6
Contact Hours: 3L + 2T or 1PS /Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): SCHM3512 Chemistry 1B


Learning Outcomes: On completing the course students should be able to:
1. Describe the concepts of thermodynamic variables, such as enthalpy, entropy, heat capacity
2. Calculate enthalpies of formation, and of reactions
3. Ability to carry out energy balance of metallurgical processes
4. Evaluate the feasibility of potential reactions from thermodynamic data
5. Apply Raoult’s and Henry’s laws to solve thermodynamic problems
6. Apply the concepts of partial and excess molar quantities

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 2, 3, 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019
<table>
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<tr>
<th>Module Title:</th>
<th>INTRODUCTION TO PROCESS METALLURGY</th>
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<td>Contact Hours</td>
<td>2L + 1T or 1PS /Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>SCHM3512 Chemistry 1B</td>
</tr>
</tbody>
</table>

**Content:** Dimensions, units and conversion factors; Stoichiometry; Sampling and measurements. Principles of materials and energy balance; Laws of thermodynamics, Thermochemistry and illustration of the concepts with suitable examples, Introduction to Mineral Processing – importance, comminution and liberation concentration and agglomeration processes – calcination, sintering, pelletizing briquetting, and nodulizing. **Basic concepts of extractive metallurgy** *(pyrometallurgy, hydrometallurgy and electrometallurgy)* – roasting, smelting, converting, leaching, precipitation processes, Faraday’s law of electrolysis, electrowinning and refining.

**Learning Outcomes:** On completing the course students should be able to:
1. Convert between different systems of units
2. Solve heat and mass balance problems
3. Illustrate the unit processes involved in extractive metallurgy

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 1, 2, 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3)

**Issue Date:** September 2015
**Next Revision:** September 2019
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>ENGINEERING MATHEMATICS IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>TEGT3672</td>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3671 Engineering Mathematics III</td>
</tr>
</tbody>
</table>


**Learning Outcomes:** On completing the course students should be able to:
1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green’s theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications.

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: METALLURGICAL THERMODYNAMICS II

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
<td>6</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS /Week</td>
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<tr>
<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TMLX 3691 Metallurgical Thermodynamics I</td>
</tr>
</tbody>
</table>


Learning Outcomes: On completing the course students should be able to:
1. Derive and apply the phase rules for reactive and non-reactive systems
2. Interpret and apply phase diagrams
3. Establish the relationship between chemical and electrical driving forces
4. Construct and apply Pourbaix diagrams
5. Apply thermodynamics to solve relevant engineering problems.

Contribution to Exit Level Outcome:
- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
- 5 Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)
- 6 Professional and Technical Communication (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MINERAL PROCESSING TECHNOLOGY I

Code: TMLP3692
NQF Level: 6
Contact Hours: 3L + 2T or 1PS /Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TMLX3641 Introduction to Process Metallurgy


**Learning Outcomes:** On completing the course students should be able to:
1. Outline the role of comminution in liberation of minerals
2. Describe the principles of concentrating valuable minerals
3. Explain the principles involved in solid-liquid separation
4. Analyze unit operations in mineral processing.
5. Design simple flowsheets for mineral processing

**Contribution to Exit Level Outcome:**
- Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
- Engineering Design (Course Outcomes 5)
- Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)
- Professional and Technical Communication (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019
<table>
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<tr>
<th>Module Title:</th>
<th>CRYSTAL STRUCTURES AND ANALYTICAL TECHNIQUES</th>
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<tr>
<td>Code</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS /Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests), Examination 50% (1 x 2 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TEGS3591 Materials Science</td>
</tr>
</tbody>
</table>

**Content:** Crystal structures: Crystals and Crystal structures. Two-dimensional patterns, lattices and symmetry. Bravais lattices and Crystal Systems. Crystal Symmetry - Point groups, Space groups and symmetry related properties. Describing lattice planes and directions in crystals – Miller indices and zones. The reciprocal lattice. Use of stereographic projections to analyze deformation in cubic materials. Analytical techniques: Metallographic techniques: Optical metallography, image analysis, quantitative phase estimation Basic descriptions of analytical techniques such as DTA, DSC, TGA, XRD, SEM/EDS and TEM. Computer applications: software for analysing and characterizing microstructure and texture of materials.

**Learning Outcomes:** On completing the course students should be able to:
1. Illustrate different basic crystal structures
2. Relate crystal structure to properties
3. Apply stereographic projections to derive active slip systems
4. Describe the basic analytical techniques
5. Apply computer software in the analysis and characterization of microstructures.

**Contribution to Exit Level Outcome:**
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 3, 5)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: PHYSICAL METALLURGY I

Code: TMLM3662
NQF Level: 6
Contact Hours: 3L + 2T or 1PS /Week
NQF Credits: 8
Assessment: Continuous 50% (At least 2 assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TEGS3591 Materials Science


Learning Outcomes: On completing the course students should be able to:
1. Discuss the solidification processes in metals and alloys.
2. Relate the effect of crystal imperfection to the strengthening of materials.
3. Discuss the mechanisms involved in the materials' deformation.
4. Describe the heat treatment procedures for carbon and alloy steels.

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 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 3, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ELECTRICAL MACHINES

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<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>Assessment</td>
<td>Continuous 100% (2 assignments, 2 Practical Labs, 2 Tests)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGT3542 Fundamentals of Electrical Engineering</td>
</tr>
</tbody>
</table>

Content: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines**: Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers**: Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine)**: generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine**: introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, special cage motors, induction regulators, energy recovery techniques. Drives Applications.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Demonstrate an understanding of the principle of operation of electrical machinery
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.
3. Describe the principle of operation and applications of transformers and AC windings
4. Describe the principle of operation and applications of three-phase induction machines

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 Information Technology (Course Outcomes 2, 4)
4. Professional and Technical Communication (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: COMPUTER APPLICATIONS IN METALLURGY

Code: TMLM3642
NQF Level: 6
Contact Hours: 2L + 1T or 1PS /Week
NQF Credits: 8
Assessment: Continuous 100% (4 Lab Exercises, 4 Assignments, 2 Tests, and 1 Mini-project)
Pre-requisite(s): TCME3621 Computer Science for Engineers

Content: Use of the chosen high level language to perform calculations in areas relevant to process engineering. Emphasis is on doing calculations and not on producing professional programming code for others to use. Advanced Microsoft Excel for metallurgical processes.

Learning Outcomes: On completing the course students should be able to:
1. Solve metallurgical problems using relevant software packages
2. Apply Advanced Microsoft Excel in Metallurgical processes

Contribution to Exit Level Outcome:
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2)
9 Independent Learning Ability (Course Outcomes 1, 2)

Issue Date: September 2015
Next Revision: September 2019

Module Title: HIV AND AIDS EDUCATION

Code: TEGT3602
NQF Level: 6
Contact Hours: 1 L+1T per week for 14 weeks
NQF Credits: None
Assessment: Continuous assessment 100% (3 Assignments and 1 report)
Pre-requisite(s): None


Learning outcomes: Upon completion of the module students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

Issue Date: September 2015
Next Revision: September 2019
## Module Title: INDUSTRIAL ATTACHMENT I

<table>
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<th>Code</th>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Total Hours</td>
<td>Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.</td>
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<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).</td>
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<tr>
<td>Pre-requisite</td>
<td>TEGW3590 Workshop Practice</td>
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</table>

### Module Description:
During Industrial Attachment I, students will work under company supervision at the level of Technician 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 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. Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
2. Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
3. Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: 2 September 2015
Next Revision: September 2019
YEAR 3 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title: EXPERIMENTAL AND RESEARCH METHODS

<table>
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<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%))</td>
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</table>

Pre-requisite(s): TEGS3661 Statistics for Engineers

Content: Experimentation planning and execution. Technical report writing. Report structure and format. Literature Review: Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). Research methodology. Formulation and presentation of research proposals. Statistical data analysis: Data description: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. Data modeling: Experimental data modelling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination $R^2$ and adjusted $R^2$ and the role of adjusted $R^2$ on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

Research Proposal: During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

Learning Outcomes: On completing the course students should be able to:
1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an engineering research process
7. Propose an engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an engineering audience following specified guidelines

CONTRIBUTION to Exit Level Outcome:
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

Issue Date: September 2015
Next Revision: September 2019
<table>
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<tr>
<th>Module Title:</th>
<th>FUNDAMENTALS OF ECONOMICS</th>
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<tr>
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<td>2L + 1T/Week</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (4 assignments, 2 Tests); Examination 50% (1 x 2 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>

