Faculty of Engineering & Information Technology

Prospectus 2015

UNAM
UNIVERSITY OF NAMIBIA

FACULTY PROSPECTUS 2015

FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

UNAM
UNIVERSITY OF NAMIBIA

NOTE

This Faculty Yearbook is valid for 2015 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 2015.

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 2015 or any subsequent year.

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

CONTENTS

FACULTY PREAMBLE

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 reached 260 in February 2014, 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 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, and the Indian Wing (Phase II), which houses the Mining Engineering Building, the Computer Engineering Building and the Information Resource Centre. Construction of the German Wing (Phase III), which will house the Department of Civil and Environmental Engineering, will commence around April 2015.

The 30 pioneer graduates produced by the Faculty during the 2012 academic year consisted of Graduate Engineers in the following disciplines: Civil Engineering, Computer Engineering, Electrical Engineering, Electronics Engineering, Mechanical Engineering, Metallurgical Engineering and Mining 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. Of the 24 Namibian Graduate Engineers, 23 are already employed in Namibia and one was offered a job in Angola. During the 2013 academic year, the Faculty produced an additional 37 Graduate Engineers in the various disciplines mentioned above, and including some who had specialized in Telecommunication Engineering. During the 2014 academic year the Faculty had 68 final year students in various engineering disciplines.

Having successfully implemented the various Bachelor of Science (Engineering) degree programmes, the Faculty launched the MSc Civil Engineering degree programme in July 2014. The MSc in Civil Engineering has three areas of specialization, namely: Structural Engineering; Transport Engineering; Water Engineering. Other MSc programmes under development and which will be launched in February 2016 include MSc in Metallurgical Engineering and MSc in Water Resources Management.

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 both 2012 and 2013, 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. During 2014, final year civil engineering students visited the University of Siegen in Germany.

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 Lazarus Hangula, 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.

Professor Frank P.L. Kavishe
FOUNDING DEAN

2015 ACADEMIC YEAR: FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

FIRST SEMESTER 2015

Thu 08 January	**University opens**
Mon 19 Jan – Fri 30 Jan	On-Line Registration: Senior Engineering Students
Tue 20 January	**Academic staff resumes office duties**
Thu 22 January	Management Meeting: Faculty of Engineering & IT (9:00)
Mon 26 Jan - Wed 28 Jan	Registration of First Year Engineering Students at Jose Eduardo Dos Santos Campus
Thu 29 Jan – Fri 30 Jan	Orientation of First Year Engineering Students at Jose Eduardo Dos Santos Campus
Mon 02 February	**Lectures commence for FIRST SEMESTER for all Engineering Students**
Thu 26 March	Faculty Board Meeting – Faculty of Eng. & IT (Curriculum changes & new programmes) (09:00)
Mon 30 March	SEMESTER BREAK STARTS
Tue 07 April	LECTURES RESUME AFTER 1ST SEMESTER BREAK
Wed 13 May	Management Meeting – Faculty of Eng. & Info Tech (09:00)
Wed 13 May	**Lectures end for FIRST SEMESTER for all Engineering Students**
Mon 18 May	1st Semester Exams commence (Semester I modules) all Engineering Students
Fri 29 May	1st Semester Exams end (Semester I modules) for Senior Engineering Students
Fri 29 May	**End of FIRST SEMESTER for Senior Engineering students**
Mon 01 June	Industrial Attachment commences for Senior Engineering Students (six weeks)
Wed 10 June	Regular Exams end (Semester I modules) for First Year Engineering Students
Mon 15 June – Fri 19 June	Supplementary/Special Examinations for First Year Engineering Students
Mon 22 June - Fri 26 June	Industrial Attachment visits
Mon 29 June – Fri 03 July	**UNAM Mid-Year Recess**
Fri 11 July	Industrial Attachment ends for Senior Engineering Students

SECOND SEMESTER 2015

Mon 13 July – Fri 17 July	Supplementary/Special Examination for Engineering Senior students
Mon 20 July	**Lectures commence for SECOND SEMESTER for all Engineering Students**
Thu 30 July	Faculty Board Meeting (Examiners and Moderators) (09:00)
Mon 24 August	2nd Semester BREAK starts
Mon 31 August	Lectures resume after 2nd Semester Break
Thu 01 October	Faculty Management Meeting – Faculty of Eng. & Info Tech (09:00)
Fri 16 October	**Lectures end for SECOND SEMESTER for First Year Engineering Students**
Thu 22 October	Regular Exams commence (Sem. II & Double modules) First Year Engineering Students
Fri 30 October	**Lectures end for SECOND SEMESTER for Engineering Senior Students**
Wed 04 November	Exams commence (Sem. II & Double modules) Engineering Senior Students
Thu 12 **November**	Regular Examinations end (Sem. II & Double modules) First Year Engineering Students
Tue 17 Nov – Mon 23 Nov	Supplementary/Special Examinations for First Year Engineering Students
Fri 20 **November**	Examinations end (Sem. II & Double modules) Engineering Senior Students
Mon **23 November**	**End of SECOND SEMESTER for First Year Engineering Students**
Mon 23 Nov – Fri 27 Nov	Supplementary/Special Examinations of Second Semester for Engineering Senior Students
Fri 27 **November**	**End of SECOND SEMESTER for Engineering Senior Students**
Tue 15 December	Academic Year ends and University closes (Until 11 January 2016)

2016 ACADEMIC YEAR

11 January 2016	University opens (2016 academic year)
21 January 2016	Academic staff resumes office duties

DUE DATES FOR THE 2015 ACADEMIC YEAR

(i) **GENERAL**

Last day for appeals (Sem 2 & Double modules – Reg & Supp/Spec exams of Nov 2014 ..... 22 Jan
Last day for application of retention of continuous assessment mark &
Promotion Exam ..... 06 Feb
Last day for application for exemption(s)..... 06 Feb
Last day for Late Registration (Late fee payable) ..... 11 Feb
Last day for approval of exemption(s) ..... 11 Feb
Last day for approval of retention of continuous assessment mark and Promotion Exam ..... 11 Feb
Last day for approval of module(s) & qualification changes..... 11 Feb
Last day for change of offering Types at Regional Centres (Semester 1 modules)..... 28 Apr
Last day for Appeals (Semester 1 modules (Reg & Supp/ Spec Exams of June 2015) ..... 24 Jul
Last day to submit outstanding documentation ..... 21 Aug
Last day to change Offering Types at Regional Centres (Semester 2 modules) ..... 19 Sep
Last day to cancel enrolment ……..24 Sept
Last day to submit Theses and Dissertations for examinations …… ……..30 Oct

(ii) CANCELLATIONS

Semester 1 modules
Last day to cancel Semester 1 modules……..... ..08 May

Semester 2 modules
Last day to cancel Semester 2 modules……..…… .24 Sept

Double modules (A double module normally extends over one academic year)
Last day to cancel Double modules…… .24 Sept

(iii) FINANCE

Semester 1 modules
Last day to cancel with 100 % credit……... 6 March
Last day to cancel with 50 % credit…….. .17 April

Semester 2 modules
Last day to cancel with 100 % credit……..…. 07 August
Last day to cancel with 50 % credit……. .28 August

Double modules (a double module normally extends over one academic year)
Last day to cancel with 100 % credit…… 6 March
Last day to cancel with 50 % credit..……... 5 June

2015 ACADEMIC YEAR: UNAM MAIN

SEMESTER 1

08 January	University opens
19 January	Registration starts: Senior under and Postgraduate students: On-line until 4 Feb)
19 January - 04 February	Registration (Last day for Late Registration: 11 February)
20 January	Academic staff resumes office duties
23 January	Registration: 1st Year Postgraduate students
26 January	Registration commences: 1st Year undergraduate students
04 February	Registration ends: All students
09 February	Lectures commence for **FIRST SEMESTER**
30 March	1st Semester break starts
07 April	Lectures resume after 1st Semester break
13 May	Lectures end for **FIRST SEMESTER**
19 May	Regular Examinations commence (Semester I modules)
10 June	Regular Examinations end
15 June - 19 June	Supplementary/Special Examinations
19 June	End of 1st Semester
29 June - 03 July	Mid-year recess

SEMESTER 2

13 July	Lectures commence for 2nd Semester
24 August	2nd Semester break starts
31 August	Lectures resume after 2nd Semester break
16 October	Lectures end for 2nd Semester
22 October	Regular Examinations commence (Semester 2 & Double modules)
12 November	Regular Examinations end
17 November - 23 Nov	Supplementary/Special Examinations
23 November	End of 2nd Semester
15 December	Academic Year ends & University closes (until 11 January 2016)

A. STRUCTURE AND PERSONNEL OF THE FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

A.1. OFFICE OF THE DEAN

Founding Dean	Professor F.P.L. Kavishe, B.Sc. (Eng) (DSM), MSc, DIC, PhD, (London), R. Eng, C.Eng. (Britain)		
Secretary to the Dean	Ms Melinda Christiaan	*Tel:*	(+264 65) 232 4002
		Fax:	(+264 65) 232 4069
Faculty Officer/Administrator	Mrs. Paulina N. Kashihakumwa	*Tel:*	(+264 65) 232 4004
Human Resources Officer	Ms. Jacqueline Nghidamwasha	*Tel:*	(+264 65) 232 4078
Campus Accountant	Mrs. Erastus Tulonga Beata	*Tel:*	(+264 65) 232 4009
Systems Administrator	Mr. Gerson Hailundu	*Tel:*	(+264 65) 232 4044
Deputy Dean	Dr. Adedayo A. Ogunmokun:	B.Sc. (Agr. Eng), (Ife), PhD (Agr. Eng) (Cranfield)	
		Tel:	(+264 65) 232 4005
Examinations Officer	Ms Tekla Ndevashiya	*Tel:*	(+264 65) 232 4107
SRC Office	Current SRC Officials	*Tel:*	(+264 65) 232 4093

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, Ongwediva Engineering Campus
Nandjembo Mengela Street
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 COMPUTER AND ELECTRONICS ENGINEERING

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

DEPARTMENT OF ELECTRICAL ENGINEERING

Academic Programmes: 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)

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.

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 has already indicated that the curriculum satisfies the requirements for Professional Bachelor Degrees at NQF Level 8. The same curriculum was submitted to the Engineering Council of South Africa for a desk-top 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 desk-top 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 stake holders, 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.

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

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

KNOWLEDGE AREA	MINIMUM CREDITS	MIN PERCENTAGE CONTENT
MATHEMATICS	56	10%
BASIC SCIENCES	56	10%
ENGINEERING PRINCIPLES	168	30%
ENGINEERING DESIGN AND SYNTHESIS	67	12%
COMPUTING AND INFORMATION TECHNOLOGY	45	8%
COMPLEMENTARY STUDIES	56	10%
SUBTOTAL (MINIMUM)	**448**	**80%**
DISCRETIONARY STUDIES (MAXIMUM)	112	20% max
TOTAL	**560**	**100%**

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

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

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:

(i) Engineering problem solving ability.
(ii) Application of fundamental and engineering knowledge.
(iii) Engineering design and synthesis.
(iv) Investigations, experiments and data analysis.
(v) Engineering methods, skills, tools and information technology.
(vi) Professional and General Communication.
(vii) Impact of engineering activity on society and the environment.
(viii) Team and multidisciplinary working skills
(ix) Independent learning ability (lifelong learning)
(x) Professional ethics and practice

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 Mechanical Engineering (Honours)	**(19BMEE)**
Bachelor of Science in Metallurgical Engineering (Honours)	**(19BMLE)**
Bachelor of Science in Mining Engineering (Honours)	**(19BMNE)**
Bachelor of Science in Telecommunication Engineering (Honours)	**(19BTCE)**
Bachelor of Science in Biomedical Engineering (Honours)	**(19BBME)**
Bachelor of Science in Chemical Engineering (Honours)	**(19BCHE)**
Bachelor of Science in Electrical Power Engineering (Honours)	**(19BEPE)**
Bachelor of Science in Industrial Engineering (Honours)	**(19BINE)**

C.2. PROGRAMMES ON OFFER IN 2014

(i) Bachelor of Science in Civil Engineering (Honours)
(ii) Bachelor of Science in Electrical Engineering (Honours)
(iii) Bachelor of Science in Electronics and Computer Engineering (Honours)
(iv) Bachelor of Science in Mechanical Engineering (Honours)
(v) Bachelor of Science in Metallurgical Engineering (Honours)
(vi) Bachelor of Science in Mining Engineering (Honours)

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.

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

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

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

(d) Admission to the Faculty of Engineering and Information Technology through the 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 (HIGCSE 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.

(c) 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.

(d) 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.

(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.

(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 Computer Science modules, 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%.**

C.8. ACADEMIC ADVANCEMENT RULES

C.8.1 PRE-ENGINEERING TO FIRST YEAR OF ENGINEERING

(a) A student should normally pass 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 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

A student must pass **at least 11** of the prescribed **First Year** modules (at least 78% of modules) to be able to register for Second Year modules. If any of the failed modules is a Pre-requisite(s) for a Second Year module, then the candidate cannot register for the affected Second Year module until the Pre-requisite(s) is passed.

C.8.3 SECOND YEAR TO THIRD YEAR OF ENGINEERING

A student **must** have passed all prescribed First Year modules. In addition, the student must pass at least 78% of the prescribed **Second Year** modules to be able to register for Third Year modules. If any of the failed modules is a Pre-requisite(s) for a Third Year module, then the candidate cannot register for the affected Third Year module until the pre-requisite is passed.

C.8.4 THIRD YEAR TO FOURTH YEAR OF ENGINEERING

A student **must** have passed all prescribed second year modules. In addition, the student must pass at least 78% of the prescribed **Third Year** modules to be able to register for Fourth Year modules. If any of the failed modules is a pre-requisite for a Fourth Year module, then the candidate cannot register for the affected Fourth Year module until the pre-requisite is passed.

C.9. MINIMUM REQUIREMENTS FOR RE-ADMISSION

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

- At least **62** credits by the end of the first year (at least **40%** of total credits in Year 1)
- At least **80%** of Year 1 credits plus **40%** of Year 2 credits by the end of the second year.
- All (**100%**) Year 1 credits plus at least **80%** of Year 2 credits plus at least **40%** of Year 3 credits by the end of the third year.
- All (**100%**) of Year 1 and Year 2 credits plus **80%** of Year 3 credits plus **20%** of Year 4 credits by the end of the fourth year.

C.10. 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 34 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
TEGP3590 Workshop Practice

D.3. YEAR 2 OF ENGINEERING (= 19BETE; 19BECE; 19BCEE; 19BTCE 19BMEE; 19BMNE; 19BMLE; 19BCME, 19BCVE)

FACULTY CORE:

TEGT3671 Engineering Mathematics III
TEGT3641 Engineering Mechanics II
TCME3621 Computer Science for Engineers
TEGT3661 Computer Aided Drawing
EGS3691 Statistics for Engineers
TEGT3672 Engineering Mathematics IV
TEGT3600 Industrial Attachment I (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.4. YEAR 3 OF ENGINEERING

FACULTY CORE:

TEGT3761 Fundamentals of Economics
TEGT3742 Entrepreneurship
EGT3762 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
TEGM3861 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
L	Lecture
T	Tutorial
PS	Practical Session or Laboratory Session
TEG_	Engineering and Technology course codes
TCV_	Civil Engineering course codes
TCM_	Computer Engineering course codes
TEC_	Electrical Engineering course codes
TET_	Electronics Engineering course codes
TCE	Electronics and computer course codes
TME_	Mechanical Engineering course codes
TML_	Metallurgical Engineering course codes
TMN_	Mining Engineering course codes
TTC_	Telecommunication Engineering course codes
SMAT	Mathematics course codes
SPHY	Physics course codes
SCHM	Chemistry course codes
U__	University core modules

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)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & CO-REQUISITE
1	English Comm. and Study Skills	ULCE3419	5	16	None
1	Fundamentals of Engineering	TEGT3521	5	8	None
1	Basic Mathematics	SMAT3511	5	16	None
1	Analytic Geometry	SMAT3501	5	8	None
1	Matrices & Complex Numbers	MAT3521	5	8	None
1	Chemistry 1A	SCHM3511	5	16	None
1	Physics for Physical Sciences I	SPHY3511	5	16	None
Total Credits				**88**	

SEMESTER	MODULE	CODE		CREDIT	PRE & CO-REQUISITE
2	English for Academic Purposes	ULEA3519	5	16	None
2	Contemporary Social Issues	UCSI3580	5	8	None
2	Pre-Calculus	SMAT3512	5	16	None
2	Introduction to Statistics	SSTS3522	5	8	None
2	Chemistry 1B	SCHM3512	5	16	SCHM3511
2	Physics for Physical Sciences II	SPHY3512	5	16	SPHY3511
2	Computer Literacy	UCLC3509	5	8	None
Total Credits				**88**	

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

SEMESTER 1

Module Title:	**ENGLISH COMMUNICATION AND STUDY SKILLS**
Code	ULCE3419
NQF Level	5
Contact hours	4 hours per week for 14 weeks
Credits	16
Assessment	Continuous 60%; Examination 40%: (1 x 3 hour paper)
Pre-requisites	None

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 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1x 2 hour paper)
Pre-requisites	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Issue Date: September 2011
Next Revision: September 2015

Module Title:	BASIC MATHEMATICS
Code	SMAT3511
NQF level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1x3 hour paper)
Pre-requisite	None

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ANALYTIC GEOMETRY**
Code	SMAT3501
NQF level	5
Contact Hours	**2**L + 1 T/Week FOR 14 Weeks
Credits	8
Assessment	Continuous 50%, Examination 50% (1x 2 hour paper)
Pre-requisite	None

Contents: Lines, Circles and tangent lines. Conic sections: ellipse, parabola, hyperbola. Translation and rotation of the axes. Parametric equations: cycloids. Polar coordinates: definition, polar equations and graphs, relating polar and Cartesian coordinates. Graphic in polar coordinates, Conic section in polar coordinates. Spheres, cylindrical surfaces, quadrics, spherical and cylindrical coordinates.

Issue Date: January 2012
Next Revision: January 2016

Module Title:	**COMPLEX NUMBERS AND MATRICES**
Code	SMAT3521
NQF level	5
Contact Hours	**2**L + 1T/Week FOR 14 Weeks
Credits	8
Assessment	Continuous 50%, Examination 50% (1x 3 hour paper)
Pre-requisite	None

Contents: 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
Issue Date: January 2012
Next Revision: January 2016

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 & 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 2009
Next Revision: January 2013

Module Title:	PHYSICS FOR PHYSICAL SCIENCES I
Code	SPHY3511
NQF level	5
Contact hours	4L + 2T or 1 PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

Contents: Units, significant figures & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA3519
NQF level	5
Contact hours	4 Contact hours per week for 14 weeks
Credits	16
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

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 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date: September 2012
Next Revision: September 2016

Module Title:	**PRE-CALCULUS**
Code	SMAT3512
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	None

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 2009
Next Revision: January 2013

Module Title:	INTRODUCTION TO STATISTICS
Code	SSTS3522
NQF Level	5
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Content: Definitions: Statistics; descriptive, inferential. Variables: qualitative versus quantitative. Data types: primary versus secondary, categorical versus discrete, continuous. Sources of data Population versus sample. Types of measurements: nominal, ordinal, interval, ratio scales. Presentation of data: tabular forms and graphical methods: histograms, pie charts, bar charts, frequency polygons, ogives, stem- and- leaf plots, box- and-whiskers plots. Measures of Central Tendency: Σ notation, mean, median, mode, quartiles, percentiles. Measures of Dispersion: variance, standard deviation, range, inter- quartile range, skewness and kurtosis. Identification of outliers. Uses of scientific calculators for statistical manipulation limited to calculation of mean, standard deviation.

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 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
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: 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 Solubilty 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 & 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 2009
Next Revision: January 2013

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 2009
Next Revision: January 2013

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

YEAR 1 OF BSc IN CIVIL ENGINEERING – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	*TEGT3521*	*5*	*8*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	*UCSI3580*	*5*	*8*	*None*
Total Credits Semester I				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credit Semester II				**80**	

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

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Fluid Mechanics	TMEE3611	6	16	**TEGT3592**
1	Computer Aided Drawing	TEGT3661	6	8	TCME3521 **TEGT3591**
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
Total Credits Semester III				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE &CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Building Materials	TCVI3692	6	12	**TEGT3562**
2	Introduction to Environmental Science	TCVE3662	6	8	None
2	Planning and Design Methodology	TCVD3622	6	8	**TEGT3521**
2	Surveying for Engineers	TCVE3642	6	8	**TEGM3591**
2	Solid Mechanics I	TMEE3642	6	8	**TEGT3592**
2	Strength of Materials	TMEE3622	6	8	**TEGT3592**
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN CIVIL ENGINEERING – 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Hydrology and Water Supply	TCVD3791	7	12	**TMNE3621**
1	Theory of Structures	TCVS3791	7	12	**TMEE3622**
1	Infrastructure Planning	TCVI3761	7	8	TCVD3622
1	Geo-Technical Engineering	TCVG3791	7	12	**TMNE3621**
1	Geology for Engineers	TCVD3761	7	8	**TMNE3621**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Buildings and Construction Management	TCVS3741	7	8	TCVI3692
Total Credits Semester V				**68**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**EGS3691**
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Computer Applications in Civil Engineering	TCVI3742	7	8	**TCME3521**
2	Hydraulics	TCVD3732	7	16	**TEGT3641** **TMEE3611**
2	Design of Steel and Timber Structures	TCVS3762	7	8	TCVS3791
2	Reinforced and Pre-stressed Concrete Design	TCVD3792	7	12	TCVS3791
2	Transport Planning and Engineering I	TCVI3752	7	16	**TCVI3692** TCVI3761
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**76**	

YEAR 4 OF BSc IN CIVIL ENGINEERING – 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Design of Buildings	TCVS3891	8	12	**TCVD3792 TCVS3762**
1	Transport Planning and Engineering II	TCVD3891	8	12	**TCVI3761 TEGT3761**
1	Wastewater and Solid Waste Management	TCVI3851	8	16	**TCVD3791**
1	Contract Management and Laws of Contract	TCVE3821	8	8	TCVS3741
1	Design of Bridges	TCVD3861	8	8	TCVD3792 TCVS3762
1	Research Proposal	TCVR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE**& CO-REQUISITE
2	Research Project	TCVR3892	8	30	All 3rd Year Mod TCVR3891
2	Civil Engineering Design Project	TCVD3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	EGT3700
Total Credits Semester VIII				**64**	

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

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: August 2011
Next Revision: August 2015

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 & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100%[Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Revision 1: September 2011
Next Revision: September 2015

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchhoff's laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information
- Describe the principles of a transformer and the basic AC generator and DC motors
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date:	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1st order and 2nd order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, 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 the 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 2009
Revision: January 2013

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

Content: Statics*:* 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. Analysis of frames and machines. **Virtual work**.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & 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 the 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 2009
Revision: January 2013

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%) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. 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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 of BSc in Civil Engineering

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**INTRODUCTION TO ENGINEERING GEOLOGY**
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 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:

- Describe composition and properties of common minerals and rocks
- Describe the nature of the interior of the earth and the plate tectonic theory
- Describe weathering processes and soil formation processes
- Demonstrate basic knowledge of geo-hydrology

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FLUID MECHANICS
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; 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; **Laminar viscous flow**: Differential equations of motion; torsional viscometer. Applications: flow with pressure gradient between parallel plate and pipe flow.

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

- Describe properties of fluids and conditions for relative equilibrium in fluids.
- Analyse one-dimensional mass and momentum conservation and applications of Bernoulli's equation
- Demonstrate skills for flow measurements
- Analyse general hydraulic systems with respect to energy changes, pipe friction, loss coefficient.
- Analyse laminar viscous flow using differential equations of motion and its applications to flow with pressure gradient between plate and pipe flow.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**STATISTICS FOR ENGINEERS**
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Contents: Probability: 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; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

YEAR 2 of BSc in Civil Engineering

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**BUILDING MATERIALS**
Code	TCVI3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3562 Materials Science

Content: Overview of properties of engineering materials. **Concrete:** Composition and production of concrete, hydraulic binders. Aggregates used in concrete mix. Composition dosage. Concrete adjuvants. Properties of fresh concrete. Preparation, treatment and pouring of concrete. Concrete testing. Grades of concrete. Concrete for special applications. **Steels:** Properties of carbon steel; selection and testing of structural steels. Steels for concrete reinforcement.
Raw clay and ceramics: Soil-cement: properties and applications; soil-line: stabilization with potassium silicate. Properties and applications of raw clay and technical ceramics. Porous materials: bricks, tiles and refractories. Non-porous materials: stoneware and porcelain. **Bitumen and asphalt technology**. Thatch and wood.

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

- Distinguish between various properties of materials
- Describe the composition and characteristics of concrete and aggregates
- Illustrate various concrete testing techniques
- Describe the characteristics and uses of carbon steels used in civil engineering
- Demonstrate knowledge of properties and characteristics of clays, bricks, tiles and technical ceramics
- Demonstrate knowledge of the properties and characteristics of stoneware and porcelain
- Describe properties and uses of bitumen and asphalt
- Describe general characteristic of thatch and wood used in the building industry

Revision 1: September 2011
Next Revision: September 2015

Module Title:	INTRODUCTION TO ENVIRONMENTALSCIENCE
Code	TCVE3662
NQF Level	6
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Environmental science as a discipline: 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 and waste management strategy, environmental management. **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. **Systems approach to environmental problem solving**: system dynamics and feedback loops; modelling environmental systems using Stella, decision making strategies and the environment.

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

- Describe the role of civil engineers in environmental problem solving
- Correlate population growth with development trends
- Demonstrate knowledge of environmental laws and regulations
- Describe techniques for environmental impact assessment
- Demonstrate knowledge of systems approach to environmental problem solving

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PLANNING AND DESIGN METHODOLOGY
Code	TCVD3622
NQF Level	6
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	**Continuous 100%** (At least 2 Written Tests (40%); Planning/Design Project (60%).
Co-requisite(s)	TEGT3521 Fundamentals of Engineering

Content: Physical infrastructure: Introduction to common infrastructure services for water, hydrology, transportation, buildings, urban and the built environment. **Civil engineering standards:** Codes and good practices. **Civil Engineering drawings:** plans, projections, sections and detailing of houses, storey buildings, bridges, storage tanks and other civil engineering structures. Drawings of foundation and roof structures. Interpreting and working with architectural drawings. **The general design process**: creative thinking techniques, engineering methodology; modelling; system analysis; decision-making. **Planning:** scenario planning, task scheduling, multi-tasking, forecasting. Presentation of reports with relevant technical specifications.

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

- Identify the elements of the physical infrastructure under civil engineering practice
- Describe standards and best practices in civil engineering
- Demonstrate knowledge of producing and interpreting civil engineering drawings
- Demonstrate knowledge of interpreting architectural drawings
- Describe the methodology for civil engineering design process
- Demonstrate general knowledge of planning, scheduling and forecasting in executing civil engineering projects
- Present information in the form of technical reports

Revision 1: September 2011
Next Revision: September 2015

Module Title	SURVEYING FOR ENGINEERS
Code	TCVE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment:	Continuous 50%; Examination 50% (1 x 2hours paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

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-lateration; tri-highting; 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:

- Demonstrate knowledge of the overview of surveying and its applications to engineering
- Describe the various techniques and tools used in practical surveying
- Demonstrate knowledge of GPS survey systems
- Demonstrate knowledge of surveying calculations
- Use contour and surface modelling software in surveying exercises

Revision 1: September 2011
Next Revision: September 2015

Module Title:	SOLID MECHANICS I
Code	TMEE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Statics: Properties of three-dimensional force systems. Equilibrium of rigid bodies subjected to two- and three-dimensional force systems. Application of principles of rigid body equilibrium to trusses, frames, and machines. **Method of virtual work:** application to equilibrium and stability analysis of interconnected systems. **Statically indeterminate problems**. Geometric compatibility. **Moments and products of inertia**: first and second moments of area, polar moment of inertia, parallel axis theorem, radius of gyration, composite area method, product of inertia. **Mechanics of Solids**: Analysis of thermal and assembly stresses. Theories of failure. **Deflection of beams**: Slope and deflection by integration, Discontinuity functions, statically indeterminate beams, method of superposition. **Energy methods**: Strain energy for various types of loading, Deflection by conservation of energy, Impact loading, Castigliano's theorem.

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

- Analyse equilibrium of rigid bodies subjected to two and three dimensional force systems and demonstrate application to trusses, frames and machines.
- Apply the method of virtual work for equilibrium and stability analysis.
- Analyse and solve statically indeterminate problems.
- Calculate area moments and products of inertia and apply them to mechanics problems.
- Analyse thermal and assembly stresses and describe general theories of failure.
- Analyse deflection of beams using integration, discontinuity functions and method of superposition.
- Apply energy methods in stress and strain analysis, deflection and impact loading.
- Describe and apply Castigliano's theorem to determine deflection of beams.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress and strain, shear stress and strain, thermal stress and strain. **Analysis of stress and strain.** Plane stress and plane strain. **Bending:** Revision of shear force/bending moment distributions, bending stress. Symmetrical and unsymmetrical bending. Inelastic bending. Residual stresses.**Transverse shear**: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **Torsion:** Torsion of circular sections, solid non-circular shafts, Thin-walled tubes. **Combined Loading**: bending and direct stresses, bending and torsional stresses. **Transformation of stresses and strains**. Mohr's circle.

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

- Demonstrate the application of Hooke's Law to normal and shear stresses.
- Analyse stresses and strains in two and three dimensions with cases of plane stress and plane strain.
- Analyse bending stresses in beams under symmetrical and unsymmetrical loading.
- Solve problems involving shear stresses and shear flow in beams.
- Analyse stresses and strains in circular shafts and tubes subjected to torsion.
- Analyses cases of combined loading involving bending, direct and torsional stresses.
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle.

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 of BSc in Civil Engineering

SEMESTER 1

Module Title	**HYDROLOGY AND WATER SUPPLY**
Code	TCVD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment:	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TMNE3621 Introduction to Engineering Geology

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. **Water Supply:** Importance of water supply to communities, water demand, water drawing; elevation, adduction, storage legislation and codes. **Distribution network:** pipelines water facilities in buildings. **Water Quality Monitoring:** water quality determination, analysis, guidelines and standards. Water sample preservation and storage, analytical instrumentation and techniques. Quality control, quality analysis and monitoring. Statistical analysis of water quality data. Contemporary issues in water quality.

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

- Describe the hydrological cycle and describe methods for determination of evaporation and transpiration.
- Describe methods of modelling floods and measuring stream flow.
- Demonstrate the understanding of processes that lead to soil erosion and sediment production.
- Describe methods for flow measurement and hydrological modelling.
- Demonstrate knowledge of water supply systems and codes pertaining to water supply.
- Demonstrate knowledge of water distribution networks.
- Demonstrate knowledge of water quality determinants and water quality monitoring and standard.
- Describe techniques and instrumentation for determining water quality.
- Demonstrate knowledge of water quality control and quality assurance systems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**THEORY OF STRUCTURES**
Code	TCVS3791
NQF Level	7
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment:	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TMEE3622 Strength of Materials

Content: Overview of static mechanics and strength of materials. Energy principles for analysis of elastic structures. Influence lines. **Matrix analysis of statically-determinate structures.** Theory of linear transformations. **Beams, arches and trusses**. Analysis of statically-indeterminate structures: Force method, displacement method. Instability of structures. **Structure dynamics**: Dynamic analysis. **Analysis of plates and simple shells**. Plastic Analysis of steels beams and frames. **Analysis of reinforced-concrete beams and columns. Ultimate Limit State (ULS) and Serviceability Limit State (SLS) design:** Structural steel works, Concrete beams.

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

- Analyse elastic structures using energy principles
- Use matrix analysis in solving statically-determinate structures
- Analyse forces and stresses in beams, arches and trusses
- Analyse statically-indeterminate structures
- Demonstrate knowledge of analysis of plates and simple shells
- Analyse steel beams and frames for structural applications
- Describe techniques for analysis of reinforced concrete beams and columns
- Demonstrate knowledge of ULS and SLS design of structural steel works and concrete beams.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**INFRASTRUCTURE PLANNING**
Code	TCVI3761
NQF Level	7
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Co-requisite(s)	TCVD3622 Planning and Design Methodology

Content: **Infrastructure planning**; demographics; urbanization/urban planning; demand for infrastructure; cost and affordability; standards; social aspects and participatory approaches; demand-driven approaches and development impact approaches. **Employment creation in construction.**

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

- Describe the methodology used in infrastructure planning
- Demonstrate knowledge of demographics and urban planning
- Describe techniques of employment creation in the construction industry

Revision 1: September 2011
Next Revision: September 2015

Module Title	**GEO-TECHNICAL ENGINEERING**
Code	TCVG3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment:	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TMNE3621 Introduction to Engineering Geology

Content: Scope of geotechnical engineering. Problems of equilibrium and deformation. 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. Effective and total stresses. **Distribution of stresses by elastic theory**: consolidation and settlements of soils, collapse and heave, settlement analysis of structures, allowable deformation, theory of shear strength in soils and rocks. **Design of foundations**, stability of slopes in earth and rock, one and two-dimensional seepage through soils and rock, plane and radial flow nets, seepage stresses, piping, filters, filter design. Earth pressures on structures, retaining walls, consolidation, bearing capacity. Laboratory work.

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

- Demonstrate knowledge of properties and classification of soils and rocks
- Describe parameters used to represent shear strength and bearing capacity of soils
- Describe distribution of stresses in soils and rocks using elastic theory
- Demonstrate knowledge of design principles for foundations
- Describe the design principles of retaining walls with respect to respective earth pressures on structures

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**GEOLOGY FOR ENGINEERS**
Code	TCVD3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	TMNE3621 Introduction to Engineering Geology

Content: Engineering properties of rocks and rock masses. Geotechnical site investigations in sedimentary, igneous and metamorphic rocks. Geological structures, natural hazards like earthquakes and mud slides and their effects on engineering structures and applications.

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

- Demonstrate knowledge of properties of rocks and rock masses
- Describe techniques for performing geotechnical site investigations in various rock structures
- Describe causes and characteristics of natural hazards like earthquakes and mud slides and their effects on engineering structures

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ECONOMICS
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. **Introduction to budgeting**. **Introduction to marketing**. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title:	BUILDINGS AND CONSTRUCTION MANAGEMENT
Code	TCVS3741
NQF Level	7
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCVI3692 Building Materials

Content: Building topologies. Drawings and other components of a project. Modular coordination in building. Drawings comprising a building project. Quoting the sizes of buildings. Drawing of services and facilities. Finishes. **Construction processes and equipment:** Steel construction. Single reinforced and pre-stressed concrete works. **Earthworks.** Rock evaluation and crushing. Foundation piles. River and offshore works. Building works and management of work yards. Programming methods and work control: PERT, CPM, Grant's diagram. **Cost calculation of work**. Staff equipment, materials. Fixed and variable costs. **Bill of quantities**. Legislation for works contracts. The construction industry. **Work safety**. Standardisation and mass production. **Quality control** principles.

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

- Demonstrate an understanding of building topologies and basic design features
- Make basic drawings for buildings and related services and facilities
- Describe the principle used in steel constructions
- Demonstrate knowledge of reinforced and pre-stressed concrete works
- Demonstrate basic knowledge of foundation design
- Describe principles of construction management and work control
- Demonstrate knowledge of application of bill of quantities in construction industry.
- Describe measures taken to ensure safety at work
- Describe basic principle of quality control

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis**.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENTREPRENEURSHIP**
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**COMPUTER APPLICATIONS IN CIVIL ENGINEERING**
Code	TCVI3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

Module Description: This module is intended to familiarize students with the latest software packages that are used in the field of civil engineering. Such packages will include remote sensing software, geographical information system (GIS) software, Google Earth, architectural design packages, construction management packages etc.

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

- Demonstrate a working knowledge of various computer packages in civil engineering
- Explain how GIS software can be used to interpret surveying data
- Use GIS software to solve civil engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	HYDRAULICS
Code	TCVD3732
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3641 Engineering Mechanics II; TMEE3611Fluid Mechanics

Content: Review of Fluid Mechanics: Fluid properties; Hydrostatics; and Basic hydrodynamics (Bernoulli equation, force, momentum, flux equation, continuity equation; ideal flow patterns, streamlines, flow nets; real flow, laminar and turbulent flow, boundary layers and drag). **Flow resistance in pipes and channels**; dimensional analysis and models. Flow with pressure gradient between parallel plate, pipes and channels. Analysis of fluid machinery; **Design of pipeline networks**. Pipe networks (simple branching circuits, single node reservoir systems, Hardy Cross method for pipe reticulation systems Permanent pressurized flows. **Design of pumps**. Variable pressure flows. Water hammer. Open channel flow. **Flows over free surfaces**: Flow resistance in channels; Flows with uniform regiments. Flow with pressure gradient between channel flows and damper systems. Critical regime. Flow through spillways and holes. Flows under bridges and flows in culverts. **Basic design of hydraulic structures**: Spillways, culverts, dams, reservoirs, canals, irrigation schemes.

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

- Demonstrate knowledge of fluid properties and applications of Bernoulli equation to fluids
- Describe characteristics of laminar flow and turbulent flow in fluids
- Describe flow characteristics in pipes and channels
- Analyse basic fluid machinery including systems with pumps and pipe networks
- Describe basic features of pipeline network design
- Demonstrate basic knowledge of pump design
- Describe characteristics of flows over free surfaces, including flows in spillways and holes
- Describe characteristics of flows under bridges and in culverts
- Demonstrate basic knowledge of design of common hydraulic structures such as culverts, dams, canals etc.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	DESIGN OF STEEL AND TIMBER STRUCTURES
Code	TCVS3762
NQF Level	7
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hours paper)
Co-requisite(s)	TCVS3791 Theory of Structures

Content: Steel and timber constructions in engineering. Traditional timber members. Steel members under compression. Rafters and trusses. Steel plate girders. Timber Beams. Ultimate limit-state design of structural steel works. Plastic analysis of steel beams and frames. Moment distribution. **Design for torsion and eccentric loading**. Column, hinges, supports in steel structures. Complex connections. Portal frames and trusses. **Roofing and special structures**. Compound beams. Composite structures. **Overview of designs using plastic materials.**

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

- Demonstrate knowledge of design features for steel structures and timber structures
- Demonstrate knowledge of limit-state design of structural steel members
- Describe design principles of structural members under torsion and eccentric loading
- Demonstrate knowledge of the design of roofs and special structures with compound or composite structures
- Demonstrate knowledge of design principles for plastic materials.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	REINFORCED AND PRE-STRESSED CONCRETE DESIGN
Code	TCVD3792
NQF Level	7
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment:	Continuous 50%; Examination 50% (1 x 3 hours paper)
Co-requisite(s)	TCVS3791 Theory of Structures

Content: Analysis of steel-reinforced-concrete beams and columns. Axial loaded members. Bending of reinforced concrete members. Yield line analysis of reinforced concrete slabs. **Design codes** for steel-reinforced concrete structures. **Limit state design**: bending, shear, twisting, buckling, serviceability limit state design: deflection, cracking. Detailed requirements. Pad, strip and stepped footings, raft foundations. **Common structural members**: Beams; Columns; Flat slabs; Ribbed and hollow slabs; stairs; retaining walls; foundations; water tanks and reservoirs, sheer walls, shorter cantilever beams; structural discontinuities in reinforced concrete members. **Introduction to pre-stressed concrete design**. Serviceability maximum stresses on the pre-stressed steel bars. Limited bolt and equivalent cable. Ultimate limit state. Loss of pre-stress force. Singularity of zones subject to point loads. Pre-stress on indeterminate structures.

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

- Carry out stress analysis of steel-reinforced concrete structures
- Demonstrate knowledge of design codes for steel-reinforced concrete structures
- Apply limit state design for reinforced concrete structures
- Demonstrate knowledge of characteristics and design features of common structural members
- Describe general principles of design of pre-stressed concrete structures.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	TRANSPORT PLANNING AND ENGINEERING I
Code	TCVI3752
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TCVI3692 Building Materials
Co-requisite(s)	TCVI3761 Infrastructure Planning

Contents: Transportation and Network Planning; **Road Safety Management**: Black Spots Management, Road Safety Inspection, Road Safety Audits, **Design of Urban Roads**: geometrical design, junctions, traffic calming; **Traffic Engineering**: capacity of junctions, planning of traffic lights. **Design of Rural Roads**: gravel and bituminous roads, mechanical stabilization of soils, bearing capacity; **Road Construction Materials**: requirements on aggregates and bitumen, building of roads; **Pavement**: requirements on surface layers, maintenance activities; **Drainage**: drainage installations for roads. **Introduction to Transport Logistics**: harbour, ports, container terminals, roads, rails, air transport. **Transport Economy.**

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

- Demonstrate knowledge of road traffic and transport planning
- Demonstrate knowledge of road safety management and traffic engineering
- Describe general layouts and geometry of urban roads and pavements
- Demonstrate knowledge of the infrastructure for roads and stabilization of soils
- Make basic designs of bituminous and gravel rural roads and pavements.
- Demonstrate working knowledge of transport logistics.
- Demonstrate working knowledge of transport economy.

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 of BSc in Civil 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; nnetwork scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	DESIGN OF BUILDINGS
Code	TCVS3891
NQF Level	8
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment:	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TCVD3792 Reinforced and Pre-Stressed Concrete Design TCVS3762 Design of Steel and Timber Structures

Content: Structural analysis of buildings. Relationship between architectural forms and structural systems. Relevant National Building Regulations .Introduction to industrialized building systems. Building specifications. **Complex building construction**. "High-tech" construction. Air conditioning, acoustics, working drawings. **Associated reports**; Bill of quantities. Aspects of professional practice.