Content: Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. Macroeconomics: inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. Financial accounting: nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. Introduction to budgeting. Introduction to marketing. Long and short-term decision making.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: HYDROMETALLURGY AND ELECTROMETALLURGY

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<th>Code</th>
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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<tr>
<td>NQF Credits</td>
<td>16</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TMLX3641 Introduction to Process Metallurgy</td>
</tr>
</tbody>
</table>

Content: Unit processes of hydrometallurgy: Overview pre-treatment, leaching, purification and recovery processes in hydrometallurgy. Thermodynamics and kinetic aspects: Thermodynamics of aqueous systems, Pourbaix diagrams; Kinetics of heterogeneous reactions: leaching reactions; Nernst model, hydrodynamic theory; modelling of leaching kinetics (shrinking particle and shrinking core models). Leaching practice and processes: leaching agents, oxidizing and reducing agents; Percolation, agitation, heap and in-situ leaching of various mineral groups; leaching processes for refractory ores, pressure leaching, bioleaching. Purification of leach liquors: Ion exchange; theory, resin composition and properties, equilibria, kinetics, practice of IX. Adsorption; Use of activated carbon, properties, loading, desorption and regeneration, practical applications in Ag and Au. CIP/CIL/CIS processes, Solvent extraction; partition between immiscible liquids, extraction mechanisms, extraction equilibria and kinetics. Solvent extraction techniques and practice for uranium and copper. Precipitation processes for metal recovery: Chemical precipitation methods for various anions; Reductive precipitation methods, cementation; hydrogen reduction methods; Application of precipitation methods in reclamation of metals from waste effluents. Electrolytic processes for metal recovery: Principles of cathodic reduction in electrolytic cells; Tafel equations; Electro-winning; cell and electrode configuration, electrolyte movement, practical applications for selected metals; SX-EW circuits; Electro-refining: Principles, electro-refining of selected metals; Use of fused salt electrolytes.

Reactor design and synthesis of hydrometallurgical plants: Hydrometallurgical reactors and their classification (BR, PFR, CSTR etc); Design of ideal batch reactors and steady state mixed flow reactors; Design of steady state plug flow reactors and their applications in metallurgical processing plants; Case studies on synthesis of full scale hydrometallurgical operations for selected metals. Hydrometallurgy of Rare Earth Elements (REE)

Learning Outcomes: On completing the course students should be able to:
1. Explain the unit processes involved in hydrometallurgical extraction of metals.
2. Apply knowledge of thermodynamics to select leaching agents and develop leaching routes for given mineral ores.
3. Develop and apply leaching kinetic models.
4. Identify and apply suitable purification and metal recovery method for given leach liquors.
5. Design reactors needed for specific hydrometallurgical operations from available data.
6. Synthesize information from full-scale hydrometallurgical plants for selected metals.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3. Engineering Design (Course Outcomes 5)
4. Investigations, Experiments and Data Analysis (Course Outcomes 5, 6)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 5, 6)
6. Professional and Technical Communication (Course Outcomes 3, 5, 6)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: TRANSPORT PHENOMENA AND RATE PROCESSES

Code: TMLX3731  
NQF Level: 7  
Contact Hours: 4L + 2T or 1 PS/Week  
NQF Credits: 16  
Assessment: Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)  
Pre-requisite(s): TMLP3622 Metallurgical Thermodynamics II

Content:

**Momentum Transfer:** Steady and Unsteady Flows; Overall mass, energy and momentum balance; Navier-Stokes equations; Newton's Law, Non-Newtonian Fluids; Laminar flow in falling film, flow through conduits etc; Inviscid fluid flow, Viscous flow, Laminar and Turbulent Boundary Layer Theory, Friction Factor; Flow past immersed objects, packed and fluidized bed.  
**Mass Transfer:** Steady state mass transfer and diffusion; molecular diffusion in gasses, liquid, biological gels and solids; Unsteady state mass transfer under different conditions, mass transfer coefficient, diffusion through porous medium and capillaries; Boundary layer flow and turbulence in mass transfer, Simulation heat, mass and momentum transfer.  
**Heat Transfer:** Conduction: Steady State: One Dimensional- Composite wall and cylinder; Multidimensional- Differential heat balance, shape factor, graphical and numerical methods. Unsteady State: Analytical solutions of one dimensional lumped heat capacity system, heat flowing semi-infinite solid, convection boundary conditions, Heisler chart solutions.  
**Convection:** Natural and forced convection, overall heat transfer coefficient, fouling factor, types of heat exchanges.  
**Radiation:** Physical mechanism, radiation properties, shape factor, heat exchange between non-black bodies, infinite parallel planes, radiation shields, gas radiation. Application of transport phenomena in modelling and simulation: theory of similarity and dimensional analysis, case studies; some case studies of mathematical modelling in metallurgical systems – gas stirred ladle, continuous casting etc.  
**Principles of Metallurgical kinetics:** reaction rates and mechanisms, homogeneous and heterogeneous systems.

**Learning Outcomes:** On completing the course students should be able to:
1. Establish the principles of metallurgical kinetics  
2. Calculate concentration gradients and reaction rates of metallurgical reactions  
3. Evaluate the turbulent flow of fluids  
4. Describe the concept of viscosity in fluid dynamics  
5. Discuss the principles of momentum transfer  
6. Explain the different modes of mass and heat transfer  
7. Categorize the different types of interface reactions  
8. Apply principles of chemical kinetics and transport phenomena to metallurgical processes  
9. Solve process and materials related problems using rate phenomena principles

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 1, 2, 3, 9)  
2. Application of Scientific and Engineering Knowledge (Course Outcomes 4, 5, 6, 7)  
3. Engineering Design (Course Outcomes 8)  
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 8, 9)

Issue Date: September 2015  
Next Revision: September 2019
Module Title: MECHANICAL BEHAVIOUR OF MATERIALS

Code: TMLN3791
NQF Level: 7
Contact Hours: 3L + 2T or 1PS /Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 Assignments, Labs, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TMLM 3692 Physical Metallurgy I

Content: Introduction to deformation behaviour: Concept of stresses and strains, engineering stresses and strains. Elasticity Theory: stress and strain tensor, tensor transformation, principal stress and strain, elastic stress-strain relation. Yielding and Plastic Deformation: yield criteria and yield surface, texture and distortion of yield surface, Limitation of engineering strain at large deformation, true stress and true strain, effective stress, effective strain, flow rules, strain hardening, Ramberg-Osgood equation, stress-strain relation in plasticity. Microscopic view of plastic deformation: crystals and defects, classification of defects, thermodynamics of defects, geometry of dislocations, slip and glide, dislocation generation – Frank-Read and grain boundary sources, stress and strain field around dislocations, force on dislocation - self-stress, dislocation interactions, partial dislocations, twinning, dislocation movement and strain rate, deformation behaviour of single crystal, critical resolved shear stress (CRSS), deformation of polycrystals and other strengthening mechanisms, grain size effect and Hall-Petch equation. Fracture, Fatigue and High temperature deformation of materials.

Learning Outcomes: On completing the course students should be able to:
1. Explain the deformation processes and their applications.
2. Analyse the mechanisms of deformation in materials.
3. Discuss the strengthening mechanism in materials; and
4. Predict fracture and fracture mechanisms in materials.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: NON-METALLIC MATERIALS

Code: TMLC3791
NQF Level: 7
Contact Hours: 3L + 2T or 1PS /Week
NQF Credits: 12
Assessment: Continuous 50% (2 assignments, 2 practical reports and 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TEGS3591 Materials Science


Learning Outcomes: On completing the course students should be able to:
1. Explain the various classes of engineering materials.
2. Evaluate the properties and applications of various engineering materials.
3. Apply the knowledge of the fabrication and characterization techniques of various engineering materials.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3 Engineering Design (Course Outcomes 3)

Issue Date: September 2015
Next Revision: September 2019
### Module Title: ENTREPRENEURSHIP

<table>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]</td>
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<tr>
<td>Co-requisite(s)</td>
<td>TEGT3761 Fundamentals of Economics</td>
</tr>
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</table>

**Contents:**

- **Entrepreneurial perspective:** types of entrepreneurs, characteristics of entrepreneurs, examples of successful ventures for national development. Carrying out feasibility studies, writing business plans. Government policies on small business ventures. **Entreprising opportunities:** business motivation, competencies and skills, innovative ideas, product concept and description, market assessment. **Starting new business ventures:** the calculated risk, business planning and organization, management planning, financial projections, possible sources of finance, resource management, projected levels of growth and operations. **Change Management theory.** Group dynamics. **Management accounting.** **Marketing strategies.**