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

- Demonstrate knowledge of structural analysis of buildings
- Describe the relationship between architectural forms and structural systems in buildings
- Demonstrate good knowledge of building specifications and building regulations
- Demonstrate knowledge of design of high-tech building designs with air-conditioning and acoustics features
- Prepare reports of bill of quantities and working drawings
- Demonstrate knowledge of civil engineering professional practice

Revision 1: September 2011
Next Revision: September 2015

Module Title:	TRANSPORT PLANNING AND ENGINEERING II
Code	TCVD3891
NQF Level	8
Contact Hours	3L+ 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TCVI3761 Infrastructure Planning; TEGT3761 Fundamentals of Economics

Content: Overview of the railway transport system. General technical features of railway layouts; geometry of railways; infrastructure for railways. Soil properties; mechanical stabilization of soils for railway lines. **Design of Railways**: main railway lines**;** underpasses; overpasses, rail traffic control systems, passenger platforms. **Public transport** systems. **Aerodromes:** general layout and design features of aerodromes.

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

- Describe the main features of railway transport systems
- Describe the general layouts and geometry of railway lines.
- Demonstrate knowledge of the infrastructure for railways
- Describe properties and stabilization methods for soils suitable for railway lines
- Make basic designs of railway lines, passenger platforms and traffic control
- Demonstrate knowledge of public transport systems
- Demonstrate knowledge of layout and design features for aerodromes.

Revision 1: September 2011
Next Revision: September 2015

Module title:	WASTEWATER AND SOLID WASTE MANAGEMENT
Code	TCVI3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TCVD3791 Hydrology and Water Supply

Content: **Wastewater Management**: Available technologies. Theory and basic design of processes for wastewater treatment. Sludge treatment and disposal, process train selection. Linking source water quality to process design: principles, experimental and pilot plant studies, design criteria, parameters for design of treatment processes. Legislation and codes. Rural, semi-urban, domestic and industrial sewerage. Treatment of sewers.

Solid Waste Management: Characterization of solid wastes, sources, quantities, characteristics. Solid waste collection and transportation systems, ultimate disposal systems. Design of landfills: site selection, environmental impact assessment of waste disposal. Treatment of solid waste for energy production. Production of biogas from semi-solid waste.

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

- Demonstrate knowledge of methods and technologies used in wastewater treatment.
- Identify parameters for design of wastewater treatment, sludge treatment and disposal.
- Demonstrate knowledge of legislation and codes of practice for wastewater treatment.
- Describe characteristics of solid wastes and the techniques for solid waste management.
- Demonstrate knowledge of solid waste disposal systems and design of landfills.
- Demonstrate knowledge of environmental impact assessment on waste disposal.
- Demonstrate knowledge of solid waste treatment, including biogas production from waste.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	CONTRACT MANAGEMENT AND LAWS OF CONTRACT
Code	TCVE3821
NQF Level	8
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hours paper)
Co-requisite(s)	TCVS3741 Buildings and Construction Management

Content: Introduction to the study of Law: basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law. Service contracts and employment law. **Managing medium to large scale civil engineering projects**: inception to completion, appropriate contacts. General conditions of contract for civil engineering works. Specific conditions of contract. **Managing community based projects in development context**: the implications of Information Technology and globalisation on civil engineering works. **Laws of arbitration.**

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

- Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
- Demonstrate knowledge of the principles of managing medium to large scale civil engineering projects
- Demonstrate knowledge of the general conditions of contract for civil engineering works
- Demonstrate knowledge of the principles of managing community-based development projects
- Demonstrate knowledge of the laws of arbitration

Revision 1:	September 2011
Next Revision:	September 2015

Module title:	DESIGN OF BRIDGES
Code	TCVD3861
NQF Level	8
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment:	Continuous 50%; Examination 50% (1 x 2 hours paper)
Co-requisite(s)	TCVD3792 Reinforced and Pre-Stressed Concrete Design TCVS3762 Design of Steel and Timber Structures

Content: Layout and topologies for bridges. Drawings of a bridge project. Various bridge designs. Bridge foundations. Bridge trusses. Suspended bridges. Calculations for load bearing in bridges. Calculations with side wind forces. Relationship between **architectural forms** and **structural systems** for bridges. Design exercises.

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

- Describe various layouts and topologies for bridges and illustrate them with engineering drawings

- Demonstrate knowledge of the design of various types of bridges, including detailed calculations for foundations and trusses
- Describe the relationship between architectural forms and bridge structural systems.

Revision 1 September 2011
Next Revision: September 2015

Module title:	**RESEARCH PROPOSAL**
Code	TCVR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:
- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1 September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TCVR3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TCVR3891Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**CIVIL ENGINEERING DESIGN PROJECT**
Code	TCVD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

H. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER ENGINEERING (HONOURS)

H.1. DEGREE NAME: Bachelor of Science in Computer Engineering (Honours) 19BCME

H.2. AIM

The curriculum for the degree of Bachelor of Science in Computer Engineering (Honours) aims at producing Graduate Engineers with knowledge, technical skills and abilities to work in the field of Computer Engineering and Information Technology, and who can competently work in computer hardware and software design, computer network design, system integration and related service industries.

H.3 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in 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 COMPUTER ENGINEERING - 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	*TEGT3521*	*5*	*8*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	*UCSI3580*	*5*	*8*	*None*
Total Credit Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credit Semester II				**80**	

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 COMPUTER ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	**TEGT3541**
1	Analogue Electronics I	TETE3691	6	12	**TEGT3541**
Total Credit Semester III				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Data Structures and Algorithms	TCME3622	6	8	TCME3621
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Telecommunication Principles	TTCE3642	6	8	**TEGT3541**
2	Computer Organisation and Assembly Language	TCME3662	6	8	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	**TEGT3590**
Total Credit Semester IV				**64**	

YEAR 3 OF BSc IN COMPUTER ENGINEERING – 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Fundamental of Economics	TEGT3761	7	8	None
1	Advanced Object Oriented Programming	TCME3791	7	12	TCME3692
1	Analogue Electronics II	TETA3791	7	12	**TETE3691**
1	Software Engineering I	TCME3741	7	8	**TCME3621**
1	Programmable Electronics Design	TETD3791	7	12	TETD3692
1	Microprocessor Systems	TCME3721	7	8	TCME3642
1	Database Systems	TCME3761	7	8	TCME3692
Total Credit Semester V				**68**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**EGS3691**
2	Entrepreneurship	TEGT3742	7	8	**TEGT3761**
2	Embedded Systems Design I	TETD3792	7	12	TETD3692
2	System Software Design	TCMH3792	7	12	**TCME3662**
2	Software Engineering II	TCME3742	7	8	TCME3741
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Artificial Intelligence	TCMH3762	8	8	**TCME3622**
2	Operating Systems	TCME3792	7	12	**TCME3662**
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credit Semester VI				**76**	

YEAR 4 OF BSc IN COMPUTER ENGINEERING - 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	**PRE** & CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Network Security	TCMH3821	8	8	**TCMH3722**
1	Digital Image Processing	TCME3831	8	16	**TCME3622 TTCE3692**
1	Control Engineering	TECP3891	7	12	**TEGT3671**
1	Computer Systems Performance	TCMH3841	8	8	**TETD3692** TCMH3792
1	Computer Design And Architecture	TCME3871	8	16	**TCME3721** TETD3791
1	Research Proposal	TCMR3891	8	4	TEGT3762
Total Credit Semester VII				**80**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	**PRE** & CO-REQUISITE
2	Research Project	TCMR3892	8	30	All 3rd Year Mod TCMR3891
2	IT Design Project	TCMD3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	EGT3700
Total Credit VIII				**64**	

TOTAL CREDITS FOR THE DEGREE OF BSc IN COMPUTER ENGINEERING (HONOURS) **584**

H.4 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN COMPUTER ENGINEERING (HONOURS)

YEAR 1 OF BSc IN COMPUTER ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
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. Particular mechanical and civil engineering drawings; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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

Content: Units, significant figures & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100%[Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**FUNDAMENTALS OF ENGINEERING**
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. Introduction to Engineering as a profession. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. Communication skills and presentation of engineering work. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. Engineering codes and standards. Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Revision 1: September 2011
Next Revision: September 2015

Module Title	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems. Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving.
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting.
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information.
- Describe the principles of a transformer and the basic AC generator and DC motors.
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date:	January 2009
Next Revision:	January 2013

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1^{st} order and 2^{nd} order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: 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 the 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 2009
Next Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: Statics: 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. Analysis of frames and machines. Virtual work.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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 2009
Next Revision: January 2013

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 %) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) 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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 OF BSc IN COMPUTER ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1: September 2011
Next Revision: September 2015

Module Title	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Probability: 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; Applications to Quality Assurance: Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; Applications to Reliability and Life Testing: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

Module Title	ELECTRIC CIRCUIT ANALYSIS I
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin's and Norton's 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. behaviour 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. **Computer circuit analysis and simulation**

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

- Apply circuit theorems to simplify and find solutions to electrical circuits.
- Interpret, develop and design electrical engineering circuits
- Use computer simulation tools for electric circuit analysis and design
- Perform DC and AC power calculations including power factor correction;
- Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
- Analyze, simulate, and experimentally validate DC and AC circuits;

Revision 1: September 2011
Next Revision: September 2015

Module Title	ANALOGUE ELECTRONICS I
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541, Fundamentals of Electrical Engineering

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

- Discuss the atomic structure of semiconductor materials
- Discuss the construction and operation of semiconductor diodes.
- Analyse and design diode based circuits.
- Discuss the construction of BJT transistors
- Analyse and design BJT transistor amplifier and switching circuits
- Discuss the construction of FET transistors
- Analyse and design FET biasing circuits
- Discuss the internal circuitry for op-amps
- Discuss the operation of op-amps
- Analyse and design basic op-amp circuits
- Use EDA software to analyse electronic circuits.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	**DATA STRUCTURES AND ALGORITHM**
Code	TCME3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous Assessment 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TCME3621 Computer Science for Engineering

Module Description: Content includes theoretical topics in algorithmic efficiency and complexity, along with abstract data types, including graphs, networks, trees, and priority queues. Search topics, including hashing, trees, external search trees (B-trees), and sorting algorithms including external sorting are introduced and compared. Computational complexity topics include the Class P and NP, NP-completeness and Reducibility, NP-completeness Proofs, and NP-complete Problems.

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

- Demonstrate an understanding of theoretical topics in algorithmic efficiency and complexity, along with abstract data types, including graphs, networks, trees, and priority queues.
- Compare and use hashing, trees, external search trees (B-trees), and sorting algorithms including external sorting.
- Evaluate Computational complexity including the Class P and NP, NP-completeness and Reducibility, NP-completeness Proofs, and NP-complete Problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title	OBJECT ORIENTED PROGRAMMING
Code	TCME3692
NQF level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development. Top-down stepwise refinement approach. **Object Oriented Programming and C++**. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, producing output and providing input in a C++ program. Elements of data structures. **Evaluating C++ Expressions**. Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. **Selection Structures**. Using the **if** statement; the **Nested if**; the **switch** statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Statements**. 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; Using Pointers. **Using C++ Functions**. Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. **Using 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; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The **cin** and **cout** class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List. **Numerical Methods:** Finding Roots of Nonlinear Equations; Numerical Differentiation; Numerical Integration.

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

- Design and represent algorithm for solving given problems using flowchart or pseudo code.
- Describe concept of object-oriented programming.
- Use the top-down stepwise approach to solve engineering problems.
- Create structures and classes in respect of a particular problem
- Design the respective algorithm for the solution of the problem identified and document the design in standard UML 2.0 notation.
- Work with object oriented concepts and terminology such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
- Apply the problem solving techniques to computational and engineering problems.
- Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++ and/or other OOP language

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	DIGITAL ELECTRONICS
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 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. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

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

- Discuss fundamental digital terminology.
- Perform different number systems and coding conversions.
- Describe the operation of different logic gates.
- Analyse and simplify logic equations
- Analyse and design different combinational logic circuits
- Analyse and design sequential logic circuits
- Compare the performance of different logic family devices
- Design and analyse internal circuitry of different logic families and interfaces between them.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: **Basic notions and definitions**: radio spectrum, definitions and terminology: analog and digital systems; communication systems components, communication channels and their characteristics; bandwidth, Channel Capacity**,** distortion, noise and other impairments. 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. Standards Organisations.
Noise: Noise sources, noise figure and noise temperature; noise models. **Analog modulation and demodulation Technique**: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; Frequency discriminator and the envelope detector; AM and FM receiver; pre-emphasis and de-emphasis filtering; FM threshold effect; comparison of angle and linear modulation systems. **Multiplexing techniques**: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM). Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication. **Radio Propagation and antenna**.
Learning Outcomes: Upon completion of this module, students should be able to**:**

- Explain the principles involved in the transmission and reception of information in a communication system.
- Discuss the architecture of a generic telecommunication systems
- Discuss and Analyse Analogue modulation process
- Discuss and analyse the effect of noise in communication systems
- Discuss and analyse the effect of radio wave propagation and antennae in a telecommunication system
- Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER ORGANISATION AND ASSEMBLY LANGUAGE
Code	TCME3662
NQF Level	6
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Overview of computer organization: history, basic computer components. **Computer arithmetic:** base number system, base number conversion, binary number addition, subtraction, multiplication and division, logical operations of binary numbers. **Computer architecture classification:** Von Neumann and Harvard architectures. **Memory systems:** memory types, memory operations, data alignment, direct memory access. **Processor systems:** registers, arithmetic and logic unit, data and address buses, interrupt mechanism, addressing modes. Instruction set: instruction execution cycle, machine code. Input/output, **Assembly language programming:** data types and declaration, data transfer instructions, arithmetic and logic instructions, input-output instructions, branching instructions, subroutine, interrupt instructions and interrupt service routine.
Learning Outcomes: Upon completion of this module, students should be able to:

- Describe functions of components in computer systems
- Perform binary number arithmetic operations
- Design and code basic programs using assembly language

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN COMPUTER ENGINEERING

Module Title	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. **Introduction to budgeting**. **Introduction to marketing**. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ADVANCED OBJECT ORIENTED PROGRAMMING**
Code	TCME3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous assessment 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TCME3692 Object Oriented Programming

Module Description: Advanced object-oriented concepts. This course covers language concepts including objects, classes, and polymorphism from the viewpoint of object-oriented design and implementation, including portability, maintainability, networking and concurrency. Applying the object-oriented approaches to the entire life-cycle of software development, in which the students work in teams to prototype a software system with design tools, and test the system against various design criteria.

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

- Discuss advanced Object-oriented concepts including, objects, classes, polymorphism and inheritance
- Apply advanced object-oriented concepts to design and implement systems including portability, maintainability, networking, and concurrency.
- Apply object-oriented approaches to the entire life-cycle of software development.

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ANALOGUE ELECTRONICS II**
Code	TETA3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics I

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 and feedback transistor based oscillator circuits), Power Supplies, Power electronics devices and applications.

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

- Model and analyse FETs based circuits
- Determine the frequency response of transistor based circuits
- Analyse and design op-amp and circuits
- Analyse and design different op-amp based circuits
- Analyse and design power amplifiers
- Analyse and design filter circuits
- Analyse and design oscillator circuits
- Analyse and design ADC and DAC circuits
- Analyse and design switching circuits employing basic power electronics components

Revision 1: September 2011
Next Revision: September 2015

Module Title	SOFTWARE ENGINEERING I
Code	TCME3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TCME3621 Computer Science for Engineers

Module Description: A formal approach to the state-of-the-art techniques in software design and development. Emphasis will be on Project Planning, Requirements, Specification, and System Design and includes object design, testing, and implementation. Provides the student with the opportunity to work on large projects in a group situation.

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

- Develop a formal approach to the state-of-the-art techniques in software design and development.
- Propose Project Planning, Requirements, Specification, and System Design concepts including object design, testing, and implementation in software development environment.
- Work on large projects within a group.

Revision 1: September 2011
Next Revision: September 2015

Module Title	PROGRAMMABLE ELECTRONICS DESIGN
Code	TETD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100% (labs 20%, assignments 10%, tests 40%, project 30%)
Pre-requisite(s)	TETD3692 Digital Electronics

Contents: Programmable Electronics Design Cycle, Structure of the development board (currently available in department). **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: Upon completion of this module, students should be able to:

- Describe and apply the programmable electronics design cycle.
- Design, test and implement concurrent statement based logic circuit descriptions.
- Design, test and implement logic circuits using structural VHDL descriptions.
- Design, test and implement sequential circuits VHDL descriptions
- Create VHDL packages, functions and procedures.

Revision 1: September 2011
Next Revision: September 2015

Module Title	MICROPROCESSOR SYSTEMS
Code	TCME3721
NQF level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3662 Computer Organisation and Assembly language

Content: Overview of microprocessors: history, types of microprocessors, microprocessors fabrication process, cost of microprocessors. **Microprocessor structures:** registers, arithmetic and logic unit, control unit, internal bus. **External buses:** address bus, data bus, control bus, bus timing. **Memory interfacing:** memory map design, memory address decoder circuit. **Input/output interfacing:** port mapping, port address decoder circuit. Clock generator circuits. **Interrupt mechanism:** interrupt priority, non-maskable interrupt, maskable interrupt, interrupt modes. Execution cycle and execution time of instructions. **Program execution time calculation.** Translation of mnemonics to machine codes.

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

- Plan and implement Memory organization including static and dynamic semiconductor memory, optical and magnetic memory, memory hierarchy and caches.
- Design memory circuit for microprocessors.
- Design input/output circuit for microprocessors.
- Design interrupt generating circuit for microprocessor
- Calculate exact execution time of programs.

Revision 1: September 2011
Next Revision: September 2015

Module Title	DATABASE SYSTEMS
Code	TCME3761
NQF Level	7
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3692 Object Oriented Programming

Module Description: 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 Demoralization

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

- Differentiate the variety of database systems.
- Plan and implement database technologies versus conventional file-processing systems.
- Develop system life cycle, prototyping methodology and enterprise data models.
- Implement protocols and effectively apply conceptual data modelling.
- Apply integrity control systems

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis.**

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	EMBEDDED SYSTEMS DESIGN I
Code	TETD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETD3692 Digital Electronics

Contents: Computer Architecture: 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; **Microprocessor Fundamentals;** Basic Elements, Bus Structure. **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, etc.

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

- Discuss the general architecture for computers.
- Differentiate between microcomputers, microprocessors and microcontrollers
- Discuss different types of micro-controller architectures
- Discuss implementation and operation of different memories.
- Discuss bus structures in microprocessor based systems.
- Design, implement and analyse assembly programs for Atmel AVR and/or PIC microcontrollers.
- Develop microcontroller based applications employing digital electronics, analogue electronics and assembly language.
- Execute micro-controller based group projects effectively.

Revision 1: September 2011
Next Revision: September 2015

Module Title	SYSTEM SOFTWARE DESIGN
Code	TCMH3792
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TCME3662 Computer Organisation and Assembly Language

Content: This course covers the design and implementation of system software. It investigates the relationship between software design and machine architecture. Topics may include assemblers, macro-processors, compilers, loaders, debugging environments, program development and archival tools, command language interpreters (shells), file systems, I/O support, processes, threads, and inter-process communication.

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

- Design and implement of system software.
- Investigate the relationship between software design and machine architecture.
- Use assemblers, macro-processors, compilers, loaders, debugging environments, program development and archival tools, command language interpreters (shells), file systems, I/O support, processes, threads, and inter-process communication

Revision 1: September 2011
Next Revision: September 2015

Module Title	SOFTWARE ENGINEERING II
Code	TCME3742
NQF Level	7
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3741 Software Engineering I

Module Description: The course will cover the analysis of requirements and software architecture and with a major emphasis on object design, implementation, testing and validation, maintenance, and software re-engineering. It will provide the student with the opportunity to work on large projects in a group situation.

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

- Analyse requirements and software architecture with a major emphasis on object design, implementation, testing and validation, maintenance, and software re-engineering.
- Apply advanced techniques in software design and development.
- Work on large projects within a group.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3521 Computing Fundamentals

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, network security. **Network Management and Troubleshooting**.

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

- Discuss computer network layers
- Compare the OSI model and the TCP/IP model
- Understand the issues related to addressing between networks
- Identify common security risks for Internet-connected computers.
- Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
- Distinguish between the different threats to wireless network security and different types of security threats.
- Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ARTIFICIAL INTELLIGENCE
Code	TCMH3762
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TCME3622 Data Structures and Algorithms

Content: Philosophy of artificial intelligence. AI programs and languages, representations and descriptions, exploiting constraints. **Rule-based and heuristic systems**. Problem spaces and search. **Heuristic search Techniques**: Generate and Test, Hill Climbing, Beat First. Knowledge representation, Predicate logic. Applications to engineering. Study of **intelligent machines and machine learning**. Includes problem solving , natural language understanding, game playing, database and expert systems. **Artificial Intelligence software** will be implemented using any AI language such as LISP, Prolog.

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

- Discuss the philosophy of artificial intelligence
- Apply Artificial Intelligent techniques in solving problems of a particular domain
- Apply intelligent algorithms in problem solving

Revision 1: September 2011
Next Revision: September 2015

Module Title	OPERATING SYSTEMS
Code	TCME3792
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TCME3662 Computer Organisation and Assembly Language

Module Description: The course covers file, process, memory and **Input/Output management**; multitasking, synchronization, and deadlocks; scheduling and inter-process communication. **System programming** using system calls. Fundamentals of the **UNIX based operating system**.

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

- Distinguish technical differences between operating systems
- Discuss the necessary components and functions of an operating system
- Use both Windows and Unix-based systems, including installation of, and managing applications in a Unix-based operating system
- Analyze operating system requirements and recommend an appropriate operating system to meet the requirements
- Assess file, process, memory and Input/Output management; multitasking, synchronization, and deadlocks; scheduling and inter-process communication.
- Investigate the kernel interface, files, processes, and inter-process communication for current operating systems.

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN COMPUTER 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title	NETWORK SECURITY
Code	TCMH3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TCMH3722 Computer Networks

Content: Mathematical Principles: Threats, secret-key crypto, hashes & message digests, public key Algorithms, number theory, operating system vulnerabilities, intrusion detection, authentication systems, Kerberos, email security (PGP, S/MIME), firewalls, IP security (IPsec), SSL, TLS, WWW security

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

- Identify common security risks for Internet-connected computers.
- Describe how unauthorized access and virus infections can compromise network data.
- Illustrate how denial-of-service (DoS) attacks operate.
- Distinguish between the different threats to wireless network security.
- Distinguish between different types of security threats.
- Identify and use the tools used to enforce network security.
- State techniques used to detect network intruders.
- Evaluate the characteristics of common access control methods.
- Distinguish between different network-security components and techniques.

Revision 1: September 2011
Next Revision: September 2015

Module Title	DIGITAL IMAGE PROCESSING
Code	TCME3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TCME3621 Computer Science for Engineers

Content: Computer imaging systems. Human visual systems. Image models. Colour models. Two-dimensional signals and systems. **Two-dimensional discrete transforms**: Discrete Fourier Transform, Discrete Cosine Transform, Walsh-Hadamard Transform, Haar Transform, Wavelet Transform. **Image enhancement**: Image sharpening, Image smoothing. **Image restoration**: noise removal, mean and adaptive filters. Edge detection. **Image compression**: lossless image compression, lossy image compression. **Image perception and human visual model**, 2-D sampling and quantization, image transformation algorithms, image compression, colour image processing, image restoration, image segmentation and region analysis, texture analysis, boundary descriptions, morphological methods, image processing system architecture.

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

- Explain the principles of two-dimensional transforms
- Apply basic transforms and filters on digital images
- Demonstrate basic colour, image perception and transformation, image enhancement and image analysis, computer vision, human vision models, 2-D sampling and quantization, image transforms, image enhancements, colour image processing and image restoration.
- Apply image and video compression techniques including image segmentation by thresholding and region analysis, texture analysis, boundary descriptions, morphological methods and image processing system architecture.
- Implement and evaluate image processing algorithms using application program such as MATLAB or equivalent

Revision 1: September 2011
Next Revision: September 2015

Module Title	CONTROL ENGINEERING
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

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 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. **Digital Control Systems:** modelling of digital computers, z-transforms, transfer functions, block diagram reduction, stability analysis, steady state errors, transient response in z-plane, gain design in z-plane, implementation of digital compensators.

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

- Discuss different control theory terminologies.
- Model basic electrical systems as a control systems or part of parts of control systems.
- Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
- Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
- Model, Analyse and design basic digital control systems.
- Use engineering software for modelling, analysis and design of control systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SYSTEMS PERFORMANCE
Code	TCMH3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETD3692 Digital Electronics
Co-requisite(s)	TCMH3792 System Software Design

Module Description: Review of probability, queueing theory, stochastic processes, bound and approximation. Computer systems performance indicators, performance measurement techniques. Synthetic workload and benchmarks. Development of broad working knowledge of probability, petri net, Asynchronization parallelism, Structure, communication and problems of MIMD System, **Synchronous Parallelism**: Structure, communication and problems of SIMD System, computer systems simulation, and empirical analysis techniques as applied to computer systems modelling. This course is oriented toward a practical application of theory and concepts to computer systems hardware and software performance.

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

- Discuss main terminologies used in computer system performance
- Optimise the performance of computer systems using parallelism
- Asses the performance of computer systems
- Explain computer performance measurement techniques
- Use proper benchmarks for measuring computers performance
- Setup experiments for measuring and analysing computers performance

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER DESIGN AND ARCHITECTURE
Code	TCME3871
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TCME3721 Microprocessor Systems
Co-requisite(s)	TETD3791 Programmable Electronics Design

Content: Instruction set architecture: types of instruction set architecture, instruction formats. **Processor structures:** registers, arithmetic and logic unit, control unit, **Datapath:** single-cycle datapath, multi-cycle datapath. **Pipelined architecture:** concept of pipeline execution, pipeline datapath structure, pipeline datapath control. Memory hierarchy, Cache memory, Multiprocessor architecture, Computer performance evaluation. Small computer system design using microcontroller. **Microcontroller architecture:** instruction sets, registers, input-output ports. **Microcontroller peripherals:** timer/counter module, ADC module, communication module, analog comparator module, analog voltage reference module, watchdog module. Microcontroller interrupt mechanism and interrupt service routine. **Interfacing:** keypad, analog sensors. LEDs, character LCDs, DC motors. Data communication over RS232.

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

- Describe functions of components in processors
- Design basic arithmetic and logical unit of processors
- Describe operations of pipeline architecture
- Analyse and identify problems of pipeline execution
- Design processor instructions
- Design and implement a simple microcontroller-based system

Revision 1: September 2011
Next Revision: September 2015

Module title:	RESEARCH PROPOSAL
Code	TCMR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1 September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TCMR3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TCMR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title	**IT DESIGN PROJECT**
Code	TCMD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

I. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

I.1. DEGREE NAME: Bachelor of Science in Electrical Engineering (Honours) 19BECE

I.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.

I.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 - 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	*TEGT3521*	*5*	*8*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	*UCSI3580*	*5*	*8*	*None*
Total NQF CREDITS Semester I				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE& CO-REQUISITE**
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credit Semester II				**80**	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3571, SPHY3572* and *SCHM3572* will be exempted from taking them in this year.

YEAR 2 OF BSc IN ELECTRICAL ENGINEERING - 152 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591 TEGM3592**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	**TEGT3541**
1	Analogue Electronics I	TETE3691	6	12	**TEGT3541**
Total Credits Semester III				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592,** TEGT3671
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Signal and Systems	TTCE3692	6	12	TEGT3671
2	Applied Electromagnetics	TTCE3622	6	8	**SPHY3512**
2	Telecommunication Principles	TTCE3642	6	8	**TEGT3541** TTCE3692
2	Electrical Machines and Drives	TECE3622	6	8	**TEGT3541**
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**76**	

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING – 136 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Fundamentals of Power Systems	TECE3731	7	16	TECE3691
1	Electric Circuit Analysis II	TECE3791	7	12	**TECE3691** TEGT3671
1	Electrical Machines Analysis and Design	TECE3711	7	16	**TTCE3622 TECE3622**
1	Power Electronics	TECC3791	7	12	**TETE3691**
1	Measurement and Instrumentation	TETA3721	7	8	**TETE3691**
Total Credits Semester V				**72**	

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING (Semester 2)

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**EGS3691**
2	Entrepreneurship	TEGT3742	7	8	**TEGT3761**
2	High Voltage Engineering	TECP3792	7	12	TECE3731
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Switching and Protection of High Voltage Systems	TECP3742	7	8	**TECE3691** TECE3731
2	Electrical Engineering Design	TECE3762	7	8	**TECE3691** TECE3711
2	Renewable Energy Technologies	TECC3792	7	12	**TECE3541**
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**64**	

YEAR 4 OF BSc IN ELECTRICAL ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Power Transmission and Distribution	TECE3831	8	16	**TECE3731**
1	Computation Methods in Power Engineering	TECE3891	8	12	**TECE3731** TECE3831
1	Microprocessors and Programmable Logic Controllers	TECE3851	8	16	**TETD3692** TCME3692
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Research Proposal	TECR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Research Project	TECR3892	8	30	All 3rd Year Mod TECR3891
2	Electrical Design Project	TECD3892	8	34	All 3rd Year modules
2	Industrial Attachment III	TEGT3800	8	-	EGT3700
Total Credits Semester VIII				**64**	

TOTAL CREDITS FOR THE DEGREE OF BSc IN ELECTRICAL ENGINEERING (HONOURS) 584

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

YEAR 1 OF BSc IN ELECTRICAL ENGINEERING

SEMESTER 1

Module Title	ENGINEERING MATHEMATICS I
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ENGINEERING DRAWING
Code	TEGT 3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Module Description: 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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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 & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100%[Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 Hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; **Fundamentals of thermodynamics systems.**
Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols
- Describe the thermodynamics system

Revision 1: September 2011
Next Revision: September 2015

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving.
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting.
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information.
- Describe the principles of a transformer and the basic AC generator and DC motors.
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date:	September 2012
Next Revision:	September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1^{st} order and 2^{nd} order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, 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 the 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 2009
Revision: January 2013

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

Content: Statics*:* 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. Analysis of frames and machines. **Virtual work**.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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.

Revision 1: January 2009
Next Revision: January 2013

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: (60%) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) 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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 OF BSc IN ELECTRICAL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCME3521Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1: September 2011
Next Revision: September 2015

Module Title	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Probability: 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; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

Module Title	ELECTRIC CIRCUIT ANALYSIS I
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin's and Norton's 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. behaviour 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. **Computer circuit analysis and simulation**

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

- Apply circuit theorems to simplify and find solutions to electrical circuits.
- Interpret, develop and design electrical engineering circuits
- Use computer simulation tools for electric circuit analysis and design
- Perform DC and AC power calculations including power factor correction;
- Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
- Analyze, simulate, and experimentally validate DC and AC circuits;

Revision 1: September 2011
Next Revision: September 2015

Module Title	ANALOGUE ELECTRONICS I
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541, Fundamentals of Electrical Engineering

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

- Discuss the atomic structure of semiconductor materials
- Discuss the construction and operation of semiconductor diodes.
- Analyse and design diode based circuits.
- Discuss the construction of BJT transistors
- Analyse and design BJT transistor amplifier and switching circuits
- Discuss the construction of FET transistors
- Analyse and design FET biasing circuits
- Discuss the internal circuitry for op-amps
- Discuss the operation of op-amps
- Analyse and design basic op-amp circuits
- Use EDA software to analyse electronic circuits.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	**DIGITAL ELECTRONICS**
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 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. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.
Learning Outcomes: Upon completion of this module, students should be able to:

- Discuss fundamental digital terminology.
- Perform different number systems and coding conversions.
- Describe the operation of different logic gates.
- Analyse and simplify logic equations
- Analyse and design different combinational logic circuits
- Analyse and design sequential logic circuits
- Compare the performance of different logic family devices
- Design and analyse internal circuitry of different logic families and interfaces between them.

Revision 1: September 2011
Next Revision: September 2015

Module Title	SIGNALS AND SYSTEMS
Code	TTCE3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: An introductory course covering the principles of signals and systems. The course combines lectures, MATLAB simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing. 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: Upon completion of this module, students should be able to:

- Analyse signals and systems in the time and frequency Domain.
- Classify signals and analyse their parameters.
- Discuss the operation and application of linear systems.
- Apply transformation techniques and various analysis approaches to signals and linear system.
- Design FIR and IIR filters.Carry out computer based simulations related to signals and systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	APPLIED ELECTROMAGNETICS
Code	TTCE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SPHY3512 Physics for Physical Science II

Content: Review of Vector Algebra: Classification of vector fields. Electrostatic Fields: Coulomb Law & Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equation. Electric potential; relationship between E and V, Maxwell Equation. Electric Field in Material Space: Properties of materials, Convection and conduction current; Polarization in Dielectric; dielectric constant and strength; Continuity Equation and Relaxation Time; Boundary Conditions; Electrostatic Boundary-Value Problems; Poisson's and Laplace Equations; Electrostatic Boundary-Value Problems: Uniqueness Theorem, Procedure for solving Poisson's and Laplace equations, Resistance and Capacitance, Methods of Images Magnetostatics: Biot-Savart's Law; ampere Circuital Law-Maxwell Equation. Application of Ampere's Law Magnetic Flux Density-Maxwell Equation. Maxwell Equation for Static EM Fields; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices: Forces due to Magnetic Fields; Magnetic Torque and Movement. Magnetic Forces, Material and Devices: Magnetization in Materials. Magnetic Forces, Material and Devices: Magnetic Boundary Conditions. Magnetic Forces, Material and Devices: Inductor and Inductance; Magnetic Energy.

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

- Perform calculations involving electric and magnetic fields.
- Explain the theories and applications of electromagnetic fields and waves in engineering.
- Explain the physical meaning and significance of Maxwell's equations.
- Analyse electromagnetic and time varying fields and waves.
- Derive and apply equations related to static electromagnetic fields.
- Use Maxwell's equations to derive one law from another..

Revision 1: September 2011
Next Revision: September 2015

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: **Basic notions and definitions**: radio spectrum, definitions and terminology: analog and digital systems; communication systems components, communication channels and their characteristics; bandwidth, Channel Capacity**,** distortion, noise and other impairments. 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. Standards Organisations.
Noise: Noise sources, noise figure and noise temperature; noise models. **Analog modulation and demodulation Technique**: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; Frequency discriminator and the envelope detector; AM and FM receiver; pre-emphasis and de-emphasis filtering; FM threshold effect; comparison of angle and linear modulation systems. **Multiplexing techniques**: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM). Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication. **Radio Propagation and antenna**.
Learning Outcomes: Upon completion of this module, students should be able to**:**

- Explain the principles involved in the transmission and reception of information in a communication system.
- Discuss the architecture of a generic telecommunication systems
- Discuss and Analyse Analogue modulation process
- Discuss and analyse the effect of noise in communication systems
- Discuss and analyse the effect of radio wave propagation and antennae in a telecommunication system

Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TECE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: 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***:* 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, semi-conductor operation of induction machines, energy recovery techniques.

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

- Describe the principle of operation of electrical machinery
- Describe the principle of operation of DC machines such as DC motors, generators, drives.
- Describe the principle of operation and applications of transformers and AC windings
- Describe the principle of operation and applications of three-phase induction machines

Revision 1: September 2011
Next Revision: September 2015

Module Title	OBJECT ORIENTED PROGRAMMING
Code	TCME3692
NQF level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development. Top-down stepwise refinement approach. **Object Oriented Programming and C++**. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, producing output and providing input in a C++ program. Elements of data structures. **Evaluating C++ Expressions**. Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. **Selection Structures**. Using the **if** statement; the **Nested if**; the **switch** statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Statements**. 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; Using Pointers. **Using C++ Functions**. Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. **Using 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; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The **cin** and **cout** class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List. **Numerical Methods:** Finding Roots of Nonlinear Equations; Numerical Differentiation; Numerical Integration.

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

- Design and represent algorithm for solving given problems using flowchart or pseudo code.
- Describe concept of object-oriented programming.
- Use the top-down stepwise approach to solve engineering problems.
- Create structures and classes in respect of a particular problem
- Design the respective algorithm for the solution of the problem identified and document the design in standard UML 2.0 notation.
- Work with object oriented concepts and terminology such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
- Apply the problem solving techniques to computational and engineering problems.
- Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++ and/or other OOP language

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING

SEMESTER 1

Module Title	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title	**FUNDAMENTALS OF POWER SYSTEMS**
Code	TECE3731
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TECE3791 Electric Circuit Analysis II

Content: **Introduction to Power System:** Introduction, History of power system supply, Power system components – generation, transmission, and distribution. Issues related to power system – new and renewable sources, effects to the environment, generating station, independent power producers, and energy policy. **Electricity Generation: Methods** of generation – conventional (gas, thermal, hydro, and nuclear) and new (solar, fuel Cell, wind, wave etc.). **Transmission Lines: Types** of lines – overhead and underground, HVAC and HVDC. Design concepts and structures of lines. Line parameters (derivation of formulae and use of tables) - resistance, inductance, and capacitance, Line modelling (using line formulae and ABCD parameters) - short, medium and long Line performance – power flow, efficiency voltage regulation. Methods of voltage control and reactive compensation **Component Representations in Power System** One line diagram. Reactance and impedance diagram. Per unit system. Component modelling – generator, transformer, line, and loads. System analysis in steady state condition using per unit approach. **Energy Utilization in Power System:** Introduction, Types and characteristics of power system loads. Load factors - concept and calculations. Generation planning to fulfil load demand. Tariff. Supply quality – reliability and power quality. Energy efficiency., Introduction to Demand Side Management.

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

- Describe the important parts and components in power system and explain roles and functions of the parts and components in power system operation.
- Explain effects of power system to environment.
- List, explain, and perform calculations related to various types of conventional and new energy sources for electricity generation.
- Describe basic design concepts and application of power transmission lines.
- Derive and apply suitable equations related to parameters, models and performances of transmission lines.
- Describe configurations and perform calculations for factors related to power system loads.
- Discuss basic concepts related to energy utilization, generation planning, tariff, power quality, energy efficiency, and demand side management.
- Perform component modelling and power system analysis using per unit system.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ELECTRIC CIRCUIT ANALYSIS II
Code	TECE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TECE3691 Electric Circuit Analysis I
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Use of Laplace and Fourier transformations in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. One and two-port Networks parameter presentations. Basics of network Synthesis

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

- Use principles and methods of analysis and modelling of electric circuits in the steady state.
- Apply Network theorems to the analysis of networks.
- Use of Laplace transformation and bode plots in circuit analysis
- Apply the concepts of frequency response, resonance, and network functions, two port networks
- Analyze and solve two port networks using different parameters
- Synthesise network circuits to meet specifications

Revision 1: September 2011
Next Revision: September 2015

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%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETE3622 Electrical machines and Drives TTCE3622 Applied Electromagnetics

Content: **Electrical Machines Design**: To develop an understanding of the relationship between dimensions and rating of machines; to introduce the principles of winding designs; to develop techniques for the design of permanent magnet machines; to calculate representative winding reactances. **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; Phase shift; equivalent circuit; per unit notation and transformers in parallel .**Induction Motor:** Development of a phasor diagram for starting and running conditions; development of equivalent and approximate equivalent circuits models; current and torque characteristics; rotor resistance variation and deep bar effects; methods of starting and speed control. **Synchronous Machine:** Development of phasor diagram for cylindrical synchronous machines; concept of synchronous reactance; short circuit ratio; operation as an isolated generator and on infinite bus bars. **Modelling of Electrical Machines.** Synchronous motors, Induction motors, Transformers. Synchronous generators. Simulation. **Multi-machine System Analysis**: Development of models, Representation of multi-machine systems. **Simulation and Applications. Economics and ergonomics in design:** Application of electrical engineering principles, principles of economics, product costing and ergonomics in realising a practical design.

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

- Design and conduct experiments, as well as to analyse and interpret data.
- An ability to design and implement practical product-oriented systems
- Apply theoretical engineering knowledge to practical designs.
- Demonstrate an understanding of the operation of electrical machines in a power system network
- Communicate the logic and detailed approach to problem solving.
- Design a system component of various electrical machines or process to meet desired needs within realistic constraints
- Demonstrate an ability to effectively communicate design concepts in a written report.
- Apply Software Design tools

Revision 1: September 2011
Next Revision: September 2015

Module Title	POWER ELECTRONICS
Code	TECC3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE3691Analogue Electronics I

Content: Power Electronic Circuits, Operating characteristics of power semiconductor devices such as Bipolar Junction Transistors, IGBTs, MOSFETs and Thyristors. Fundamentals of power converter circuits including dc/dc converters phase controlled ac/dc rectifiers and dc/ac inverters. Practical issues in the design and operation of converters

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

- Describe the operation of diode and SCR based power electronic circuits
- Demonstrate an understanding of the basic concepts of switched-mode power supplies and control principles

Revision 1: September 2011
Next Revision: September 2015

Module Title	MEASUREMENTS AND INSTRUMENTATION
Code	TETA3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETE3691Analogue Electronics I

Content: 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, Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Data Acquisitioning systems.