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Discuss the methods used to carry out feasibility studies
3. Develop a business plan relating to an engineering endeavor
4. Discuss the concepts of motivation, competencies, innovation and product marketing
5. Describe the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

**Contribution to Exit Level Outcome:**

- **7** Sustainability and Impact of Engineering Activity (Course Outcomes 2)
- **11** Engineering Management (Course Outcomes 4, 5)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: NON-FERROUS PYROMETALLURGY

Code TMLF3792
NQF Level 7
Contact Hours 3L + 2T or 1PS /Week
NQF Credits 12
Assessment Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s) TMLX3641 Introduction to Process Metallurgy

Content: General methods of extraction: Pre-treatment processes – calcinations, roasting and agglomeration. Extraction Processes – smelting and refining: Basic approaches, preparation of pure compounds, purification of crude metal produced in bulk. Construction and application of Predominance/stability diagrams (Kellogg-Basu diagrams) for extraction of metals. Extraction of metals from oxide sources: (Basic approaches and special features of specific extraction processes, extraction of metals such as magnesium, lead, tin. Extraction of metals from sulphide ores: (Pyrometallurgy of sulphides, production of metals such as copper, lead, zinc, nickel etc.). Slag chemistry, refractories and fluxes. Pyrometallurgy of Rare Earth Elements (REE). Environmental Management: Management of solid and liquid waste; reprocessing of dumps; processing and recovery of toxic metals. Particulate and gaseous emissions control. Codes of practice and legislation governing the Metallurgical industry in Namibia and the SADC region.

Learning Outcomes: On completing the course students should be able to:
1. Summarise the general methods of metal extraction and refining.
2. Apply thermodynamics and kinetics principles to solve high temperature processing problems.
3. Explain the various pre-treatment and smelting unit processes.
4. Analyse pyrometallurgical methods of extracting non-ferrous metals and illustrate them with appropriate flowsheets.
5. Discuss the impact of metallurgical processes on the environment.
6. Apply relevant techniques to reduce the impact of hazardous substances on the environment.
7. Analyse the health and safety issues, and relevant legislation governing metallurgical industries locally and regionally.
8. Value the concept of sustainability.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 6, 7)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 6, 7)
4. Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6, 7, 8)

Issue Date: September 2015
Next Revision: September 2019
Module Title: CORROSION AND WEAR

Code: TMLM3792

NQF Level: 7

Contact Hours: 3L + 2T or 1PS /Week

NQF Credits: 12

Assessment: Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

Pre-requisite(s): TMLP3622 Metallurgical Thermodynamics II


Learning Outcomes: On completing the course students should be able to:
1. Identify the common corrosion processes
2. Explain the principles of electrochemistry and corrosion
3. Recommend processes to reduce or avoid corrosion
4. Identify the different wear mechanisms
5. Manipulate the interplay between abrasive forces and wear in specific environments
6. Recommend processes to reduce wear.
7. Predict suitable materials on the basis of corrosion and wear.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 2, 3, 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 6, 7)
3. Engineering Design (Course Outcomes 3)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 6, 7)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 1, 5, 6, 7)

Issue Date: September 2015
Next Revision: September 2019
Module Title: METALLURGICAL PROCESS DESIGN

Code TMLN 3752
NQF Level 7
Contact Hours 4L + 2T or 1PS /Week
NQF Credits 16
Assessment Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s) TMLP 3692 Mineral Processing Technology I

Content: Fundamental principles of design: Process design criteria. Design of metallurgical processing systems. Method of estimating process cost and profitability. Translation of process design to plant design. Process flow sheet. Plant flow sheet. The application of fundamental metallurgical principles to the design process which includes thermodynamics, rate phenomena, unit operations and pilot plant design. Design stages: laboratory scale, pilot plant and industrial scale. Introduction to modeling and simulation as applied to metallurgical processes. Selection and design of process. General characteristic of metallurgical processing equipment. Integration of process units into a working plant, its construction and operations. Case studies on design of metallurgical equipment: furnaces, ball mills, sintering plant, metal forming mills, flotation cell etc. Feasibility of design including energy requirements for new plant design.

Learning Outcomes: On completing the course students should be able to:
1. Apply process engineering and materials engineering principles to the design of metallurgical processes;
2. Assess design cost of metallurgical processes; and
3. Design a process or plant for a specific metallurgical operation

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2)
3 Engineering Design (Course Outcomes 3)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3)
6 Professional and Technical Communication (Course Outcomes 3)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
8 Individual, Team and multi-discipline Working (Course Outcomes 2, 3)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FUELS, FURNACES AND REFRACTORIES

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<td>Pre-requisite(s)</td>
<td>TEGS3591 Materials Science</td>
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Content: Fuels: Introduction - Types of solid fuel, origin of coal petrography, mineral matter in coal, classification and grading of coal, chemical and physical properties of coal, plastic/coking properties of coal, thermal decomposition of coal, selection, testing utilization of coking and Non-coking coal. Coal carbonization: Fundamentals of coal carbonization, types of carbonization process, by product recovery and coke properties; non-recovery coke ovens. Liquid Fuels: Classification of petroleum, characterization of petroleum and their products. Coal liquefaction. Gaseous Fuels: Classification of gaseous fuels, production of gaseous fuels such as producer gas, water gas, natural gas and coal bed methane. Furnaces: Classification of metallurgical furnaces and reactors: blast furnaces, electric furnaces, rotary kilns, crucible furnaces, tilting furnaces, reverberatory furnaces, open hearth furnaces, converters, fluidized bed reactors. Refractories: Classification of refractories, raw materials, manufacture, testing and properties of heavy and special refractories, silica, siliceous aluminosilicate, high alumina, magnesite, chrome, chrome-magnesite, dolomite, forsterite, chemically bonded basic, carbon and insulating refractories and special purpose oxides, carbide nitride refractories. Binary phase diagrams of Al2O3-SiO2, CaO-MgO, Cr2O3-MgO and MgO-SiO2 systems. Refractory mortars and cements, Refractory castables, selection of refractories for coke oven, iron blast furnace, copper convertor, soaking reheating furnaces and heat treatment furnaces, electric arc furnace.

Learning Outcomes: On completing the course students should be able to:

1. Appraise the various types of fuels, furnaces and refractories used in metallurgical industries.
2. Explain the properties of various metallurgical fuels, furnaces and refractories
3. Distinguish coal proximate analysis from the ultimate analysis and report coal analysis on moist basis, dry basis, dry mineral-matter-free basis, and moist mineral-matter-free basis.
4. Select appropriate fuels, furnaces and refractories for different metallurgical processes.
5. Relate the environmental impacts of burning fossil fuels and remediation strategies for the impacts
6. Analyse combustion processes and calculate air requirements
7. Evaluate processes for production of secondary fuels from coal
8. Predict properties and composition of refractories from the phase diagrams

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 4, 6, 7, 8)
3 Engineering Design (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 6, 7, 8)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5)

ECN Exit Outcomes Assessed:

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 (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

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

At least 2 Assignments and at least 2 Tests making 30%, Presentation (10%) and Report on selected topics on the selection of appropriate fuels, furnaces and refractories for different metallurgical processes and the environmental impact of such selected fuels (10%), Examination (1 x 3 hour paper) making 50%

To pass this course a student should obtain a minimum CA of 50% to qualify for the examination and a sub-minimum of 40% from the examination in order to meet the requirement of ECN exit level outcome 7.
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 presentation and report should show evidence of the student’s ability to consider the impact and benefits of the selected fuel, furnace and refractories for the particular metallurgical process on social, legal, health, safety and environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitute satisfactory performance?

After consideration of the tests, assignments, presentation and submitted report, and with reference to evidence showing awareness of Sustainability and Impact of Engineering activity and how this knowledge is 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 CA 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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: PHYSICAL METALLURGY II

Code  TMLX3762
NQF Level  7
Contact Hours  3L + 2T or 1PS /Week
NQF Credits  12
Assessment  Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)  TMLM3692 Physical Metallurgy I


Learning Outcomes: On completing the course students should be able to:
1. Predict the relationship between structure, properties and performance of metallic materials.
2. Discuss the solid state transformations in metals and alloys.
3. Explain the strengthening mechanisms in metals and alloys.
4. Manipulate the properties of cold worked materials by recovery and recrystallization processes.
5. Illustrate the process of precipitation hardening of non-ferrous alloys
6. Apply the transformation diagrams to predict structure of ferrous alloys;
7. Explain the use of thermochemical and thermomechanical treatment for structural modification of ferrous alloys.
8. Discuss the various heat treatment procedures for non-ferrous alloys.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1-8)
4 Investigations, Experiments and Data Analysis (Course Outcomes 8)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: INDUSTRIAL ATTACHMENT II

Code: TEGT3700
NQF Level: 7
Total Hours: Six (6) weeks preferably during the June/July break in Year 3 or 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: TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of Technologist 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 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 technologists and technicians in an industrial setting and identify the associated reporting channels.
2. Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
3. Describe the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: September 2019
YEAR 4 OF BSCE IN METALLURGICAL ENGINEERING
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

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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: PROJECT MANAGEMENT

Code          TEGM3881
NQF Level      8
Contact Hours  3L + 1T/Week
NQF Credits    12
Assessment     Continuous 100% (1 Group Project Presentation, 2 Test, 4 assignments/case studies)
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 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:
11 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 work 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 constitute 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 constitute 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 determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

**Issue Date:** September 2015  
**Next Revision:** September 2019
Module Title: MINERAL PROCESSING TECHNOLOGY II

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<td>Pre-requisite(s)</td>
<td>TMLP 3692 Mineral Processing Technology I</td>
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Learning Outcomes: On completing the course students should be able to:
1. Discuss the Techno-economic aspects of mineral processing
2. Explain the nature and behaviour of particulate materials
3. Apply appropriate methods to size particulate materials
4. Analyse the influence of different forces on the movement and fracture of particles
5. Design experimental programmes to evaluate important parameters in minerals processing
6. Report on the techniques, results and limitations of the different available processes
7. Design specific operations for the processing of a given ore body

Contribution to Exit Level Outcome:
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3. Engineering Design (Course Outcomes 5, 7)
4. Investigations, Experiments and Data Analysis (Course Outcomes 6)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 5, 6)
6. Professional and Technical Communication (Course Outcomes 1,6)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 1)

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
Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

To pass this module 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 constitute 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?

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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: METALLURGICAL PRODUCTION PROCESSES

Code: TMLM3851  
NQF Level: 8  
Contact Hours: 4L + 2T or 1PS /Week  
NQF Credits: 16  
Assessment: Continuous 50% (At least 2 assignments, 2 Tests), Examination 50% (1 x 3 hour paper)  
Pre-requisite(s): TMLN3791 Mechanical Behaviour of Materials


Learning Outcomes: On completing the course students should be able to:
1. Summarize the various metal working principles and processes.
2. Explain joining and welding metallurgy and their applications.
3. Expound on the principles involved in powder metallurgy
4. Discuss metal casting processes and basic foundry operations for ferrous and Non-ferrous metals
5. Manipulate different casting designs and methods
6. Analyse the quality control technique in foundry operations

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, 6)
3. Engineering Design (Course Outcomes 5)
4. Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 4, 5, 6)
6. Professional and Technical Communication (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FERROUS EXTRACTIVE METALLURGY

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<td>TMLX3641 Introduction to Process Metallurgy</td>
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Learning Outcomes: On completing the course students should be able to:
1. Expound on the principles iron ore reduction
2. Explain the blast furnace production of iron
3. Discuss alternative iron making methods
4. Summarize the principles of steel making and various methods of their application
5. Manipulate data relating to iron making and conversion to steel
6. Explain the production of stainless steel and its limitations
7. Assess the techno-economic and environmental aspects of iron and steel making
8. Apply relevant computer software to solve heat and mass balance problems in iron and steel making

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 8)
6 Professional and Technical Communication (Course Outcomes 5, 6)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 7)

Issue Date: September 2015
Next Revision: September 2019
Module Title: PROCESS MODELLING AND CONTROL

Code  
NQF Level  
Contact Hours  
NQF Credits  
Assessment  
Pre-requisite(s)  


Learning Outcomes: On completing the course students should be able to:
1. Employ the principles of mathematical modelling and simulation in metallurgical processes.
2. Apply suitable computer software to control metallurgical processes.
3. Ascertain the objectives of process control in a given system
4. Interpret industrial conventions of process control.
5. Employ specialized control systems in metallurgical processes

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2, 3, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3. Engineering Design (Course Outcomes 2, 5)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2)
6. Professional and Technical Communication (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: RESEARCH PROJECT

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<td>Pre-requisite</td>
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**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.
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 (30%); Final Oral Presentation of Research Report (20%); Final Research Report (50%)

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 conduct 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 analyze, interpret and derive information from data.

What constitute 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 conduct 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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: METALLURGICAL DESIGN PROJECT

Code: TMLD 3890
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. Implement 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. 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, 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.
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, analyze and solve complex engineering problems creatively and innovatively. The final design report should show evidence of the student’s ability to identify, analyze 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 constitute 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 constitute 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 constitute 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.
H. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

H.1. DEGREE NAME: BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) 19BMNE

H.2. 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.

H.3. 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 BSc IN MINING ENGINEERING – 164 Credits

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NB: Students who have done UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512 and SCHM3512 will be exempted from taking them in this year.
### YEAR 2 OF BSc IN MINING ENGINEERING – 132 Credits

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### YEAR 3 OF BSc IN MINING ENGINEERING – 148 Credits

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YEAR 4 OF BSc IN MINING ENGINEERING – 140 CREDITS

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TOTAL CREDITS FOR BSc IN MINING ENGINEERING (HONOURS) 584
## H.4. DETAILED COURSE CONTENT FOR BSc IN MINING ENGINEERING (HONOURS)

### YEAR 1 OF BSc IN MINING ENGINEERING

#### SEMESTER 1

<table>
<thead>
<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS I</th>
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<td>Code</td>
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<td>Assessment</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>

**Content:** Lines and planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersections 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. **Sequences and number series:** the limit of a sequence, tests for convergence, absolutely convergent series. **Functions:** Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to engineering. **Radian measure and applied problems,** trigonometric identities, inverse of a function, inverse trigonometric functions, 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, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration:** anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers:** definition, addition, subtraction, multiplication, division of complex numbers. Demoivre’s theorem.

**Learning Outcomes:** Upon completion of this module, students should be able to:

1. Solve basic mathematics and engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to engineering
4. Apply trigonometry in solving mathematical and engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
6. Solve mathematical and engineering problems using partial differentiation

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 1, 2 and 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
5. Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: ENGINEERING DRAWING

Code TEGT3561
NQF Level 5
Contact Hours 2L + 2T or 1PS/Week
NQF Credits 8
Assessment Continuous 100% (minimum of 2 tests and 4 drawing assignments)
Pre-requisite(s) None


Learning Outcomes: Upon completion of this 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 drawings and assembly drawings of various engineering components

Contribution to Exit Level Outcome:

1. Eng Design (Course Outcomes 4, 5)
2. Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
3. Professional and Technical Comm (Course Outcomes 2, 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019
<table>
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<tr>
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<td>Assessment</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
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</table>

**Contents:** Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton's laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

**Learning Outcomes:** Upon completion of the module, the student is expected to:

1. Employ units, do unit conversions and use of significant figures.
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.

**Contribution to Exit Level Outcome:**

2  Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4  Investigations, Experiments and Data Analysis (Course Outcome 9)

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: COMPUTING FUNDAMENTALS

Code: TCME3521
NQF Level: 5
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50 % (minimum 2 tests and 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Pre-requisite(s): None


Learning Outcomes: Upon completion of this module, students should be able to:

1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

CONTRIBUTION to Exit Level Outcome
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

Issue Date: September 2015
Next Revision: September 2019
<table>
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<tr>
<th>Module Title: WORKSHOP PRACTICE</th>
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<tr>
<td>Code</td>
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<td>NQF Level</td>
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<td>Contact Hours</td>
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</tr>
<tr>
<td>Assessment</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
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</table>

**Content:** Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Turning, Fitting, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components. Refrigeration and Air-conditioning and their installation.

**Learning Outcomes:** Upon completion of this course, students should be able to:

1. Describe general safety procedures applicable to engineering workshops.
2. Describe specific hand tools used in engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of 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.
10. Install air-conditioning and refrigeration systems
11. Describe the general operation of air-conditioning and refrigeration systems.