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

- Explain different types and methods of measurement
- Describe the measurement system
- Define and understand the Static and Dynamic Characteristic of an instrument
- Understand Importance of signal generators and signal analysers in measurements
- accurately measure Electrical and non-Electrical physical quantity
- Classify, calculate errors and reduce them in measurements
- Demonstrate an understanding of instrument Calibration
- Understand the use of sensors and transducers
- Acquire practical skills on the use of instruments and theoretical calculation of error
- Process the result of measurements and obtain information

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis.**

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENTREPRENEURSHIP**
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	HIGH VOLTAGE ENGINEERING
Code	TECP3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TECE3731 Fundamentals of Power Systems

Content: Calibration, measurement amplifiers, interconnections of sensors and amplifiers, spectrum analysers and correlation measurements, noise and interference, grounding, CMR and processing of measurement results. High voltage measurement and testing techniques. Insulation assessment and design considerations for HV equipment.
Fundamentals of HVDC transmission systems and Technology

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

- Demonstrate an understanding of the measurement systems. Instrumentation concept, signal conditioning and processing
- Describe the standard HV tests, and design the test generator circuits for ac, dc and impulse voltages (and currents)
- Conduct selected HV tests, and be sensitised to basic HV experimental techniques
- Competently use testing methods and testing equipment for the electrical industry
- Analyse the HVDC transmission system

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3521 Computing Fundamentals

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, network security. **Network Management and Troubleshooting**.

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

- Have a comprehensive understanding of computer network layers
- Identify and use internetworking, broadband, electrical interface, and data transmission concepts
- Discuss the history and development of the internet
- List the four layers of the TCP/IP model
- Describe the functions of each layer of the TCP/IP model
- Compare the OSI model and the TCP/IP model
- Understand the issues related to addressing between networks
- Use appropriate networking tools to troubleshoot and verify the operations of computer networks

Revision 1: September 2011
Next Revision: September 2015

Module Title	SWITCHING AND PROTECTION OF HIGH VOLTAGE SYSTEMS
Code	TECP3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TECE3691Electric Circuit Analysis I
Co-requisite(s)	ECE3731 Fundamentals of Power Systems

Module Description: Protection and switching: relays, protection schemes, switchgears, fuses, isolators, circuit breakers. Distribution and protection systems, steady state operation of transmission line. Load flow studies, fault calculations, system operations. **Power system stability and control**, dynamic security analysis. **Conduction** and breakdown processes in gases, liquids and solids. **Generation of High Voltage.** Testing of high voltage and high current.

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

- Understand the principles of switching and protection of power systems and components
- Understand the protection equipment used in the switching and protection of electrical power systems,
- Understand the response of a power system to demand conditions and corrective measures for its control,

Revision 1: September 2011
Next Revision: September 2015

Module Title	ELECTRICAL ENGINEERING DESIGN
Code	TECE3762
NQF Level	7
Contact Hours	2L +1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Project Presentation (20%); Lab Reports (20%)
Co-requisite(s)	TECE3711 Electrical Engineering machines Analysis & Design TECE3731 Fundamentals of Power Systems

Module Description: 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 electric power 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

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

- Using both basic circuit theorems as well as more advanced circuit analysis methods
- Discuss basic concepts related to energy utilisation, generation planning, tariff, power quality, energy efficiency, and demand side management.
- Perform component modelling and power system analysis using per unit system.
- Use Demonstrate the knowledge and practical skills to analyse and design Electrical circuits
- Computer based software for electrical circuits design, power system analysis software and simulation
- Apply methods and tools used in the design process to analyse and test an electrical circuit system

Revision 1: September 2011
Next Revision: September 2015

Module Title	RENEWABLE ENERGY TECHNOLOGIES
Code	TECC3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: Fundamentals of various sources of renewable energy and their applications: Solar (thermal and photovoltaic), fuel cells, hydro-electric, bio-energy, wind energy, tidal power, wave energy, geothermal energy, ocean thermal, heat pump systems. 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:

- Analyze and design energy systems to supply the electricity/heat/cooling requirements using wind energy, bio-energy and/or solar energy.
- Describe in detail the fundamentals and main characteristics of wind energy, bio-energy and solar energy and their differences compared to fossil fuels.
- Describe in detail the main components of these 3 different renewable energy systems
- Explain the technological basis for harnessing these renewable energy sources
- Recognize the effects that current energy systems based on fossil fuels have over the environment and the society
- Compare different renewable energy technologies and choose the most appropriate based on local conditions
- 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

Revision 1:	September 2011
Next Revision:	September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision:	October 2012
Next Revision:	September 2015

YEAR 4 OF BSc IN ELECTRICAL 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3682 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title	POWER TRANSMISSION AND DISTRIBUTION
Code	TECE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TECP 3742 Switching and Protection of High Voltage Systems, TECE3731 Fundamentals of Power systems

Content: Power transmission and distribution network architecture and composition; representation of system elements, per unit quantities, network equations and solutions, load curves; 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; protection systems; switching equipment; voltage and power static control; power system stability and methods of improving stability, surge voltages and protection. Protection: Current and voltage transformers; symmetrical components, fault calculations, characteristics of protective relays; protection of transformers, generators, motors and transmission lines.

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

- Understand of electric power distribution systems and equipment.
- Understand the principles of operation and applied design of bulk power distribution and transmission systems and substations
- Provide an insight into the main issues concerning the design and performance of a large power network
- 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
- Develop and demonstrate the use of system models for unsymmetrical fault analysis and load flow studies
- Analyse the stability of power systems and power system protection using appropriate software and tools

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTATIONAL METHODS IN POWER ENGINEERING
Code	TECE 3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TECE3731 Fundamental of Power Systems, TECP3742 Switching and Protection of High Voltage Systems

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-Seidal and Newton-Raphson methods. Computer-aided short circuit analysis of large systems; transient stability analysis; overvoltage calculations; and fundamentals of power system protection.

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

- Perform the power system analysis using software package.
- Demonstrate the use of system models for unsymmetrical fault analysis and load flow studies
- Demonstrate knowledge of major engineering problems associated with building high power engineering systems and how they are solved.
- Use a range of software tools which synthesize electrical power systems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MICROPROSSESSORS AND PROGRAMMABLE LOGIC CONTROLLERS
Code	TECE3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE 3692 Digital Electronics, TCME3692 Object Oriented Programming

Content: Microprocessors: Introduction to microprocessor system basics, historical background, microprocessor technologies, number systems and codes, microprocessor based system structure and operation, arithmetic logic processing unit, memory devices, microprocessor architectures, designing central processing unit module, designing main memory unit, microprocessor instruction set, microprocessor programming techniques, microprocessor development systems, data communications, basic input/output techniques, microprocessor peripheral units, microprocessor based system applications of Digital Electronics Analysis &Design ,microprocessor systems e.g. industrial process control (e.g. speed control of a d.c. motor or similar), robotics, vehicle electronics, domestic electronics or similar. Computer Simulation. **Programmable Logic Controller**: Review of hardwire control technique, hardware of PLC: components and their operating functions, PLC operating principle & language structure, principles of PLC programming: writing technique, reading technique, error diagnostics. Sensors and actuators for PLC, Introduction to SCADA systems.

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

- Perform binary and hexadecimal calculations and conversions.
- Design combinational circuits.
- To use programmable logic to implement various digital designs
- Design simple synchronous circuits including counters and state machines.
- Understand the operation, microprocessor system architecture, and its circuitry
- Analyze microcontroller assembly language and write simple application programs.
- Use VHDL to produce digital designs suitable for implementation on PLDs.
- Program and use PLDs to implement digital logic designs.
- Demonstrate an understanding of the concept of small programmable system architecture, interface peripherals and the principle of interface design.
- Use modern engineering simulation software and tools

Revision 1: September 2011
Next Revision: September 2015

Module Title	CONTROL ENGINEERING
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

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 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. **Digital Control Systems:** modelling of digital computers, z-transforms, transfer functions, block diagram reduction, stability analysis, steady state errors, transient response in z-plane, gain design in z-plane, implementation of digital compensators.

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

- Discuss different control theory terminologies.
- Model basic electrical systems as a control systems or part of parts of control systems.
- Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
- Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
- Model, Analyse and design basic digital control systems.
- Use engineering software for modelling, analysis and design of control systems

Revision 1: September 2011
Next Revision: September 2015

Module title:	**RESEARCH PROPOSAL**
Code	TECR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title:	**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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TECR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	ELECTRICAL DESIGN PROJECT
Code	TECD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

J. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRONICS ENGINEERING (HONOURS)

J.1. DEGREE NAME: Bachelor of Science in Electronics Engineering (Honours) 19BETE

J.2 AIM

The curriculum for the degree of Bachelor of Science in Electronics Engineering (Honours) aims at producing Graduate Engineers with knowledge and skills in electronics engineering, and who can competently work in the design, production and service of electronic hardware, as well as the information and communication technology industry.

J.3 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Electronics 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 ENGINEERING – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences* I	SPHY3511	5	16	None
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	TEGT3521	5	8	None
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences* II	SPHY3512	5	16	SPHY3511
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	SCHM3512	5	16	None
2	*English for Academic Purposes*	ULEA3519	6	16	None
Total Credit Semester II				**80**	

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 ENGINEERING - 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	**TEGT3541**
1	Analogue Electronics I	TETE3691	6	12	**TEGT3541**
Total Credits Semester III				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE&CO-REQUISITE**
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Signals and Systems	TTCE3692	6	12	TEGT3671
2	Applied Electromagnetics	TTCE3622	6	8	**SPHY3512**
2	Telecommunication Principles	TTCE3642	6	8	**TEGT3541**
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN ELECTRONICS ENGINEERING - 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Analogue Electronics II	TETA3791	7	12	**TETE3691**
1	Digital Communication	TTCD3791	7	12	**EGS3691** TTCE3642
1	Electric Circuit Analysis II	TECE3791	7	12	**TECE3691** TEGT3671
1	Measurements and Instrumentation	TETA3721	7	8	**TETE3691**
1	Programmable Electronics Design	TETD3791	7	12	TETD3692
1	Power Electronics	TECC3791	7	12	**TETE3691**
Total Credits Semester V				**76**	

YEAR 3 OF BSc IN ELECTRONICS ENGINEERING – SEMESTER 2

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**EGS3691**
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Embedded Systems Design I	TETD3792	7	12	TETD3692
2	Opto-electronics	TETA3732	7	16	**SPHY3512**
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Electronic Products Development	TETE3712	7	16	**TETE3691** TETD3692
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**68**	

YEAR 4 OF BSc IN ELECTRONICS ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Digital Signal Processing	TTCD3831	8	16	**TTCE3692**
1	Embedded Systems Design II	TETD3831	8	16	TETD3792
1	Communication Electronics	TETC3891	8	12	**TETA3791 TTCE3642**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Research Proposal	TETR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Research Project	TETR3892	8	30	All 3rd Year Mod TETR3891
2	Electronics Design Project	TETD3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

TOTAL CREDITS FOR THE DEGREE OF BSc IN ELECTRONICS ENGINEERING (HONOURS) **584**

J.4 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN ELECTRONICS ENGINEERING (HONOURS)

YEAR 1 OF BSc IN ELECTRONICS ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Contents: 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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ENGINEERING DRAWING**

Code TEGT3591
NQF Level 5
Contact Hours 3L + 2T or 1PS/Week
NQF Credits 12
Assessment Continuous 50%, Examination 50% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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

Content: Units, significant figures & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum – 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Revision: January 2013

Module Title:	**COMPUTING FUNDAMENTALS**
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**WORKSHOP PRACTICE**
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100% [Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 Hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Fundamentals **of thermodynamics systems.**
Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols
- Describe the thermodynamics system

Revision 1: September 2011
Next Revision: September 2015

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving.
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting.
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information.
- Describe the principles of a transformer and the basic AC generator and DC motors.
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date:	September 2012
Next Revision:	September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1st order and 2nd order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: 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 the 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 2009
Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: Statics: 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. Analysis of frames and machines. Virtual work.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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.

Revision 1: January 2009
Next Revision: January 2013

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 %) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) (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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 OF BSc IN ELECTRONICS ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Probability: 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; Applications to Quality Assurance: Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; Applications to Reliability and Life Testing: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

Module Title	ELECTRIC CIRCUIT ANALYSIS I
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin's and Norton's 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. behaviour 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. **Computer circuit analysis and simulation**

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

- Apply circuit theorems to simplify and find solutions to electrical circuits.
- Interpret, develop and design electrical engineering circuits
- Use computer simulation tools for electric circuit analysis and design
- Perform DC and AC power calculations including power factor correction;
- Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
- Analyze, simulate, and experimentally validate DC and AC circuits;

Revision 1: September 2011
Next Revision: September 2015

Module Title	ANALOGUE ELECTRONICS I
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541, Fundamentals of Electrical Engineering

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

- Discuss the atomic structure of semiconductor materials
- Discuss the construction and operation of semiconductor diodes.
- Analyse and design diode based circuits.
- Discuss the construction of BJT transistors
- Analyse and design BJT transistor amplifier and switching circuits
- Discuss the construction of FET transistors
- Analyse and design FET biasing circuits
- Discuss the internal circuitry for op-amps
- Discuss the operation of op-amps
- Analyse and design basic op-amp circuits
- Use EDA software to analyse electronic circuits.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	**SIGNALS AND SYSTEMS**
Code	TTCE3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: An introductory course covering the principles of signals and systems. The course combines lectures, MATLAB simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing. 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: Upon completion of this module, students should be able to:

- Analyse signals and systems in the time and frequency Domain.
- Classify signals and analyse their parameters.
- Discuss the operation and application of linear systems.
- Apply transformation techniques and various analysis approaches to signals and linear system.
- Design FIR and IIR filters.Carry out computer based simulations related to signals and systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	APPLIED ELECTROMAGNETICS
Code	TTCE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SPHY3512 Physics for Physical Sciences II

Content: Review of Vector Algebra: Classification of vector fields. Electrostatic Fields: Coulomb Law & Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equation. Electric potential; relationship between E and V Maxwell Equation. **Electric Field in Material Space**: Properties of materials, Convection and conduction current; Polarization in Dielectric; dielectric constant and strength; Continuity Equation and Relaxation Time; Boundary Conditions; Electrostatic Boundary-Value Problems; Poisson's and Laplace Equations; Electrostatic Boundary-Value Problems: Uniqueness Theorem, Procedure for solving Poisson's and Laplace equations, Resistance and Capacitance, Methods of Images **Magnetostatics**: Biot-Savart's Law; ampere Circuital Law-Maxwell Equation. Application of Ampere's Law Magnetic Flux Density-Maxwell Equation. Maxwell Equation for Static EM Fields; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices: Forces due to Magnetic Fields; Magnetic Torque and Movement. **Magnetic Forces, Material and Devices**: Magnetization in Materials. Magnetic Forces, **Material and Devices:** Magnetic Boundary Conditions. Magnetic Forces, **Material and Devices:** Inductor and Inductance; Magnetic Energy.

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

- Perform calculations involving electric and magnetic fields.
- Explain the theories and applications of electromagnetic fields and waves in engineering.
- Explain the physical meaning and significance of Maxwell's equations.
- Analyse electromagnetic and time varying fields and waves.
- Derive and apply equations related to static electromagnetic fields.
- Use Maxwell's equations to derive one law from another.

Revision 1: September 2011
Next Revision: September 2015

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: **Basic notions and definitions**: radio spectrum, definitions and terminology: analog and digital systems; communication systems components, communication channels and their characteristics; bandwidth, Channel Capacity**,** distortion, noise and other impairments. 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. Standards Organisations.

Noise: Noise sources, noise figure and noise temperature; noise models. **Analog modulation and demodulation Technique**: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; Frequency discriminator and the envelope detector; AM and FM receiver; pre-emphasis and de-emphasis filtering; FM threshold effect; comparison of angle and linear modulation systems. **Multiplexing techniques**: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM). Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication. **Radio Propagation and antenna**.

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

- Explain the principles involved in the transmission and reception of information in a communication system.
- Discuss the architecture of a generic telecommunication systems
- Discuss and Analyse Analogue modulation process
- Discuss and analyse the effect of noise in communication systems
- Discuss and analyse the effect of radio wave propagation and antennae in a telecommunication system

Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication

- .

Revision 1: September 2011
Next Revision: September 2015

Module Title	DIGITAL ELECTRONICS
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 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. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

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

- Discuss fundamental digital terminology.
- Perform different number systems and coding conversions.
- Describe the operation of different logic gates.
- Analyse and simplify logic equations
- Analyse and design different combinational logic circuits
- Analyse and design sequential logic circuits
- Compare the performance of different logic family devices
- Design and analyse internal circuitry of different logic families and interfaces between them.

Revision 1: September 2011
Next Revision: September 2015

Module Title	OBJECT ORIENTED PROGRAMMING
Code	TCME3692
NQF level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development. Top-down stepwise refinement approach. **Object Oriented Programming and C++**. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, producing output and providing input in a C++ program. Elements of data structures. **Evaluating C++ Expressions**. Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. **Selection Structures**. Using the **if** statement; the **Nested if**; the **switch** statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Statements**. 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; Using Pointers. **Using C++ Functions**. Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. **Using 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; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The **cin** and **cout** class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List. **Numerical Methods:** Finding Roots of Nonlinear Equations; Numerical Differentiation; Numerical Integration.

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

- Design and represent algorithm for solving given problems using flowchart or pseudo code.
- Describe concept of object-oriented programming.
- Use the top-down stepwise approach to solve engineering problems.
- Create structures and classes in respect of a particular problem
- Design the respective algorithm for the solution of the problem identified and document the design in standard UML 2.0 notation.
- Apply the problem solving techniques to computational and engineering problems.
- Apply object-oriented concepts such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism in C++ and/or other OOP language to design and implement successful programs

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN ELECTRONICS ENGINEERING

SEMESTER 1

Module Title:	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

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, financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

Learning Outcomes: Upon completion of this module, students should be able to:
- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ANALOGUE ELECTRONICS II**
Code	TETA3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics

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 and feedback transistor based oscillator circuits), Power Supplies, Power electronics devices and applications.

Learning Outcomes: Upon completion of this module, students should be able to:
- Model and analyse FETs based circuits
- Determine the frequency response of transistor based circuits
- Analyse and design op-amp and circuits
- Analyse and design different op-amp based circuits
- Analyse and design power amplifiers
- Analyse and design filter circuits
- Analyse and design oscillator circuits
- Analyse and design ADC and DAC circuits
- Analyse and design switching circuits employing basic power electronics components

Revision 1: September 2011
Next Revision: September 2015

Module Tite:	DIGITAL COMMUNICATION
Code	TTCD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	EGS3691 Statistics for Engineers
Co-requisite(s)	TTCE3642 Telecommunications Principles

Content: Introduction: Introduction: 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, quantisation, pulse code modulation. Quantisation noise, companding, standards for companding. Voice codecs and codec standards. **Multiplexing**: 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. Baseband detection, error rate calculation. Intersymbol interference and equalisation. Eye diagrams. Signal transmission. **Information Theory**: Definition of Information, entropy, conditional entropy and redundancy, entropy rate, channel capacity. **Source Coding**: Symbol source encoding, coding for data compression. Error control coding, representation and analysis of codes, types of errors. Linear block codes, generator and parity check matrices, syndrome testing, typical linear block codes and their applications. Cyclic codes, polynomial representation of codes. **Data Transmission**: Baseband data transmission through a channel, intersymbol interference, baseband error probabilities, Channel coding, channel capacity. Performance of communication over AWGN channels.

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

- Identify the main elements of a digital communications system.
- Analyse the different digital modulation techniques
- Analyse information content of information sources
- Analyse and Design error control codes and decoding techniques.
- Analyse and choose digital communication techniques for band limited channels.
- Use simulation packages (e.g. MATLAB or equivalent) to evaluate the performance of various digital communications coding systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	ELECTRIC CIRCUIT ANALYSIS II
Code	TECE3791
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TECE3691 Electric Circuit Analysis I
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Use of Laplace and Fourier transformations in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. One and two-port Networks parameter presentations. Basics of network Synthesis

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	MEASUREMENTS AND INSTRUMENTATION
Code	TETA3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics I

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, Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Data Acquisition systems.

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

- Explain different types and methods of measurement.
- Discuss static and dynamic characteristics of an instrument.
- Explain the importance of signal generators and signal analysers in measurements.
- Accurately measure electrical and non-electrical physical quantities.
- Classify, calculate errors and reduce them in measurements.
- Discuss the concept of instrument calibration.
- Explain the use of sensors and transducers.
- Practically measure different quantities and specify the errors associated with the measurements.
- Analyse and interpret measurement results.

Revision 1: September 2011
Next Revision: September 2015

Module Title	PROGRAMMABLE ELECTRONICS DESIGN
Code	TETD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100% (labs 20%, assignments 10%, tests 40%, project 30%)
Pre-requisite(s)	TETD3692 Digital Electronics

Contents: Programmable Electronics Design Cycle, Structure of the development board (currently available in department). **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: Upon completion of this module, students should be able to:

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	POWER ELECTRONICS
Code	TECC3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE3691Analogue Electronics I

Content: Power Electronic Circuits, Operating characteristics of power semiconductor devices such as Bipolar Junction Transistors, IGBTs, MOSFETs and Thyristors. Fundamentals of power converter circuits including dc/dc converters phase controlled ac/dc rectifiers and dc/ac inverters. Practical issues in the design and operation of converters

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

- Describe the operation of diode and SCR based power electronic circuits
- Demonstrate an understanding of the basic concepts of switched-mode power supplies and control principles

Revision 1: September 2011
Next Revision: September 2015
SEMESTER 2

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis**.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	EMBEDDED SYSTEMS DESIGN I
Code	TETD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETD3692 Digital Electronics

Contents: Computer Architecture: 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; **Microprocessor Fundamentals;** Basic Elements, Bus Structure. **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, etc.