**Contribution to Exit Level Outcome:**

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: MATERIALS SCIENCE

Code: TEGS3591
NQF Level: 5
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (2 Assignments, 2 Practical Reports and 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s): None


Learning Outcomes: On completing the course students should be able to:

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
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. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019
Module Title: CONTEMPORARY SOCIAL ISSUES

Code: UCSI3580
NQF: 5
Contact Hours: 1 Contact hours per week for 28 weeks
Credits: 8
Assessment: Continuous Assessment (100%). variety of assessments which evaluate and test the students’ individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.
Prerequisite: None

Module Descriptor: The module, Contemporary Social Issues (CSI3580), is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

Learning Outcomes
By the end of this module students should be able to:

- Contribute to family, community and society;
- Develop social consciousness, thinking skills, self-concepts as well as moral and ethical sensitivity;
- Illustrate key contemporary social issues and challenges experienced within the Namibian society and globally;
- Discuss the role of human conduct, structures, institutions and relations of power in shaping social life in the country;
- Promote ethical and moral reasoning, anticorruption behaviours, human rights, healthy lifestyles, gender equality, productive citizenship, responsible leadership, social media ethics and environmental sustainability; and
- Open their minds to possible meaningful and worthwhile career opportunities.

Contribution to Exit Level Outcome:

10 Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

Issue Date: September 2015
Next Revision: September 2019
Module Title: FUNDAMENTALS OF ENGINEERING

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<td>Assessment</td>
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<td>Pre-requisites</td>
<td>None</td>
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Learning Outcomes: Upon completion of this module, students will be able to:

- Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
- Describe the various branches of engineering, possible careers, and job prospects
- Describe how to solve basic engineering problems
- Identify general steps involved in engineering design and communication
- Use modern engineering and communication tools and procedures.

Issue Date: September 2015
Next Revision: September 2019
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<tr>
<th>Module Title</th>
<th>ENGINEERING MATHEMATICS II</th>
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<td>Co-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
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Content: **Further Matrix Algebra:** Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **Further integration:** Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral:** area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations:** Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

**Learning Outcomes:** Upon completion of this 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. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and engineering problems

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 1, 2, 4, 5)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6)

**Issue Date:** September 2015
**Next Revision:** September 2019
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<th>Module Title</th>
<th>FUNDAMENTALS OF ELECTRICAL ENGINEERING</th>
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<td>Assessment</td>
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<td>Pre-requisite(s)</td>
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Learning Outcomes: Upon completion of this 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
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

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019

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<td>Contact Hours</td>
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<td>Assessment</td>
<td>Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports) , Examination 50% (1 x 3 hour paper)</td>
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<td>Co-requisite(s)</td>
<td>SPHY3511 Physics for Physical Sciences I</td>
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Contents: Electric charge; insulators and conductors; Electric force and coulomb’s law, Electric field and Gauss’s law; Electric potential; Capacitance and capacitors; Direct current; Ohm’s law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

Learning Outcomes: Upon completion of this 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.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING MECHANICS I

Code: TEGT3592
NQF Level: 5
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 tests and 4 assignments); Examination 50% (1 x 3 hour paper)
Co-requisite(s): SPHY3511 Physics for physical Sciences I

Content: 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. Analysis of forces in a truss: Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces. Distributed forces: centroids and centre of gravity.

Learning Outcomes: Upon completion of this 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

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1-6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: CHEMISTRY 1B

Code SCHM3512
NQF Level 5
Contact Hours 4L + 2T or 1PS/Week
NQF Credits 16
Assessment Continuous 50% (At least 2 tests and 4 assignments or 2 assignments and 2 practical reports), Examination 50% (1 x 3 hour paper)

Pre-requisite(s) None

Content: Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid–Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Explain and use the gas laws
2. Discuss energy changes in chemical reactions
3. Analyse the rates of chemical reactions.
4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
5. Distinguish between the three laws of thermodynamics
7. Demonstrate an understanding of how galvanic cells work.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019
<table>
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<tr>
<th>Module Title</th>
<th>ENGLISH FOR ACADEMIC PURPOSES</th>
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</tbody>
</table>

**Content: Structure of materials:** Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

**Learning outcomes:** Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

**Contribution to Exit Level Outcome:**
6  Professional and Technical Communication (Course Outcomes 1, 2, 3)
9  Independent Learning Ability (Course Outcome 4)

**Issue Date:** September 2015
**Next Revision:** September 2019
YEAR 2 of BSc in Mining Engineering

SEMESTER 1

Module Title: ENGINEERING MATHEMATICS III

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<th>Code</th>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>4L + 2T or 1PS/Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
</tr>
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</table>

Content: Vector Calculus: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binormal, torsion, curvature, the gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and engineering applications. Functions of Several Variables: limits, continuity derivatives, differentials, the Jacobian matrix and determinants, composite functions, higher order derivatives, extrema with constraints, surfaces, applications in Science and Engineering. Integral Transforms: Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems. Power series solutions of second order ordinary differential equations and introduction to Bessel functions. Analytic functions: Cauchy-Riemann equations, Cauchy’s theorem, Cauchy’s integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem, evaluation.

Learning Outcomes: Upon completion of this module, students should be able to:

7. Apply differential vector calculus to solve mathematical and engineering problems
8. Use Laplace and Fourier transforms in solving differential equations
9. Apply functions of several variables in solving engineering problems
10. Apply the power series method in approximation of solutions of ordinary differential equations
11. Describe the basis for complex analysis in engineering problem solving
12. Apply the residual theorem to engineering problems

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

Issue Date: September 2015
Next Revision: September 2019
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<thead>
<tr>
<th>Module Title</th>
<th>COMPUTER SCIENCE FOR ENGINEERS</th>
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<td>Code</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (At least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TCME3521 Computing Fundamentals</td>
</tr>
</tbody>
</table>


**Learning Outcomes:** On completing the course students should be able to:

1. Generate data structures and algorithms
2. Apply binary trees to specific programming environment
3. Demonstrate knowledge of MATLAB programming
4. Create and use user-defined MATLAB functions
5. Apply MATLAB programming for solving engineering problems
6. Write simple C programs

**Contribution to Exit Level Outcome:**

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

**Issue Date:** September 2015
**Next Revision:** September 2019
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<tr>
<td><strong>Assessment</strong></td>
</tr>
<tr>
<td><strong>Co-requisite(s)</strong></td>
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</table>


**Learning Outcomes:** On completing the course 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. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, 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. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 3, 4, 5, 6)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)
3. Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 6, 7)

**Issue Date:** September 2015
**Next Revision:** September 2019
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<th>Module Title:</th>
<th>STATISTICS FOR ENGINEERS</th>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (at least 4 assignments (40%) and 2 Tests (60%)), Examination 50% (1 x 2 hour paper)</td>
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<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
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</table>

**Contents:** Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; Sampling Distributions: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; Linear Regression and Correlation: Simple and Multiple Linear Regression, Correlation; Analysis of Variance: Completely Randomized and Randomized Block Designs, Multiple Comparisons;

**Learning Outcomes:** On completing the course students should be able to:

1. Describe the theory of probability
2. Analyse data using probability distribution and densities
3. Use the principles of sampling distribution to analyse data
4. Apply linear regression and correlation to a set of data
5. Apply analysis of variance to solve engineering problems

**Contribution to Exit Level Outcome:**

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

**Issue Date:** September 2015

**Next Revision:** September 2019
Module Title: COMPUTER AIDED DRAWING

Code: TEGT3661
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 100% (At least 2 Tests (40%), 1 Mini-project (25%), 4 Assignments (35%))
Co-requisite(s): TCME3521 Computing Fundamentals
Pre-requisite(s): TEGT3561 Engineering Drawing

Content: Getting started; Setting up the drawing Environment; Using commands and system variables; Using coordinate systems; 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 your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this 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

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 4)
6 Professional and Technical Communication (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title: INTRODUCTION TO ENGINEERING GEOLOGY

Code: TMNE3621
NQF Level: 6
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s): None

Contents: 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; introductory geo-hydrology. Brief on Ore and mineral exploration methods and Prospecting Techniques. Practical work involving geological map interpretation.

Learning Outcomes: On completing the course 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. Apply basic knowledge of geology.

Contribution to Exit Level Outcome:
1 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: INTRODUCTION TO MINING ENGINEERING

<table>
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<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)</td>
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<td>Pre-requisite(s)</td>
<td>None</td>
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Learning Outcomes: On completing the course students should be able to:

1. Explain the basic mining terminologies
2. Comprehend the Namibian mining industry and Namibian mineral deposits
3. Describe various mining methods and mining equipment
4. Explain various mine transportation methods
5. Discuss mine safety and mine environmental issues

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 3, 4)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 4, 5)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 5)

ECN Exit Outcomes Assessed:

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 constitute the following:

At least 2 Assignments and at least 2 Tests making 30%, Presentation (10%) and Report on selected topics on the Mine Safety, Health and Environment (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 7 assessed in the presentation and the submitted report as follows:

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 presentation and report should show evidence of the student’s ability to consider the impact of Mining activities on the social, legal, health, safety, environmental dimensions and perform techno-economic analysis including impacts on the physical environment.
What constitute satisfactory performance?

After consideration of the test, assignments and presentation and submitted report, and with reference to evidence showing awareness of Sustainability and Impact of Engineering activity and how this knowledge is 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 CA 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?

If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019
Module Title: STRENGTH OF MATERIALS I

Code: TCVM3621
NQF Level: 6
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)
Pre-requisite(s): TEGT3592 Engineering Mechanics I

Contents: Basic concepts: Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams. Stress and strain: Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke’s Law; Modulus of Elasticity; Normal stress and strain; Poisson’s ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson’s ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants. Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems: Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars. Geometrical characteristics of plane sections: Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem. Bending: Shear force and bending moment diagrams. Bending and shear stresses in beams: Theory of beam bending; Section modulus; Composite beams; Shear stress distribution due to bending. 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 and longitudinal stress.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Demonstrate the application of Hooke’s Law to normal and shear stresses.
2. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
3. Calculate geometrical characteristics of plane sections.
4. Draw bending and shear force diagrams in beams.
5. Employ bending and shear stresses in beams.
6. Solve problems involving shear stresses and shear flow in beams.
7. Calculate stresses and strains in circular shafts subjected to torsion.
8. Relate stresses in thin cylinders and spheres subjected to internal pressure.

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, 6, 7)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5, 6, 7)

Issue Date: September 2015
Next Revision: September 2019
SEMESTER 2

Module Title: ENGINEERING MATHEMATICS IV

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<td>NQF Credits</td>
<td>16</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)</td>
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<td>Co-requisite(s)</td>
<td>(TEGT3671 Engineering Mathematics III)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3512 Engineering Mathematics II</td>
</tr>
</tbody>
</table>


Learning Outcomes: On completing the course students should be able to:
1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green’s theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications.

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: STRUCTURAL GEOLOGY

Code: TMNE3622
NQF Level: 6
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): TMNE3621 Introduction to Geology

Contents: Structural geology: brittle and ductile deformation and formation of folds and faults; solution of structural problems involving folded and fractured rocks. Economic Geology: 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.

Learning Outcomes: On completing the course students should be able to:
1. Describe processes leading to the formation of folds and faults
2. Comprehend ore forming processes and the classification of ore deposits
3. Recognise the world’s major ore deposits
4. Discuss African geology
5. Interpret geological maps.

Contribution to Exit Level Outcome:
1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
9 Independent Learning Ability (Course Outcomes 5)

Issue Date: September 2015
Next Revision: September 2019
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<tr>
<th>Module Title:</th>
<th>THERMOFLUIDS</th>
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<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests ) 50%, Examination 50% (1 x 3 hour paper)</td>
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<td>Co-requisite(s)</td>
<td>SCHM3512 Chemistry 1B</td>
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</table>

Content: Thermodynamics; Basics concepts in thermodynamics, 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. Application of first law to non-flow processes; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. Second law of thermodynamics: concept of the heat engine; cycle efficiency; Reversibility and irreversibility. Engine efficiency. The Carnot cycle. Entropy; determination and property diagrams. 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. Heat transfer: Modes of heat transfer, conduction, convection and radiation. Fluid Mechanics: 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 (constant acceleration); forces on submerged surfaces; buoyancy. One-dimensional flows with inertia: 1-D mass conservation; 1-D momentum conservation (Bernoulli equation); total head diagrams; free liquid jets; Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram) flow measurement, state of flow, pumps and fan characteristics.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the first law of thermodynamics and its applications to non-flow and flow processes
2. Explain the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
3. Analyse and quantify the properties of working fluids
4. Interpret and use thermodynamic property diagrams
5. Explain the equation of state of a perfect gas

Contribution to Exit Level Outcome:
1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2,3, 4)
6. Professional and Technical Communication (Course Outcomes 4)
8. Individual, Team and Multidisciplinary Working (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: ENGINEERING MATERIALS

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<td>Contact Hours</td>
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<td>Assessment</td>
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<td>Co-requisite(s)</td>
<td>TEGS3591 Materials Science</td>
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</tbody>
</table>


Learning Outcomes: Upon completion of this 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.

CONTRIBUTION to ECN Exit Programme Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3 and 4)

Issue Date: September 2015
Next Revision: September 2019
Module Title: **ELECTRICAL MACHINES**

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<td>Continuous 100% (At least 2 assignments, 2 Tests, 2 Practical Labs, )</td>
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<td>TEGT3541 Fundamentals of Electrical Engineering</td>
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**Contents:** Introduction to electrical machinery: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines:** Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers:** Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine):** generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine:** introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, special cage motors, induction regulators, energy recovery techniques. Drives Applications

**Learning Outcomes:** On completing the course students should be able to:
1. Demonstrate an understanding of the principle of operation of electrical machinery
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.
3. Describe the principle of operation and applications of transformers and AC windings
4. Describe the principle of operation and applications of three-phase induction machines

**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 Information Technology (Course Outcomes 2, 4)
4. Professional and Technical Communication (Course Outcomes 4)

**Issue Date:** September 2015  
**Next Revision:** September 2019
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<th><strong>Module Title</strong></th>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGM3591 Engineering Mathematics I</td>
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</table>

**Contents:** *Introduction to surveying:* theory of measurement errors; surveying instrumentation; observation and reduction of observations; levelling, taping and electronic distance measurement; setting out; 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:** joins, polars; intersections; traverse; resections; triangulation; tri-lateral; tri-highting; direction sheet; contouring and surface modelling software. Survey camp (1 week during holidays).

**Learning Outcomes:** On completing the course 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. Explain the GPS survey systems
4. Demonstrate knowledge of surveying calculations
5. Use contour and surface modelling software in surveying exercises

**Contribution to Exit Level Outcome:**
1. Problem Solving (Course Outcomes 4)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3. Investigations, Experiments and Data Analysis (Course Outcomes 4, 5)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5)
5. Independent Learning Ability (Course Outcomes 5)

**Issue Date:** September 2015
**Next Revision:** September 2019

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<th><strong>Module Title</strong></th>
<th><strong>HIV AND AIDS EDUCATION</strong></th>
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<tr>
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<tr>
<td>NQF Level</td>
<td>5</td>
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<tr>
<td>Contact Hours</td>
<td>1L + 1T per week for 14 weeks</td>
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<tr>
<td>NQF Credits</td>
<td>None</td>
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<tr>
<td>Assessment</td>
<td>Continuous assessment 100% (3 Assignments and 1 report)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
</tr>
</tbody>
</table>

**Content:** *The Engineer and HIV:* Basic facts of HIV and AIDS; Prevention, Counselling and Testing, and Treatment of HIV and AIDS; Drivers of the HIV and AIDS Epidemic in Namibia, The Engineering Sector and HIV and AIDS. **Impact of HIV and AIDS:** Socio-Economic Impacts on the workforce; Impact Assessment; HIV and AIDS cost benefit analysis. **HIV and AIDS Mitigation:** The Policy Environment; Design and Implementation of HIV and AIDS workplace programmes

**Learning outcomes:** Upon completion of the module students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

**Issue Date:** September 2016
**Next Revision:** September 2020

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Module Title: INDUSTRIAL ATTACHMENT I

Code: TEGT3600
NQF Level: 6
Total Hours: Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week x 6 weeks = 180 hours.
NQF Credits: Not assigned.
Assessment: Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite: TEGW3590 Workshop Practice

Content: During Industrial Attachment I, students will work under company supervision at the level of an Artisan and will undertake at least six 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 organisational structure and the operational processes of the company or organisation
2. Describe in details his/her contribution to the company during the internship

Issue Date: September 2015
Next Revision: September 2019
## YEAR 3 OF BSc IN MINING ENGINEERING

### SEMESTER 1

<table>
<thead>
<tr>
<th>Module Title:</th>
<th>EXPERIMENTAL AND RESEARCH METHODS</th>
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</thead>
<tbody>
<tr>
<td>Code</td>
<td>TEGR3760</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1IPS/Week</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%))</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TEGS3661 Statistics for Engineers</td>
</tr>
</tbody>
</table>

**Content:** Experimentation planning and execution. Technical report writing. Report structure and format. Literature Review. Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). Research methodology. Formulation and presentation of research proposals. Statistical data analysis: Data description: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. Data modeling: Experimental data modeling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination $R^2$ and adjusted $R^2$ and the role of adjusted $R^2$ on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

**Research Proposal:** During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

**Learning Outcomes:** On completing the course students should be able to:

1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an engineering research process
7. Propose an engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an engineering audience following specified guidelines

**CONTRIBUTION to Exit Level Outcome:**

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

**Issue Date:** September 2015

**Next Revision:** September 2019
## Module Title: FUNDAMENTALS OF ECONOMICS

<table>
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<th>Code</th>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T /Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 4 assignments, 2 Tests); Examination 50% (1 x 2 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>None</td>
</tr>
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</table>

**Contents:** Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. **Macroeconomics:** inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. **Financial accounting:** nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. **Introduction to budgeting. Introduction to marketing.** Long and short-term decision making.