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

- Discuss the general architecture for computers.
- Differentiate between microcomputers, microprocessors and microcontrollers
- Discuss different types of micro-controller architectures
- Discuss implementation and operation of different memories.
- Discuss bus structures in microprocessor based systems.
- Design, implement and analyse assembly programs for Atmel AVR and/or PIC microcontrollers.
- Develop microcontroller based applications employing digital electronics, analogue electronics and assembly language.
- Execute micro-controller based group projects effectively.

Revision 1: September 2011
Next Revision: September 2015

Module Title	OPTO-ELECTRONICS
Code	TETA3732
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	SPHY3512, Physics for physical Sciences II

Contents: Geometrical, wave and, quantum optics, optical instruments, optical fibres and their properties, sources of radiation (the radiation of black body, LED- and laser structures), photo detectors (photo conductive detector, light multiplier, PIN and AMP diodes, position sensitive detectors), light source modulation, pre-amplifiers and their bandwidth/stability/noise analysis, the signal analysis methods used in opto-electronics. LEDs, Plasma displays, Lasers and their applications in communications, industries, computers, mines, medicine, and agriculture.

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

- Derive and analyse geometrical and physics characteristics of optical materials
- Discuss the operation of optical amplifiers, detectors, modulators, transmitters and receivers
- Discuss different applications of optical devices
- Use basic optical devices and instruments.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3521 Computing Fundamentals

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, network security. **Network Management and Troubleshooting**.

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

- Discuss computer network layers
- Compare the OSI model and the TCP/IP model
- Understand the issues related to addressing between networks
- Identify common security risks for Internet-connected computers.
- Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
- Distinguish between the different threats to wireless network security and different types of security threats.
- Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ELECTRONIC PRODUCTS DEVELOPMENT
Code	TETE3712
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 100% (Assignments 20%, Labs 30%, Mini Project 50%)
Pre-requisite(s)	TETE3691 Analogue Electronics I
Co-requisite(s)	TETD3692 Digital Electronics

Module Description: The students will develop 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: Upon completion of this module, students should be able to:

- Carry out need analysis and feasibility studies for electronic products.
- Develop design specifications for electronics products to meet user, functional and system requirements as well as industrial standards.
- Develop a product/prototype following a clear and standard electronic product development cycle.
- Formulate testing methods for an electronics product.
- Test and troubleshoot the electronic circuit product.
- Produce a technical document of the product.

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN ELECTRONICS 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	DIGITAL SIGNAL PROCESSING
Code	TTCD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TTCE3692, Signals and Systems;

Contents:Discrete-Time Signals, Systems, & Transforms: Basic Sampling Theory and D/A Conversion; Discrete-Time Linear Systems; Autocorrelation; Cross-Correlation (VIP); Z Transform; Discrete-Time Fourier Transform; Frequency Selective Linear Filtering; Sampling and Reconstruction; Multirate DSP: Efficient Up-sampling/Down-sampling, Multi-Stage Interpolation, Digital Subbanding; Applications: CD Players, Cell Phones, wireless networks. **Digital Filter Design:** FIR Filters – Equiripple Designs; IIR Filters: Common analog filters, Bilinear transformation, Frequency transformations. **Discrete Fourier Transform:** Definition and Properties; Fast Fourier Transform Algorithms: Divide and Conquer Approach, Radix-2 FFT; Sectioned Convolution**. Nonparametric methods of power spectrum estimation:** Discrete random processes; Estimation of autocorrelation sequence; Periodogram; Smoothed periodograms. **Model-Based Spectrum Estimation:** Autoregressive (AR) Modeling; Forward/Backward Linear Prediction; Levinson-Durbin Algorithm; Minimum Variance Method; Eigenstructure Methods I: MUSIC; Eigenstructure Methods II: ESPRIT; Applications in Speech Processing, Communications, and Acoustics. **Adaptive Signal Processing:** Applications: Equalization, etc; Adaptive Direct-Form FIR Filters – LMS; Adaptive Direct-Form FIR Filters – RLS

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

- Discuss the fundamental concepts of DSP
- Analyse discrete signals and systems
- Apply the analysis of discrete signals and systems in the design, implementation and testing of digital filters.
- Analyse linear and adaptive filter
- Apply mathematical tools and computation methods for signal processing
- Develop audio and video systems incorporating DSP algorithms

Revision 1: September 2011
Next Revision: September 2015

Module Title	EMBEDDED SYSTEMS DESIGN II
Code	TETD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-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 operations), 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. **Introduction to Real Time Operating Systems** (e.g. FreeRTOS) including real time executives (RTX). Mini group projects.

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

- Discuss merits and demerits of high level and assembly languages as used in embedded systems.
- Explain the embedded systems design cycle
- Discuss advanced embedded systems programming concepts
- Design and write efficient C programs for embedded systems.
- Optimise C code for embedded systems
- Discuss and use different embedded systems optimisation methods and algorithms
- Discuss the concept of Real Time operating Systems relating to embedded systems.
- Execute micro-controller based individual and/or group projects effectively.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMMUNICATION ELECTRONICS
Code	TETC3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TETA3791, Analogue Electronics II TTCE3642, Telecommunication Principles

Contents: HF Analogue Communication Circuits: Application of s parameters in design of high frequency circuits including resonant circuits, analogue filter circuits, Matching networks, oscillator and signal synthesiser circuits, high frequency amplifier circuits. Digital filters circuits, analogue and digital modulation/demodulation circuits, mixers, phase-locked loop circuits, high frequency receiver, and transmitter circuits (including antenna types and matching), automatic gain control circuits. **Digital Communication Circuits:** source coding techniques implementation, channel coding techniques implementation, line coding techniques implementation, Analogue to Digital Conversion circuits and Digital to analogue conversion circuits, basic switching circuits.

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

- Analyse different analogue high frequency electronics circuits used in communication systems.
- Design and implement different high frequency analogue communication electronic circuits to meet set requirements.
- Simulate and validate high frequency communication electronics designs using EDA software.
- Analyse different digital electronics circuits/systems used in communication systems.
- Design and implement different digital communication electronic circuits/systems fixed logic, programmable logic and/or micro-controllers.
- Execute communication electronics projects individually and/or in groups.

Revision 1: September 2011
Next Revision: September 2015

Module Title	CONTROL ENGINEERING
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

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 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. **Digital Control Systems:** modelling of digital computers, z-transforms, transfer functions, block diagram reduction, stability analysis, steady state errors, transient response in z-plane, gain design in z-plane, implementation of digital compensators.

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

- Discuss different control theory terminologies.
- Model basic electrical systems as a control systems or part of parts of control systems.
- Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
- Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
- Model, Analyse and design basic digital control systems.
- Use engineering software for modelling, analysis and design of control systems

Revision 1: September 2011
Next Revision: September 2015

Module title:	RESEARCH PROPOSAL
Code	TETR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TETR3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TETR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ELECTRONICS DESIGN PROJECT**
Code	TETD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011

Next Revision: September 2015

K. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

K.1. DEGREE NAME: Bachelor of Science in Electronics and Computer Engineering (Honours) 19BCEE

K.2 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 & Information Technologies, Complementary Studies and design and analysis.

K.3 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 – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences* I	SPHY3511	5	16	None
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	TEGT3521	5	8	None
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences* II	SPHY3512	5	16	SPHY3511
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	SCHM3512	5	16	None
2	*English for Academic Purposes*	ULEA3519	6	16	None
Total Credit Semester II				**80**	

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

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	**TEGT3541**
1	Analogue Electronics I	TETE3691	6	12	**TEGT3541**
Total Credits Semester III				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE&CO-REQUISITE**
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Signals and Systems	TTCE3692	6	12	TEGT3671
2	Applied Electromagnetics	TTCE3622	6	8	**SPHY3512**
2	Telecommunication Principles	TTCE3642	6	8	**TEGT3541**
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Software Engineering	TCEE3662	6	8	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**76**	

YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Analogue Electronics II	TETA3791	7	12	**TETE3691**
1	Electric Circuit Analysis II	TECE3791	7	12	**TECE3691** TEGT3671
1	Measurements and Instrumentation	TETA3721	7	8	**TETE3691**
1	Programmable Electronics Design	TETD3791	7	12	TETD3692
1	Microprocessor Systems	TCEE3791	7	12	TETD3692
1	Database Systems	TCME3761	7	8	TCME3692
Total Credits Semester V				**72**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**TEGS3691**
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Embedded Systems Design I	TETD3792	7	12	TETD3692
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Electronic Products Development	TCEE3792	7	12	**TETE3691** TETD3692
2	Digital Communication	TTCD3792	7	12	**TEGS3691** TTCE3642
2	Operating Systems	TCME3792	7	12	TCEE3791
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

YEAR 4 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Digital Signal Processing	TCEE3891	8	12	**TTCE3692**
1	Embedded Systems Design II	TETD3891	8	12	TETD3792
1	Computer Systems Performance	TCMH3891	8	12	**TETD3692**
1	Wireless Communication	TCEE3821	8	8	**TTCD3792** TTCE3642
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Research Proposal	TCER3891	8	4	TEGT3762
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE&CO-REQUISITE**
2	Research Project	TCER3892	8	30	All 3rd Year Mod TETR3891
2	Design Project	TCEE3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

TOTAL CREDITS FOR THE BSc IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS) 584

K.4 DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

YEAR 1 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Contents: 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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.
-

Revision 1: September 2011
Next Revision: September 2015

Module Title	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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

Content: Units, significant figures & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum – 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100% [Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components**.**

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 Hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Fundamentals **of thermodynamics systems.**
Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols
- Describe the thermodynamics system

Revision 1: September 2011
Next Revision: September 2015

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving.
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting.
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information.
- Describe the principles of a transformer and the basic AC generator and DC motors.
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date:	September 2012
Next Revision:	September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1st order and 2nd order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: 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 the 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 2009
Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: Statics: 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. Analysis of frames and machines. Virtual work.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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.

Revision 1: January 2009
Next Revision: January 2013

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 %) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) (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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

Module Title	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Probability: 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; Applications to Quality Assurance: Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; Applications to Reliability and Life Testing: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

Module Title	ELECTRIC CIRCUIT ANALYSIS I
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin's and Norton's 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. behaviour 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. **Computer circuit analysis and simulation**

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

- Apply circuit theorems to simplify and find solutions to electrical circuits.
- Interpret, develop and design electrical engineering circuits
- Use computer simulation tools for electric circuit analysis and design
- Perform DC and AC power calculations including power factor correction;
- Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
- Analyze, simulate, and experimentally validate DC and AC circuits;

Revision 1: September 2011
Next Revision: September 2015

Module Title	ANALOGUE ELECTRONICS I
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541, Fundamentals of Electrical Engineering

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

- Discuss the atomic structure of semiconductor materials
- Discuss the construction and operation of semiconductor diodes.
- Analyse and design diode based circuits.
- Discuss the construction of BJT transistors
- Analyse and design BJT transistor amplifier and switching circuits
- Discuss the construction of FET transistors
- Analyse and design FET biasing circuits
- Discuss the internal circuitry for op-amps
- Discuss the operation of op-amps
- Analyse and design basic op-amp circuits
- Use EDA software to analyse electronic circuits.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	**SIGNALS AND SYSTEMS**
Code	TTCE3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: An introductory course covering the principles of signals and systems. The course combines lectures, MATLAB simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing. 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: Upon completion of this module, students should be able to:

- Analyse signals and systems in the time and frequency Domain.
- Classify signals and analyse their parameters.
- Discuss the operation and application of linear systems.
- Apply transformation techniques and various analysis approaches to signals and linear system.
- Design FIR and IIR filters.Carry out computer based simulations related to signals and systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	APPLIED ELECTROMAGNETICS
Code	TTCE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SPHY3512 Physics for Physical Sciences II

Content: Review of Vector Algebra: Classification of vector fields. Electrostatic Fields: Coulomb Law & Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equation. Electric potential; relationship between E and V Maxwell Equation. **Electric Field in Material Space**: Properties of materials, Convection and conduction current; Polarization in Dielectric; dielectric constant and strength; Continuity Equation and Relaxation Time; Boundary Conditions; Electrostatic Boundary-Value Problems; Poisson's and Laplace Equations; Electrostatic Boundary-Value Problems: Uniqueness Theorem, Procedure for solving Poisson's and Laplace equations, Resistance and Capacitance, Methods of Images **Magnetostatics**: Biot-Savart's Law; ampere Circuital Law-Maxwell Equation. Application of Ampere's Law Magnetic Flux Density-Maxwell Equation. Maxwell Equation for Static EM Fields; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices: Forces due to Magnetic Fields; Magnetic Torque and Movement. **Magnetic Forces, Material and Devices**: Magnetization in Materials. Magnetic Forces, **Material and Devices:** Magnetic Boundary Conditions. Magnetic Forces, **Material and Devices:** Inductor and Inductance; Magnetic Energy.

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

- Perform calculations involving electric and magnetic fields.
- Explain the theories and applications of electromagnetic fields and waves in engineering.
- Explain the physical meaning and significance of Maxwell's equations.
- Analyse electromagnetic and time varying fields and waves.
- Derive and apply equations related to static electromagnetic fields.
- Use Maxwell's equations to derive one law from another.

Revision 1: September 2011
Next Revision: September 2015

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: **Basic notions and definitions**: radio spectrum, definitions and terminology: analog and digital systems; communication systems components, communication channels and their characteristics; bandwidth, Channel Capacity**,** distortion, noise and other impairments. 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. Standards Organisations.

Noise: Noise sources, noise figure and noise temperature; noise models. **Analog modulation and demodulation Technique**: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; Frequency discriminator and the envelope detector; AM and FM receiver; pre-emphasis and de-emphasis filtering; FM threshold effect; comparison of angle and linear modulation systems. **Multiplexing techniques**: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM). Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication. **Radio Propagation and antenna**.

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

- Explain the principles involved in the transmission and reception of information in a communication system.
- Discuss the architecture of a generic telecommunication systems
- Discuss and Analyse Analogue modulation process
- Discuss and analyse the effect of noise in communication systems
- Discuss and analyse the effect of radio wave propagation and antennae in a telecommunication system

Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication

Revision 1: September 2011
Next Revision: September 2015

Module Title	DIGITAL ELECTRONICS
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 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. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

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

- Discuss fundamental digital terminology.
- Perform different number systems and coding conversions.
- Describe the operation of different logic gates.
- Analyse and simplify logic equations
- Analyse and design different combinational logic circuits
- Analyse and design sequential logic circuits
- Compare the performance of different logic family devices
- Design and analyse internal circuitry of different logic families and interfaces between them.

Revision 1: September 2011
Next Revision: September 2015

Module Title	OBJECT ORIENTED PROGRAMMING
Code	TCME3692
NQF level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development. Top-down stepwise refinement approach. **Object Oriented Programming and C++**. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, producing output and providing input in a C++ program. Elements of data structures. **Evaluating C++ Expressions**. Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. **Selection Structures**. Using the **if** statement; the **Nested if**; the **switch** statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Statements**. 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; Using Pointers. **Using C++ Functions**. Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. **Using 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; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The **cin** and **cout** class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List. **Numerical Methods:** Finding Roots of Nonlinear Equations; Numerical Differentiation; Numerical Integration.

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

- Design and represent algorithm for solving given problems using flowchart or pseudo code.
- Describe concept of object-oriented programming.
- Use the top-down stepwise approach to solve engineering problems.
- Create structures and classes in respect of a particular problem
- Design the respective algorithm for the solution of the problem identified and document the design in standard UML 2.0 notation.
- Apply the problem solving techniques to computational and engineering problems.
- Apply object-oriented concepts such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism in C++ and/or other OOP language to design and implement successful programs

Revision 1: September 2011
Next Revision: September 2015

Module Title	SOFTWARE ENGINEERING
Code	TCEE3662
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

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 Module students should be able to:

- Develop a formal approach to the state-of-the-art techniques in software design and development.
- Analyse requirements and software architecture with a major emphasis on object design, implementation, testing and validation, maintenance, and software re-engineering.
- Propose Project Planning, Requirements, Specification, and System Design concepts including object design, testing, and implementation in software development environment.
- Work on large projects within a group.

Revision 1: September 2012
Next Revision: September 2016

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING
SEMESTER 1

Module Title:	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

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, financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ANALOGUE ELECTRONICS II**
Code	TETA3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics

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 and feedback transistor based oscillator circuits), Power Supplies, Power electronics devices and applications.

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

- Model and analyse FETs based circuits
- Determine the frequency response of transistor based circuits
- Analyse and design op-amp and circuits
- Analyse and design different op-amp based circuits
- Analyse and design power amplifiers
- Analyse and design filter circuits
- Analyse and design oscillator circuits
- Analyse and design ADC and DAC circuits
- Analyse and design switching circuits employing basic power electronics components

Revision 1: September 2011
Next Revision: September 2015

Module Title	ELECTRIC CIRCUIT ANALYSIS II
Code	TECE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TECE3691 Electric Circuit Analysis I
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Use of Laplace and Fourier transformations in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. One and two-port Networks parameter presentations. Basics of network Synthesis

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	MEASUREMENTS AND INSTRUMENTATION
Code	TETA3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics I

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, Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Data Acquisition systems.

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

- Explain different types and methods of measurement.
- Discuss static and dynamic characteristics of an instrument.
- Explain the importance of signal generators and signal analysers in measurements.
- Accurately measure electrical and non-electrical physical quantities.
- Classify, calculate errors and reduce them in measurements.
- Discuss the concept of instrument calibration.
- Explain the use of sensors and transducers.
- Practically measure different quantities and specify the errors associated with the measurements.
- Analyse and interpret measurement results.

Revision 1: September 2011
Next Revision: September 2015

Module Title	PROGRAMMABLE ELECTRONICS DESIGN
Code	TETD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100% (labs 20%, assignments 10%, tests 40%, project 30%)
Pre-requisite(s)	TETD3692 Digital Electronics

Contents: Programmable Electronics Design Cycle, Structure of the development board (currently available in department). **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: Upon completion of this module, students should be able to:

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	MICROPROCESSOR SYSTEMS
Code	TCEE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-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 Module students should be able to:

- Discuss the organization and design principles behind modern microprocessor-based systems
- Design memory circuit for microprocessors.
- Design input/output circuit for microprocessors.
- Design interrupt generating circuit for microprocessor
- Calculate exact execution time of programs.

Revision 1: September 2012
Next Revision: September 2016

Module Title	DATABASE SYSTEMS
Code	TCME3761
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TCME3692 Object Oriented Programming

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 Module students should be able to:

- Differentiate the variety of database systems.
- Plan and implement database technologies versus conventional file-processing systems.
- Develop system life cycle, prototyping methodology and enterprise data models.
- Implement protocols and effectively apply conceptual data modelling.
- Apply integrity control systems

Revision 1: September 2012
Next Revision: September 2016

SEMESTER 2

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis**.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENTREPRENEURSHIP**
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	EMBEDDED SYSTEMS DESIGN I
Code	TETD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETD3692 Digital Electronics

Contents: Computer Architecture: 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; **Microprocessor Fundamentals;** Basic Elements, Bus Structure. **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, etc.

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

- Discuss the general architecture for computers.
- Differentiate between microcomputers, microprocessors and microcontrollers
- Discuss different types of micro-controller architectures
- Discuss implementation and operation of different memories.
- Discuss bus structures in microprocessor based systems.
- Design, implement and analyse assembly programs for Atmel AVR and/or PIC microcontrollers.
- Develop microcontroller based applications employing digital electronics, analogue electronics and assembly language.
- Execute micro-controller based group projects effectively**.**

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3521 Computing Fundamentals

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, network security. **Network Management and Troubleshooting**.

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

- Discuss computer network layers
- Compare the OSI model and the TCP/IP model
- Understand the issues related to addressing between networks
- Identify common security risks for Internet-connected computers.
- Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
- Distinguish between the different threats to wireless network security and different types of security threats.
- Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ELECTRONIC PRODUCTS DEVELOPMENT
Code	TCEE3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100% (Assignments 20%, Labs 30%, Mini Project 50%)
Pre-requisite(s)	TETE3691 Analogue Electronics I
Co-requisite(s)	TETD3692 Digital Electronics

Module Description: The students will develop 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 Module students should be able to:

- Carry out need analysis and feasibility studies for electronic products.
- Develop design specifications for electronics products to meet user, functional and system requirements as well as industrial standards.
- Develop a product/prototype following a clear and standard electronic product development cycle.
- Formulate testing methods for an electronics product.
- Test and troubleshoot the electronic circuit product.
- Produce a technical document of the product.