**Learning Outcomes:** On completing the course students should be able to:

1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

### Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

**Issue Date:** September 2015  
**Next Revision:** September 2019

## Module Title: HYDROGEOLOGY

<table>
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<th>Code</th>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS /Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests and practical's) 50%, Examination 50% (1 x 2 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TMNE3622 Structural Geology</td>
</tr>
</tbody>
</table>

**Contents:** Basic hydrogeology: 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.

**Learning Outcomes:** On completing the course students should be able to:

1. Explain the mechanics of groundwater recharge and its analysis.
2. Discuss the theory of aquifer hydraulics, model underground aquifers and evaluate them.
3. Appraise the reactions governing underground solutions.
4. Explain the effect of groundwater and its pumping on underground openings.
5. Design 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.

### Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4, 5, 6)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3)

**Issue Date:** September 2015  
**Next Revision:** September 2019

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<table>
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<tr>
<th>Module Title:</th>
<th>EXCAVATION ENGINEERING</th>
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<tr>
<td>Code</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 3 Tests) 50%, Examination 50% (1 x 3 hour paper)</td>
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<tr>
<td>Pre-requisite(s)</td>
<td>TMNE3661 Introduction to Mining Engineering</td>
</tr>
</tbody>
</table>

**Contents:**

**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 shearsers, 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.  
**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. Field Trip to surface and underground mines

**Learning Outcomes:** On completing the course students should be able to:  
1. Explain various powering systems used in the mining industry  
2. Discuss the various techniques of mechanical excavation of rock and earth matter  
3. Analyse the mechanics of impact breaking of solid materials  
4. Assess rock drilling and use of explosives in mining  
5. Discuss various rock breaking and blasting techniques  
6. Appraise blasting techniques for underground and surface mining.

**Contribution to Exit Level Outcome:**  
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)  
3 Engineering Design (Course Outcomes 4)  
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 5, 6)

**Issue Date:** September 2015  
**Next Revision:** September 2019
Module Title: MINE EQUIPMENT AND MACHINERY

<table>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T /Week</td>
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<td>NQF Credits</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TMNE3661 Introduction to Mining Engineering</td>
</tr>
</tbody>
</table>

Contents: Description of the following systems and their production capabilities, Consideration of the mechanics of operation and the basis for performing calculations to determine cycle times, sizes, numbers, power and strengths. **Bulk solids handling:** Conveyor systems: conventional, cable belt, pipe conveyor, high angle conveyors, calculation of power requirements and carrying capacity of belts. Chairlifts. 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. **Selected topics:** Off-highway haul trucks and traceless haul trucks. Mine water distribution service, collection, treatment, storage and pumping. Pneumatic conveying of solids in pipelines. Underground powered supports and coal cutters. **Rail transport system and selection of wagons/rail cars**

Coal mining equipment, panel design and production potential. **Mine visits.**

Learning Outcomes: On completing the course students should be able to:

1. Explain modern mining machinery and mine transportation systems
2. Design and select appropriate mine equipment, machinery and systems for loading and hauling
3. Analyse and control haulage operations
4. Evaluate fluid power systems in mining.
5. Discuss electrical systems used in mining operations
6. Explain the principles of materials handling and power system consideration and performance.

Contribution to Exit Level Outcome:

- 2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
- 3 Engineering Design (Course Outcomes 2)
- 5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4)
- 7 Sustainability and Impact of Engineering Activity (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MINE VENTILATION AND CLIMATE CONTROL

Code: TMNC3791
NQF Level: 7
Contact Hours: 3L + 2T or 1PS /Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 assignments, 2 Tests and practical) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TMNE3632 Thermofluid


Learning Outcomes: On completing the course students should be able to:
1. Appraise air quantity required in mines
2. Apply the principles of fluid flow to ventilation systems.
3. Evaluate and apply fan behaviour to ventilation systems.
4. Design a ventilation system for a mine.
5. Explain the environmental hazards found in mines and outline the control measures that detect, monitor, minimise and/or manage these hazards.
6. Discuss typical ventilation systems in selected mines such as coal, gold and uranium mines.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 3, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: SOIL AND ROCK MECHANICS

Code
TMNU3791

NQF Level
7

Contact Hours
3L + 2T or 1PS /Week

NQF Credits
12

Assessment
Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

Pre-requisite(s)
TMNE3621 Introduction to Engineering Geology

Contents: 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, 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.

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. Assess 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.

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)

Issue Date: September 2015
Next Revision: September 2019
Contents: Entrepreneurial perspective: types of entrepreneurs, characteristics of entrepreneurs, examples of successful ventures for national development. Carrying out feasibility studies, writing business plans. Government policies on small business ventures. **Entreprising opportunities:** business motivation, competencies and skills, innovative ideas, product concept and description, market assessment. **Starting new business ventures:** the calculated risk, business planning and organization, management planning, financial projections, possible sources of finance, resource management, projected levels of growth and operations. **Change Management theory.** Group dynamics. Management accounting. **Marketing strategies.**

### Learning Outcomes:

On completing the course students should be able to:

1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Distinguish the methods used to carry out feasibility studies
3. Develop a business plan relating to an engineering endeavor
4. Separate the concepts of motivation, competencies, innovation and product marketing
5. Relate the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

### Contribution to Exit Level Outcome:

- 7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
- 11 Engineering Management (Course Outcomes 4, 5)

**Issue Date:** September 2015  
**Next Revision:** September 2019
Module Title: SURFACE MINING

Code: TMNS3792
NQF Level: 7
Contact Hours: 3L + 2T or 1PS/Week
NQF Credits: 12
Assessment: Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s): TMNE3711 Excavation Engineering

Contents: Introduction to open-pit mining; factor affecting the selection of open pit mining; ore reserve estimation methods Open pit design; slope stability in relation to design; haul road design; drilling and blasting patterns; economics and stripping ratios; economic cut-offs; pit optimization. Quarry operations; working platforms; bench width; optimum depth Strip mining of mineral deposits; strip mine design and planning; optimum pit limit, economics of strip mining; environmental considerations; dragline operations; range diagrams. Marine mining: dredging; mechanized earth-moving; hydraulic mining; equipment selection; power systems; matching and fleet optimization; economic considerations of equipment selection and purchase; type life; cycle times. Practical exercises, Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:

1. Explain surface mining technologies and operations
2. Design granite quarries for production of aggregates and dimension stones
3. Design layouts for strip mining of coal and include important economic and environmental considerations
4. Explain the technology for marine mining and include important economic and environmental considerations

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 2, 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3. Engineering Design (Course Outcomes 2, 3)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8. Individual, Team and Multidisciplinary Working (Course Outcomes 2, 3)

Issue Date: September 2015
Next Revision: September 2019
Module Title: MINE SURVEYING

Code: TMNU3722
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (At least 2 assignments, 2 Tests and practicals) 50%. Examination 50% (1 x 2 hour paper)
Co-requisite(s): TCVE3642 Surveying for Engineers

Contents: 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 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. 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, reserve estimation of mineral deposits The plane-meter and areas Interpretation of maps and plan: Understanding map projections, developable surfaces and distortions; 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. 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; GPS instruments; observations and producing mine surveying records in terms of the mining laws.