Revision 1: September 2012
Next Revision: September 2016

Module Title	DIGITAL COMMUNICATION
Code	TTCD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TTCE3642 Telecommunications Principles
Pre-requisite(s)	EGS3691 Statistics for Engineers

Contents: Introduction: 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, quantisation, pulse code modulation. Quantisation noise, companding, standards for companding. Voice codecs and codec standards. **Multiplexing**: 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. Baseband detection, error rate calculation. Intersymbol interference and equalisation. Eye diagrams. Signal transmission. **Information Theory**: Definition of Information, entropy, conditional entropy and redundancy, entropy rate, channel capacity. **Source Coding**: Symbol source encoding, coding for data compression. Error control coding, representation and analysis of codes, types of errors. Linear block codes, generator and parity check matrices, syndrome testing, typical linear block codes and their applications. Cyclic codes, polynomial representation of codes. **Data Transmission**: Baseband data transmission through a channel, intersymbol interference, baseband error probabilities, Channel coding, channel capacity. Performance of communication over AWGN channels.

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

- Identify the main elements of a digital communications system.
- Analyse the different digital modulation techniques
- Analyse information content of information sources
- Analyse and Design error control codes and decoding techniques.
- Analyse and choose digital communication techniques for band limited channels.
- Use simulation packages (e.g. MATLAB or equivalent) to evaluate the performance of various digital communications coding systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	OPERATING SYSTEMS
Code	TCME3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TCEE3791 Microprocessor Systems

Contents: Introduction The course covers file, process, memory and **Input/Output management**; multitasking, synchronization, and deadlocks; scheduling and inter-process communication. **System programming** using system calls. Fundamentals of the **UNIX based operating system**. Mobile operating system.

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

- Distinguish technical differences between operating systems
- Discuss the necessary components and functions of an operating system
- Use both Windows and Unix-based systems, including installation of, and managing applications in a Unix-based operating system
- Analyze operating system requirements and recommend an appropriate operating system to meet the requirements
- Assess file, process, memory and Input/Output management; multitasking, synchronization, and deadlocks; scheduling and inter-process communication.
- Investigate the kernel interface, files, processes, and inter-process communication for current operating systems.

Revision 1: September 2012
Next Revision: September 2016

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN ELECTRONICS AND COMPUTER 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	DIGITAL SIGNAL PROCESSING
Code	TTCD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TTCE3692, Signals and Systems;

Contents: Discrete-Time Signals, Systems, & Transforms: Basic Sampling Theory and D/A Conversion; Discrete-Time Linear Systems; Autocorrelation; Cross-Correlation (VIP); Z Transform; Discrete-Time Fourier Transform; Sampling and Reconstruction; Efficient Up-sampling/Down-sampling. **Overview of DSP. Digital Filter Design:** FIR Filters and Design; IIR Filters: Common analog filters, bilinear transformation, Frequency transformations.

Frequency Domain Analysis - Discrete Fourier Transform: Definition and Properties; Fast Fourier Transform Algorithms: Divide and Conquer Approach, Radix-2 FFT; Sectioned Convolution**. Adaptive Signal Processing:** Applications: Equalization, etc; Adaptive Direct-Form FIR Filters – LMS; Adaptive Direct-Form FIR Filters – RLS. Digital Signal Processing design.

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

- Discuss the fundamental concepts of DSP
- Analyse discrete signals and systems
- Apply the analysis of discrete signals and systems in the design, implementation and testing of digital filters.
- Analyse linear and adaptive filter
- Apply mathematical tools and computation methods for signal processing
- Develop audio and video systems incorporating DSP algorithms

Revision 1: September 2011
Next Revision: September 2015

Module Title	EMBEDDED SYSTEMS DESIGN II
Code	TETD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-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 operations), 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. **Introduction to Real Time Operating Systems** (e.g. FreeRTOS) including real time executives (RTX). Mini group projects.

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

- Discuss merits and demerits of high level and assembly languages as used in embedded systems.
- Explain the embedded systems design cycle
- Discuss advanced embedded systems programming concepts
- Design and write efficient C programs for embedded systems.
- Optimise C code for embedded systems
- Discuss and use different embedded systems optimisation methods and algorithms
- Discuss the concept of Real Time operating Systems relating to embedded systems.
- Execute micro-controller based individual and/or group projects effectively**.**

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SYSTEMS PERFORMANCE
Code	TCMH3891
NQF Level	8
Contact Hours	3L + 1T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETD3692 Digital Electronics
Co-requisite(s)	TCMH3792 System Software Design

Module Description Review of probability, queueing theory, stochastic processes, bound and approximation. Computer systems performance indicators, performance measurement techniques. Synthetic workload and benchmarks. Development of broad working knowledge of probability, petri net, Asynchronization parallelism, Structure, communication and problems of MIMD System, Synchronous Parallelism: Structure, communication and problems of SIMD System, computer systems simulation, and empirical analysis techniques as applied to computer systems modelling. This course is oriented toward a practical application of theory and concepts to computer systems hardware and software performance.

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

- Discuss main terminologies used in computer system performance
- Optimise the performance of computer systems using parallelism
- Asses the performance of computer systems
- Explain computer performance measurement techniques
- Use proper benchmarks for measuring computers performance
- Setup experiments for measuring and analysing computers performance

Revision 1: September 2011
Next Revision: September 2015

Module Title	WIRELESS COMMUNICATION
Code	TCEE3821
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	TTCD3792 Digital Communication
Pre-requisites	TTCE3642Telecommunication Principles

Contents:Wireless communication basics: introduction**, f**requency reuse, handoff, interference and system capacity, sectorization, cell splitting, spectral efficiency. **Wireless Propagation**: Channels Large scale and small scale, Channel Models. Design of point to point wireless links, link budget. Modulation and error probability. Multiple access techniques.

Wireless communication systems: Principles of mobile communication systems, 1G, 2G, 2.5G & 3G Cellular mobile systems Spread spectrum systems, Generalized transmitter/receiver architectures, , Wireless LANs.

Optical communication systems: Introduction to Optical Communication Systems; Optical Sources I: Light Emitting Diodes; Optical Sources II: Lasers and Fibre Amplifiers; The Optical Channel: Optical Fibres; Optical Detection I: Photodiodes; Optical Detection II: Receiver Noise; Digital Optical Fibre Communication Systems; Analogue Optical Fibre Communication Systems; Components for Optical Systems; Wavelength Division Multiplexing (WDM); Optical Networks; Nonlinear Effects on Optical Systems.

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

- Carryout network planning in wireless communication
- Discuss and analyse various Modulation and Coding techniques used in combating channel uncertainties
- Distinguish between the major cellular communication standards (1G/2G/3G systems)
- Analyse multiple access techniques in wireless communication
- Discuss the Architecture and operation of wireless communications networks
- Design point to point wireless links

Revision 1: September 2012
Next Revision: September 2016

Module Title	CONTROL ENGINEERING
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

Contents: Control Systems Basics: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems:** Laplace transform review**,** transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of electrical systems. **Control System Analysis:** system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques:** Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators. **Digital Control Systems:** modelling of digital computers, z-transforms, transfer functions, block diagram reduction, stability analysis, steady state errors, transient response in z-plane, gain design in z-plane, implementation of digital compensators.

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

- Discuss different control theory terminologies.
- Model basic electrical systems as a control systems or part of parts of control systems.
- Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
- Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
- Model, Analyse and design basic digital control systems.
- Use engineering software for modelling, analysis and design of control systemS

Revision 1:	September 2011
Next Revision:	September 2015

Module title:	RESEARCH PROPOSAL
Code	TCER3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description: 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

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

- Make a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1	September 2011
Next Revision:	September 2015

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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TCER3891 Research Proposal; All third year modules

Module Description: 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:

- Carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2012
Next Revision: September 2016

Module Title	**DESIGN PROJECT**
Code	TCEE3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

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

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2012
Next Revision: September 2016

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

L. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

L.1. DEGREE NAME: Bachelor of Science in Mechanical Engineering (Honours) 19BMEE

L.2. AIM

The curriculum for the degree of Bachelor of Science in Mechanical Engineering (Honours) aims at producing Graduate Engineers with knowledge, skills and abilities in mechanical engineering design, manufacturing technology, industrial management, production systems, applications of fluid and thermal machines and research techniques.

L.3. CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Mechanical Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) 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 MECHANICAL ENGINEERING – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	*Computing Fundamentals*	*TCME3521*	*5*	*8*	*None*
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	*TEGT3521*	*5*	*8*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	*UCSI3580*	*5*	*8*	*None*
Total Credits Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credits Semester II				**80**	

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 MECHANICAL ENGINEERING –144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Computer Aided Drawing	TEGT3661	6	8	TCME3521 **TEGT3591**
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Engineering Thermodynamics I	TMEE3661	6	8	SCHM3512
1	Fluid Mechanics	TMEE3611	6	16	TEGT3592
Total Credits Semester III				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Solid Mechanics I	TMEE3642	6	8	**TEGT3592**
2	Strength of Materials	TMEE3622	6	8	**TEGT3592**
2	Mechanical Engineering Design I	TMEM3642	6	8	**TEGT3592**
2	Engineering Materials	TMEM3622	6	8	TEGT3562
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Electrical Machines & Drives	TECE3622	6	8	**TEGT3541**
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN MECHANICAL ENGINEERING –144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Manufacturing Technology	TMEM3731	7	16	TMEM3622 **TEGT3562**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Engineering Thermodynamics II	TMEM3741	7	8	**TMEE3661**
1	Principles of Control Engineering	TMEE3741	7	8	**TEGT3671**
1	Mechanical Engineering Design II	TMEE3731	7	16	TMEM3642
1	Machine Tools	TMEM3721	7	8	**TEGT3592**
1	Solid Mechanics II	TMEM3791	7	12	TMEE3642
Total Credits Semester V				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**EGS3691**
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Measurements and Control	TMEE3792	7	12	TETE3622
2	Fundamentals of Mechatronics	TMEM3742	7	8	TMEE3741
2	Operations Management	TEGT3722	7	8	**EGS3691**
2	Computer Aided Manufacturing	TMEM3792	7	12	**TEGT3661**
2	Rigid Body Dynamics	TMED3792	7	12	**TEGT3641**
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**68**	

YEAR 4 OF BSc IN MECHANICAL ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Mechanical Vibrations	TMEE3821	8	8	TMED3792
1	Renewable Energy	TMEE3841	8	8	**TMEE3661**
1	Thermal Machines	TMEE3831	8	16	TMEM3741
1	Fluid Machinery	TMEE3851	8	16	**TMEE3611**
1	Mechanical Engineering Design III	TMEM3821	8	8	**TMEE3731**
1	Research Proposal	TMER3891	8	4	TEGT3762
Total Credits Semester VII				**72**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Research Project	TMER3892	8	30	All 3rd Year Modules TMER3891
2	Mechanical Engineering Design Project	TMED3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**68**	

TOTAL CREDITS FOR THE DEGREE OF BSc IN MECHANICAL ENGINEERING (HONOURS) 584

L.4. 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**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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 & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100%[Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Revision 1: September 2011
Next Revision: September 2015

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving.
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting.
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information.
- Describe the principles of a transformer and the basic AC generator and DC motors.
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date:	September 2012
Next Revision:	September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1^{st} order and 2^{nd} order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, 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 the 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 2009
Revision: January 2013

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

Content: Statics*:* 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. Analysis of frames and machines. **Virtual work**.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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.

Revision 1: January 2009
Next Revision: January 2013

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%) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) 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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.
-

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Contents: Probability: 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; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date:	January 2009
Revision:	January 2013

Module Title:	ENGINEERING THERMODYNAMICS I
Code	TMEE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	SCHM3512 Chemistry 1B

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. 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. **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.

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

- Describe the first law of thermodynamics and its applications to non-flow and flow processes.
- Describe the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
- Describe and quantify the properties of working fluids.
- Interpret and use thermodynamic property diagrams.
- Describe the equation of state of a perfect gas.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	FLUID MECHANICS
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; 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; **Laminar viscous flow**: Differential equations of motion; torsional viscometer. Applications: flow with pressure gradient between parallel plate and pipe flow.

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

- Describe properties of fluids and conditions for relative equilibrium in fluids.
- Analyse one-dimensional mass and momentum conservation and applications of Bernoulli's equation
- Demonstrate skills for flow measurements
- Analyse general hydraulic systems with respect to energy changes, pipe friction, loss coefficient.
- Analyse laminar viscous flow using differential equations of motion and its applications to flow with pressure gradient between plate and pipe flow.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations: Modelling** with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**SOLID MECHANICS I**
Code	TMEE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Statics: Properties of three-dimensional force systems. Equilibrium of rigid bodies subjected to two- and three-dimensional force systems. Application of principles of rigid body equilibrium to trusses, frames, and machines. **Method of virtual work:** application to equilibrium and stability analysis of interconnected systems. **Statically indeterminate problems**. Geometric compatibility. **Moments and products of inertia**: first and second moments of area, polar moment of inertia, parallel axis theorem, radius of gyration, composite area method, product of inertia. **Mechanics of Solids**: Analysis of thermal and assembly stresses. Theories of failure. **Deflection of beams**: Slope and deflection by integration, Discontinuity functions, statically indeterminate beams, method of superposition. **Energy methods**: Strain energy for various types of loading, Deflection by conservation of energy, Impact loading, Castigliano's theorem.

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

- Analyse equilibrium of rigid bodies subjected to two and three dimensional force systems and demonstrate application to trusses, frames and machines.
- Apply the method of virtual work for equilibrium and stability analysis.
- Analyse and solve statically indeterminate problems.
- Calculate area moments and products of inertia and apply them to mechanics problems.
- Analyse thermal and assembly stresses and describe general theories of failure.
- Analyse deflection of beams using integration, discontinuity functions and method of superposition.
- Apply energy methods in stress and strain analysis, deflection and impact loading.
- Describe and apply Castigliano's theorem to determine deflection of beams.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress and strain, shear stress and strain, thermal stress and strain. **Analysis of stress and strain.** Plane stress and plane strain. **Bending:** Revision of shear force/bending moment distributions, bending stress. Symmetrical and unsymmetrical bending. Inelastic bending. Residual stresses.**Transverse shear**: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **Torsion:** Torsion of circular sections, solid non-circular shafts, Thin-walled tubes. **Combined Loading**: bending and direct stresses, bending and torsional stresses. **Transformation of stresses and strains**. Mohr's circle.

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

- Demonstrate the application of Hooke's Law to normal and shear stresses.
- Analyse stresses and s
- trains in two and three dimensions with cases of plane stress and plane strain.
- Analyse bending stresses in beams under symmetrical and unsymmetrical loading.
- Solve problems involving shear stresses and shear flow in beams.
- Analyse stresses and strains in circular shafts and tubes subjected to torsion.
- Analyses cases of combined loading involving bending, direct and torsional stresses.
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MECHANICAL ENGINEERING DESIGN I
Code	TMEM3642
NQF Level	6
Contact Hours	2L + 1T or 1 PS/Week
NQF Credits	8
Assessment:	Continuous 100% (Completed drawings, practical laboratory work)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: The design spectrum. Design methodology. Design of parts and machine elements. **Auto-CAD software:** use for drawing and design. Introduction to computer aided design. **Mechanism design principles**: Concepts of mechanisms, definitions, classification systems. Design principles for Link mechanisms; Cam mechanisms; Pin wheel mechanisms; Gear mechanisms. Analysis and synthesis of mechanisms.

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

- Describe the methodology for engineering design
- Describe key features in the design of machine elements
- Use Auto-CAD software in mechanical engineering drawing and design
- Demonstrate basic mechanisms used in machine design
- Describe the fundamentals of different methods of mechanism design, analysis and synthesis

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING MATERIALS
Code	TMEM3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3562 Materials Science

Content: Properties of materials: Review of mechanical properties. Thermal properties. Practical methods of determining mechanical properties. **Classification of steels and cast irons**: plain carbon, alloy and stainless steels. Grey, nodular and austempered ductile cast irons. **Technical heat treatment of steels**: annealing, normalizing, quench hardening, tempering, austempering, martempering. Hardenability; Jominy end-quench test. Other strengthening methods: solid solution hardening, strain hardening, cold working, annealing and recrystallization, precipitation-hardening. **Non-ferrous alloys**: copper, aluminium, titanium, nickel and their alloys. **Non-metallic materials:** engineering polymers and plastics, composites, introduction to ceramics.

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

- Demonstrate an understanding of the various mechanical and thermal properties of materials.
- Describe methods of determining mechanical properties.
- Distinguish between various classes of steels and cast irons and their uses.
- Demonstrate knowledge of the various techniques used to harden and strengthen metallic materials.
- Describe the characteristics and uses of non-ferrous metals and alloys based on aluminium, copper and titanium.
- Describe the characteristics and uses of non-metallic materials such as plastics, composites and ceramics.

Revision 1: September 2011
Next Revision: September 2015

Module Title	OBJECT ORIENTED PROGRAMMING
Code	TCME3692
NQF level	6
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Module Description: Problem Solution and Software Development. Top-down stepwise refinement approach. **Object Oriented Programming and C++**. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, producing output and providing input in a C++ program. Elements of data structures. **Evaluating C++ Expressions**. Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. **Selection Structures**. Using the **if** statement; the Nested **if**; the switch statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Statements**. 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; Using Pointers. **Using C++ Functions**. Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. **Using 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; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The **cin** and **cout** class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List; **Numerical Methods:** Finding Roots of Nonlinear Equations; Numerical Differentiation; Numerical Integration.

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

- Use the top-down stepwise approach to the solution of an engineering problem.
- Create structures and classes in respect of a particular problem
- Design the respective algorithm for the solution of the problem identified and document the design in standard UML 2.0 notation.
- Work with object oriented concepts and terminology such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
- Apply the problem solving techniques to computational and engineering problems.
- Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++ and/or other OOP language

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TECE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Contents: Introduction to electrical machinery*:* review of magnetic circuits, 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***:* 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, semi-conductor operation of induction machines, energy recovery techniques.

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

- Describe the principle of operation of electrical machinery
- Describe the principle of operation of DC machines such as DC motors, generators, drives etc
- Describe the principle of operation and applications of transformers and AC windings
- Describe the principle of operation and applications of three-phase induction machines

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	**MANUFACTURING TECHNOLOGY**
Code	TMEM3731
NQF Level	7
Contact Hours	4L + 2Tor 1PS/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMEM3622 Engineering Materials
Pre-requisite:	TEGT3562 Materials Science

Content: Elastic and plastic behaviour of materials. Technology of sheet metal forming. Forging, extrusion, stretching, wire drawing, hot and cold forming and printing. Annealing and recrystallization. **Introduction to physico-mechanical basis of metal cutting.** Tool materials. **Metal casting processes**. Special smelting processes. Continuous casting. Ferrous and non-ferrous foundry practice. Defects in castings and how to avoid them. **Welding Processes**: Manual and automated systems. Welding of mild steels, stainless steels and aluminium alloys. Robotics in welding. Weld defects and how to avoid them. Brazing. **Advanced cutting techniques**. Use of water jet, compressed air, ultrasound; Electro erosion; Cutting by penetration with a wire. Electro-chemical dissolution treatment. **Powder metallurgy**, composite materials treatment. Surface engineering. **Processing and foaming of plastics and rubber**. Extrusion; Injection moulding; blow moulding, foaming processes. Rapid prototyping.

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

- Describe elastic and plastic behaviour of materials and its application to metal forming, forging, extrusion, wire drawing and printing
- Describe the processes of annealing and recrystallization
- Describe the principles of metal cutting
- Describe metal casting processes and basic foundry operations for ferrous and non-ferrous metals
- Describe the various casting defects and how to control them.
- Describe the principles of various welding processes used in engineering and associated welding parameters
- Describe the principles of non-conventional cutting techniques used in engineering
- Apply the knowledge of powder metallurgy to composite materials and to surface engineering
- Describe the various techniques used in the processing and forming of plastics and rubber

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING THERMODYNAMICS II
Code	TMEM3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMEE3661 Engineering Thermodynamics I

Contents: **Vapour power systems**. Steam calculations. Boiler systems. Introduction to refrigeration and air conditioning systems. **Heat pump systems**. Non reacting gas mixtures and psychometrics. Heat transfer: Thermal conductivity. Steady state one-dimensional conduction. **Forced and natural convection**. Black and grey body thermal radiation. Thermal insulation. Lagging materials. Laboratory work.

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

- Analyse vapour systems and perform calculations on steam, refrigeration and air conditioning
- Analyse and perform calculations on heat pump systems
- Describe the principles of forced and natural convection and perform calculations on the same
- Describe the principles of heat radiation
- Describe the principles of heat insulation and appropriate insulation materials

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PRINCIPLES OF CONTROL ENGINEERING
Code	TMEE3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

Contents: Basic principles of systems control: Definition of a system, open and closed loop; Methods for system representation and analysis; Mathematical models of control systems: Laplace transform, block diagrams, transfer function, characteristic equations; Applications to simple spring-damper system; Dynamic response of systems: polar and Bode plots; stability analysis: Routh-Hurwitz method, root locus method, pole-zero location on s-plane; Design of closed loop systems: P, PI and PID controllers. Laboratory exercises.