Learning Outcomes: On completing the course students should be able to:
1. Explain the principles of surveying as applied to mines
2. Apply the knowledge of producing and analysing plans, maps and photographs of mines
3. Interpret map projections, geometrical constructions and diagonal scales
4. Evaluate rectangular and polar coordinates for contours and cartographic sections
5. Apply the detailed knowledge of underground mine surveying methods
6. Analyse and interpret mine surveying data for decision making
7. Relate practical knowledge of surveying in the field
8. Analyse map projections and interpret mine surveying data

Contribution to Exit Level Outcome:
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8)
4. Investigations, Experiments and Data Analysis (Course Outcomes 3, 7, 8)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 5, 7)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 2, 8)
8. Individual, Team and Multidisciplinary Working (Course Outcomes 3, 6, 8)

Issue Date: September 2015
Next Revision: September 2019
<table>
<thead>
<tr>
<th>Module Title:</th>
<th>COMPUTER APPLICATIONS IN MINING</th>
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<tbody>
<tr>
<td>Code</td>
<td>TMNU3792</td>
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<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>3L + 2T or 1PS /Week</td>
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<td>NQF Credits</td>
<td>12</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% (At least 4 Lab Exercises, 4 Assignments, 2 Tests, and 1 Mini-project)</td>
</tr>
<tr>
<td>Pre-requisite(s)</td>
<td>TCME3621 Computer Science for Engineers</td>
</tr>
</tbody>
</table>

**Contents:** This course builds on the basic computing skills learnt in Computer Aided Drawing and extends to the use of these skills in applications relevant to Mining Engineering. Topics covered include applications of software like MinSched, Surpac etc. geo-statistical evaluation packages. GIS software. Contouring packages, CAD packages, MATLAB, RocLab, SPSS. applications in mining and mine design packages. Ore body modelling and its role in mineral deposit evaluation and exploitation. Practical exercises on ore body modelling. A mini project on an approved topic will be included.

**Learning Outcomes:** On completing the course students should be able to:

1. Apply Computer Aided Drawing skills
2. Use GIS, Contouring packages and MATLAB in resource modelling
3. Apply software packages for mine design.

**Contribution to Exit Level Outcome:**

1. Problem Solving (Course Outcomes 2, 3)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3. Engineering Design (Course Outcomes 3)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3)
9. Independent Learning Ability (Course Outcomes 1, 2, 3)

**Issue Date:** September 2015
**Next Revision:** September 2019
Module Title: MINERAL PROCESSING

Code: TMNS3742
NQF Level: 7
Contact Hours: 2L + 1T or 1PS/Week
NQF Credits: 8
Assessment: Continuous 50% (At least 2 assignments, 2 Tests and practical’s) 50%. Examination 50% (1 x 2 hour paper)
Pre-requisite(s): TMNE3661 Introduction to Mining Engineering


Learning Outcomes: On completing the course 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 principles involved in solid-liquid separation
5. Sketch simple flowsheets for mineral processing
6. Explain the basic methods of extracting metals from concentrated ores.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 1, 2, 6)

Issue Date: September 2015
Next Revision: September 2019
Module Title: TECHNICAL VALUATION

Code            TMNU3742
NQF Level       7
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]
Pre-requisite(s) TEGS3691 Statistics for Engineers

Contents: 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. 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.

Learning Outcomes: On completing the course students should be able to:
1. Review statistical valuation methods
2. Analyse various geo-statistical models
3. Apply geo-statistical methods in ore valuations.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2, 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3)
11 Engineering Management (Course Outcomes 9)

ECN Exit 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
Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

To pass this module 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 constitute 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: MINE DESIGN

Code: TMNS3732
NQF Level: 7
Contact Hours: 4L + 2T or 1PS /Week
NQF Credits: 16

Assessment:
Continuous 50% (At least Assignments 2 and 3 Tests making 30%, presentation (10%) and report (10%) on selected topics in Mining Engineering), Examination 50% (1 x 3 hour paper)

Co-requisite(s):
TMNS3791 Mine Equipment and Machinery

Contents:
Factors affecting the selection of surface mining methods: Different technological diagrams of surface mining methods Determination of parameters such as optimum depth of a quarry or open pit. Design of Bench element: Design of slopes. Determination of overall slope angle, Design of width or working platform of a bench, Design of surface mines: Feasibility study of granite or dimension stones quarries. Selection of mine equipment and machinery: Typical drilling and blasting pattern designs. Design and construction of explosive magazines Economic indices of surface mine design. Application of software packages to surface mine design. Design of transportation systems and haul roads. Opening of mineral deposits and the design of mine: Factors to be considered during the location of shafts, Shaft selection and location, Shaft design, construction. Development of mine fields (levels, panels, and combined methods). Design of different underground mining methods for different types of deposits: Design of ventilation circuits, Design of ventilation networks in an underground mine. Design of support systems: wood, bolt and nut, concrete and steel arch supports. Geological modelling of a coal deposit from borehole longs. Selection of transportation systems Application of software packages to mine design- Ventism software.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Analyse surface mining systems
2. Evaluate the working platform and optimum depth
3. Design a surface mine e.g. a granite quarry
4. Design and construct explosive magazines magazine
5. Select of location of a shaft during the opening of a mine
6. Design or select an appropriate method of development of a mine
7. Design support systems in an underground mine
8. Design of ventilation system of a typical underground mine
9. Apply software packages in mine design

Contribution to Exit Level Outcome:
1. Problem Solving (Course Outcomes 1, 2)
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, 6, 7, 8, 9)
4. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
5. Sustainability and Impact of Engineering Activity (Course Outcomes 1, 5)
6. Individual, Team and Multidisciplinary Working (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
7. Engineering Management (Course Outcomes 1, 5)

Issue Date: September 2015
Next Revision: September 2019
Module Title: INDUSTRIAL ATTACHMENT II

Code: TEGT3700
NQF Level: 7
Total Hours: Six (6) weeks preferably during the June/July break in Year 3 or 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: TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of Technologist 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 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 technologists and technicians in an industrial setting and identify the associated reporting channels.
2. Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
3. Describe the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: September 2019
Module Title: SOCIETY AND THE ENGINEER

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
</tr>
<tr>
<td>Credits</td>
<td>8</td>
</tr>
<tr>
<td>Assessment</td>
<td>Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Exit Level Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (ethics), 4 and 5 (Law), 7 (health and safety), 8</td>
<td>Sustainability and Impact of Engineering Activity</td>
</tr>
<tr>
<td>1, 2, 3, 6</td>
<td>Engineering Professionalism</td>
</tr>
</tbody>
</table>

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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: PROJEKT 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:

8. Discuss the principles of project management and project implementation including the importance of project time management, risk management and performance monitoring and evaluation
9. Apply the processes, tools and techniques of project management in an engineering context
10. Discuss the principles of managing medium to large scale engineering projects
11. Discuss the principles of managing community-based development projects
12. Discuss the concepts of close-out phases of the project life cycle
13. Integrate and balance overall project management functions and apply available software tools for project management
14. 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:

12 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 work 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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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) (TMNM3791 Mine Ventilation and Climate Control), (TMNS3762 Surface Mining)


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)

Issue Date: September 2015
Next Revision: September 2019
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


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)

Issue Date: September 2015
Next Revision: September 2019
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<th>Module Title:</th>
<th>ROCK ENGINEERING</th>
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<td>Code</td>
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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>2L + 1T or 1PS/Week</td>
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<td>NQF Credits</td>
<td>8</td>
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<tr>
<td>Assessment</td>
<td>Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TMNU3791 Soil and Rock Mechanics</td>
</tr>
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**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 ratio 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)

**Issue Date:** September 2015
**Next Revision:** September 2019
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)

Issue Date: September 2015
Next Revision: September 2019
SEMESTER 2

Module Title: RESEARCH PROJECT

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<td>NQF Level</td>
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<tr>
<td>Contact Hours</td>
<td>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.</td>
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<tr>
<td>NQF Credits</td>
<td>30</td>
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<tr>
<td>Assessment</td>
<td>Continuous 100% Two Seminar Presentations (20%); Final Oral Presentation of Research Report (20%); Final Research Report (60%)</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TCER3891 Research Proposal, All third year modules</td>
</tr>
</tbody>
</table>

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 analyze,
interpret and derive information from data.

What constitute 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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
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, 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.

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, analyze and solve complex engineering problems creatively and innovatively. The final design report should show evidence of the student’s ability to identify, analyze 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 constitute 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 constitute 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 constitute 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.

Issue Date: September 2015
Next Revision: September 2019
Module Title: INDUSTRIAL ATTACHMENT III

<table>
<thead>
<tr>
<th>Code</th>
<th>TEGT3800</th>
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</thead>
<tbody>
<tr>
<td>NQF Level</td>
<td>8</td>
</tr>
<tr>
<td>Total Hours</td>
<td>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.</td>
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<tr>
<td>NQF Credits</td>
<td>Not assigned. The Module is required to be satisfactorily done before graduation.</td>
</tr>
<tr>
<td>Assessment</td>
<td>100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).</td>
</tr>
<tr>
<td>Co-requisite(s)</td>
<td>TEGT3700 Industrial Attachment II</td>
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**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

**Issue Date:** September 2015
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