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

- Describe a control system and distinguish between an open loop and a closed loop system
- Apply mathematical modelling with transforms and block diagrams to control systems
- Produce polar and Bode plots for control systems
- Describe the Routh-Hurwitz method and the root locus method
- Design closed loop systems and demonstrate the use of P, PI and PID controllers

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MECHANICAL ENGINEERING DESIGN II
Code	TMEE3731
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMEM3642 Mechanical Engineering Design I

Content: Analysis, synthesis and design of machine elements and components. Shafts, gears, hydrostatic bearings, springs, clutches, braking systems, bolted joints, riveted joints, welded joints. **Design of assemblies.** Consideration for tolerances, fits and reliability. Dynamic load systems. Power transmission systems. Professional communication techniques. **Tribology**: 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 and lubricating oils. Design exercises.

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

- Design a range of machine elements as applicable to mechanical engineering and present them as drawings and technical reports.
- Apply the knowledge of tolerances, fits dynamic loading and power transmission in the design of assemblies.
- Describe tribological processes that take place due to the interaction of surfaces moving against each other
- Describe the fundamentals of tribology with respect to friction, wear and lubrication
- Apply tribological considerations in the design and maintenance of machines.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MACHINE TOOLS
Code	TMEM3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Contents: **Principal methods of metal cutting**. Types of machine tools. Basic operations of the Lathe, shaping machine, milling machine, drilling 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:

- Describe the principles of the various methods used in metal cutting
- Describe the features of various cutting tools and perform calculations on machining parameters
- Describe conventional and non-conventional machining operations
- Describe the principle of computer numerical controlled machines

Revision 1: September 2011
Next Revision: September 2015

Module Title:	SOLID MECHANICS II
Code	TMEM3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMEE3642 Solid Mechanics I

Content: Mechanics of composite bodies: Materials; Manufacturing methods; Micromechanics; Macro-mechanics of a lamina; Failure criteria; Laminate analysis; Design of composite structures. **Stress analysis of asymmetric solids:** Thick-walled and compound cylinders; Rotating discs and cylinders; Autofrettage. **Fracture Mechanics:** Theories of linear-elastic and elastic-plastic fracture mechanics and their applications. Crack propagation models. Failure criteria.

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

- Analyse composite bodies using the principles of engineering mechanics.
- Describe design features of composite structures.
- Analyse stresses in asymmetric solids including cylinders and rotating discs.
- Demonstrate an understanding of linear elastic fracture mechanics and failure criteria.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	TEGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis**.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENTREPRENEURSHIP**
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MEASURMENTS AND CONTROL
Code	TMEE3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETE3622 Electrical Machines and Drives

Content: **Measurement theory and analysis:** The General measurement system: Measuring pressure, force and torque. Measuring position and orientation. Static characteristics of measurement system elements. Propagation of errors and accuracy of measurement systems in steady state. Dynamic characteristics of measurement system elements. Transferring and processing sensor signals and protecting signals from noise. Using sensors in feedback circuits. **Sensing elements in measurement systems:** Transducers and Sensors: performance, terminology. Systems measuring displacement, position, proximity, velocity, force, fluid pressure, fluid flow, liquid level, temperature and light. Thermocouples, ultrasonic measuring devices, optical measuring instruments. Selection and positioning of sensors. **Mechanical and electrical drives and actuators**: Pneumatic and hydraulic actuation systems, regulating valves, cylinders, motors. Mechanical Actuation Systems: Elementary kinematic chains; gear trains; belt and chain drives. Electrical Actuation Systems: Relays, solid state switches, solenoids, the permanent magnet DC motor, mechanical aspects of electric motors. Design of simple actuation systems. **Signal conditioning:** Amplification, filtering, sampling. A/D, D/A conversion. Pulse width modulation.

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

- Describe the principles behind various techniques for measuring physical quantities
- Describe the various sensors used in measurement systems
- Describe various mechanical and electrical drives and actuators used in machine automation
- Describe the principles of signal conditioning

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF MECHATRONICS
Code	TMEM3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMEE3741 Principles of Control Engineering

Contents: Modelling of mechatronical systems. Modelling of kinematic and dynamic mechanisms. Calculation of set value. **Sensors in back feed systems**. Regulating units which are adapted to servo-systems. Intelligent devices. Hydraulic servo-systems. **Digital control in regulating units**. Distributed control. **Lab design exercises.**

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

- Apply knowledge of mechanisms, electronics and computer technology to model mechatronical systems
- Describe the principles of hydraulic servo systems
- Describe the application of digital control in mechatronical systems
- Design simple mechatronical systems or machines

Revision 1: September 2011
Next Revision: September 2015

Module Title:	OPERATIONS MANAGEMENT
Code	TEGT3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: 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:

- Describe the various techniques of operation management
- Demonstrate knowledge of quality assurance and reliability measures in engineering projects
- Describe the key features of Total Quality Management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER AIDED MANUFACTURING
Code	TMEM3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3661 Computer Aided Drawing

Content: Three dimensional automated modelling: automated computer graphics, types of modelling, solid modelling and its limitations. **Computer aided design:** design constraints and requirements, flow models and analysis, conceptual design, evaluation of design, engineering analysis. **Computer integrated manufacturing:** computer controlled machine tools, control systems for numerical controlled (NC) machines, NC programming with interactive graphics, tool path generation, cutter location source files.

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

- Describe various techniques of 3-D automated modelling
- Demonstrate an understanding of the principles of computer aided design
- Demonstrate an understanding of the main features of computer integrated manufacturing

Revision 1: September 2011
Next Revision: September 2015

Module Title:	RIGID BODY DYNAMICS
Code	TMED3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3641 Engineering Mechanics II

Content: Revision of kinematics and kinetics of a system of particles. **Kinematics of rigid bodies**: Translational motion, rotational motion, absolute Motion. Relative and absolute velocity, instantaneous centre of zero velocity. Plane kinematics of a rigid body. **Plane Kinetics of a rigid Body.** Rotation of a rigid body about a fixed axis. General plane motion. Work- relationships for rigid bodies.

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

- Describe the kinematic principles of rigid bodies and perform calculations on the motion of rigid bodies
- Describe the kinetic principles of rigid bodies and perform calculations on plane kinetics
- Apply the work-energy principle to describe the dynamics of rigid bodies

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN MECHANICAL 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MECHANICAL VIBRATIONS
Code	TMEE3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMED3792 Rigid Body Dynamics

Content: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:

- Describe the fundamentals of vibration analysis
- Distinguish between the various forms of vibration
- Describe methods used to control vibration in practice including balancing techniques
- Describe techniques used in vibration absorption

Revision 1: September 2011
Next Revision: September 2015

Module Title:	RENEWABLE ENERGY
Code	TMEE3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMEE3661 Engineering Thermodynamics I

Content: Current energy demands, environmental effects, renewable energy resources, including photovoltaic, thermal solar, wind, tidal, ocean thermal and wave energies. Construction of simple solar arrays for energy production. Comparison between renewable and nuclear energy. Mixture of energy sources. Smart grid technology.

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

- Describe and analyse the benefits and limitation of using different renewable energy resources.
- Have a basic understanding of the underlying concepts, theory and applications of different renewable energy resources.
- Build simple photovoltaic arrays or thermal solar arrays to produce electric or thermal energy for different uses.
- Demonstrate an understanding of energy mix and smart grid technology.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	THERMAL MACHINES
Code	TMEE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMEM3741 Engineering Thermodynamics II

Content: Vapour power cycles. Analysis of aavailable energy. Heat pump cycles. Gas power cycles. **Internal combustion engines**. Principles and applications. **Principles of steam and gas turbines**. Energy analysis in the steam cycle in steam and gas turbines. Vapour flow in turbine blades and turbine phases. Turbine losses. Turbine performance. Multi-phase turbines. Thermal calculations of the gas turbine scheme. Load regulation system. Control and safety. **Power plants**. **Refrigeration**: Basic components, refrigeration agents. Refrigeration systems and their applications. Calculations on refrigeration machines. **Air-conditioning**: Basic components, air-conditioning systems and applications. Air-conditioning calculations. Fault diagnosis and maintenance. Environmental problems, alternative refrigerants.

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

- Describe and analyse vapour power cycles
- Describe the principles and characteristics of internal combustion engines
- Describe the principles and characteristics of steam turbines
- Describe the principles and characteristics of gas turbines
- Perform thermal calculations on thermal machines
- Describe the general design principle of power plants
- Perform calculations involving refrigeration and air conditioning
- Demonstrate knowledge of the various factors that are used to select or determine an appropriate air conditioning system

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FLUID MACHINERY
Code	TMEE3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3hour paper)
Pre-requisite(s)	TMEE3611 Fluid Mechanics

Content: Momentum principles applied to fluids. Jet propulsion. Design of fluid machinery: **Centrifugal and axial flow machines**, pipe-machine characteristics, cavitation, water hammer. Inclined and tilting hydrodynamic thrust bearings, journal bearings. Hydrostatic thrust bearings. Nozzles. **Power hydraulics**. Turbulent flow. Supersonic flow. Pressure and temperature measurements.

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

- Describe the principles used in the design of jet engines and general fluid machinery
- Describe the principles and characteristics of centrifugal and axial flow machines
- Describe the principles and characteristics of power hydraulics

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MECHANICAL ENGINEERING DESIGN III
Code	TMEM3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMEE3731 Mechanical Engineering Design II

Content: Design for manufacture: Design optimisation. Material selection. Rapid prototyping techniques. Reliability. Standards and specifications. Safety aspects. **Material handling systems**: Belts, conveyors, lifting cranes, ropes and chains, bulk material movement. **Industrial design engineering**. Ergonomics in design. Innovation. Product development. Design exercises. **Model design process:** Design exercises will be done in groups during Tutorial Classes whereby all steps in design methodology, including design realization, material selection, manufacturing and production process, technical and financial constraints, innovation and ergonomics will be demonstrated.

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

- Demonstrate knowledge of design features appropriate to a manufacturing undertaking
- Describe the principles of operation of the various equipment and machines used in handling bulk engineering materials
- Demonstrate the roles of ergonomics, innovation and product development in industrial design engineering
- Demonstrate an in-depth knowledge of design methodology and the entire design process

Revision 1:	September 2011
Next Revision:	September 2015

Module title:	RESEARCH PROPOSAL
Code	TMER3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description: 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMER3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TMER3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MECHANICAL ENGINEERING DESIGN PROJECT**
Code	TMED3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

M. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS)

M.1. DEGREE NAME: Bachelor of Science in Metallurgical Engineering (Honours) 19BMLE

M.2. 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 or Physical Metallurgy and Materials Engineering.

M.3 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 and 3 (semesters **III** to **VI**), all students in this degree programme take the same discipline-specific modules and a few common modules. In Year 4 (semester **VII** and **VIII**), students take either the **Extractive Metallurgy Option** or the **Physical Metallurgy Option**. 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 – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	Physics *for Physical Sciences* I	SPHY3511	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	Fundamentals of Engineering	TEGT3521	*5*	*8*	*None*
1	Contemporary Social Issues	UCSI3580	*5*	*8*	*None*
Total Credits Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credits Semester II				**80**	

NB: Students who have done *UCSI3529, ULEA3529, ULEA3519, TEGT3521, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN METALLURGICAL ENGINEERING – 148 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Chemistry for Metallurgists	TMLE3621	6	8	SCHM3512
1	Process Eng. for Metallurgists I	TMLE3641	6	8	**SCHM3512**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Statistics for Engineers	TEGS3691	6	12	TEGT3571
1	Properties of Materials	TMLE3661	6	8	**TEGT3562**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
Total Credits Semester III				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Metallurgical Thermodynamics I	TMLX3692	6	12	**SCHM3512**
2	Process Eng. for Metallurgists II	TMLE3692	6	12	TMLE3641
2	Introduction to Mineralogy	TMLE3622	6	8	**TEGT3521**
2	Computer Science for Metallurgists	TMLE3642	6	8	TCME3621
2	Electrical Machines & Drives	TECE3622	6	8	**TEGT3541**
2	Strength of Materials	TMEE3622	6	8	**TEGT3592**
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**72**	

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Solidification, Heat Treatment and Microstructure	TMLE3791	7	12	**TEGT3562**
1	Metallurgical Thermodynamics II	TMLP3721	7	8	**SCHM3512** TMLX3692
1	Pyrometallurgy	TMLX3791	7	12	TMLE3692 TMLX3692
1	Materials Technology	TMLP3791	7	12	**TMLE3661** **TEGT3562**
1	Non Destructive Testing of Materials	TMLP3741	7	8	**TEGT3562**
1	Rate Processes I	TMLX3761	7	8	**TMLE3621**
1	Fundamentals of Economics	TEGT3761	7	8	None
Total Credits Semester V				**68**	

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING – Semester 2

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Hydrometallurgy I	TMLX3722	7	8	TMLE3692 TMLP3721
2	Rate Processes II	TMLX3792	7	12	TMLX3761
2	Crystal Structure and Analysis	TMLP3742	7	8	TMLE3791
2	Energy and the Environment	TMLP3792	7	12	TMLX3692 TMLE3692
2	Process and Materials Design	TMLP3732	7	16	TMLE3692 TMLP3791
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Experimental and Research Methods	TEGT3762	7	8	TEGS3691
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

YEAR 4 OF BSc IN METALLURGICAL ENGINEERING

OPTION 1: EXTRACTIVE METALLURGY – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3521 TEGT3742
1	Project Management	TEGM3861	8	8	TEGT3761
1	Particulate Systems	TMLX3811	8	16	TMLE3692
1	Non-Ferrous Pyrometallurgy	TMLN3891	8	12	TMLX3791
1	Metallurgy of Iron and Steel	TMLN3821	8	8	TMLX3791
1	Hydrometallurgy II	TMLN3841	8	8	TMLX3722
1	Process Control	TMLC3891	8	12	TMLP3732
1	Research Proposal	TMLR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	
2	Research Project	TMLR3892	8	30	All 3rd Year Mod TMLR3891
2	Metallurgical Design Project	TMLD3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

Total credits for the Degree of BSc in Metallurgical Engineering - Extractive (Honours) **584**

OPTION 2: PHYSICAL METALLURGY – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3521, TEGT3742
1	Project Management	TEGM3861	8	8	TEGT3761
1	Structure and Properties of Materials	TMLP3831	8	16	TMLE3791 TMLP3742
1	Corrosion and Wear	TMLE3891	8	12	TMLP3721
1	Fracture Mechanics	TMLP3841	8	8	TMLP3791 TMLP3741
1	Carbon Engineering	TMLP3861	8	8	TMLP3742, TMLP3792
1	Forming and Welding Processes	TMLP3891	8	12	TMLP3791 TMLE3791
1	Research Proposal	TMLR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	

SEMESTER	MODULE	CODE	8	NQF CREDITS	
2	Research Project	TMLR3892	8	30	All 3rd Year Mod TMLR3891
2	Metallurgical Design Project	TMLD3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

Total credits for the Degree of BSc in Metallurgical Engineering – Physical (Honours) **584**

M.4 DETAILED COURSE CONTENT FOR BSC IN METALLURGICAL ENGINEERING (HONOURS)

YEAR 1 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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 & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date:	January 2009
Revision:	January 2013

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving.
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting.
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information.
- Describe the principles of a transformer and the basic AC generator and DC motors.
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100% [Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date: September 2012
Next Revision: September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1^{st} order and 2^{nd} order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, 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 the 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 2009
Revision: January 2013

Module Title:	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Content: Statics*:* 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. Analysis of frames and machines. **Virtual work**.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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.

Revision 1: January 2009
Next Revision: January 2013

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: (60%) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) 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

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**CHEMISTRY FOR METALLURGISTS**
Code	TMLE3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SCHM3512 Chemistry 1B

Content: Gases; Equations of State, Intermolecular forces, liquids and solids; Properties of solutions; Additional aspects of aqueous equilibria; Chemical thermodynamics; Chemical Kinetics; Electrochemistry; Transition metals chemistry. Analytical methods: Atomic Absorption Spectroscopy (AAS), Gas Chromatography- Mass Spectroscopy (GC-MS), Ion Chromatography, Infrared Spectrography.

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

- Demonstrate an understanding of the science of liquids and solids
- Demonstrate an understanding of chemical thermodynamics, kinetics and chemical equilibrium
- Demonstrate an understanding of the chemistry of transition metals
- Demonstrate knowledge of various analytical methods used in metallurgical investigations.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PROCESS ENGINEERING FOR METALLURGISTS I
Code	TMLE3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	SCHM3512 Chemistry 1B

Content: Dimensions, units and conversion factors used in metallurgical engineering. Dimensional analysis fundamentals. Sampling and measurements statistics. Stoichiometry and Material balances. Thermochemistry and energy balances.

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

- Manipulate and convert between different systems of units
- Demonstrate an understanding of stoichiometry
- Demonstrate an understanding of the necessity of sampling procedures and statistical evaluation
- Demonstrate an understanding of material balances
- Demonstrate an understanding of formulating and calculation of energy balances

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Contents: Probability: 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; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

Module Title:	PROPERTIES OF MATERIALS
Code	TMLE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3562 Material Science

Content: Review of Quantum mechanics: the basic principles required to understand the physical properties of materials (wave-particles duality, quantisation, Pauli exclusion principle, Fermi-Dirac statistic and band structure of materials). **Electrical Properties:** the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Magnetic properties:** ferromagnetic, paramagnetic and diamagnetic materials and their electronic structure. Domain structure, magnetisation and applications. **Thermal properties:** thermal expansion, thermal conductivity, heat capacity. Electron and phonon conduction. Optical properties: absorption, optical fibres, lasers. **Mechanical Properties and applications to metallurgy:** Tensile, compression, hardness, bending, impact and torsion tests; plane strain, fracture toughness, fatigue and creep.

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

- Describe the origin of physical properties of materials.
- Describe the origin of electrical properties.
- Describe the mechanisms of semi-conducting materials.
- Describe the origin of magnetic properties.
- Define and explain the significance of various mechanical properties.
- Demonstrate knowledge of methods used to measure mechanical properties.
- Describe the importance of measured properties on the selection of materials.

Revision 1: September 2011
Next Revision: September 2015

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)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**METALLURGICAL THERMODYNAMICS I**
Code	TMLX3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	SCHM3512 Chemistry 1B

Content: First law of thermodynamics: internal energy, work and heat. Constant volume and constant pressure processes. Isothermal and adiabatic process paths. Enthalpy and heat capacity. Enthalpies of formation and enthalpies of reactions. **Second law of thermodynamics:** entropy, reversibility and irreversibility, equilibrium. Combination of first and second laws. Free energy and equilibrium constant. Reactions involving gases and pure condensed phases. The Ellingham diagram. **Solution thermodynamics:** Partial, relative partial and excess partial molar quantities, Chemical potential. Integral, relative integral and excess integral molar properties: Gibbs-Duhem equation. Behaviour of solutions, simple solution types; Raoult's and Henry's laws. Activity and activity coefficients. Dilute solutions, alternate reference and standard states. Interaction parameters. Reactions involving gases and components in solution.

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

- Describe the concepts of thermodynamic variables, such as enthalpy, entropy, heat capacity
- Calculate enthalpies of formation, and of reactions
- Evaluate the feasibility of potential reactions from thermodynamic data
- Demonstrate an understanding of Raoult's and Henry's laws
- Demonstrate an understanding of the concepts of partial, and excess molar quantities

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PROCESS ENGINEERING FOR METALLURGISTS II
Code	TMLE3692
NQF Level	6
Contact Hours	**3**L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMLE3641 Process Engineering for Metallurgists I

Content: Introduction to minerals engineering: the stages involved in conversion of minerals to metals; Common minerals for ferrous and non-ferrous metals and routes of processing them; definitions. **Mineral Processing:** Role of mineral processing in extractive metallurgy. Comminution; theory and machines. Screening and classification. laboratory sizing techniques. Concentration: recovery-grade calculations; physical concentration methods (gravity, magnetic, flotation, electrostatic). Solid-liquid separation techniques. **Pyrometallurgy**: Pre-treatment processes: calcination, roasting, agglomeration, sintering. Introduction to unit processes for extracting ferrous and non-ferrous metals. **Hydrometallurgy**: Metal leaching and recovery methods. **Electrometallurgy**: Electrolysis; Faraday's law of electrolysis; electro-winning and electro-refining. **Basic Process Flowsheet design**: Designing simple extractive metallurgy flowsheets based on the learnt principles.

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

- Demonstrate an understanding of the various stages involved in extracting metals from ores
- Demonstrate an understanding of comminution and sizing processes and their selection
- Explain the underlying principles in different separation techniques
- Perform calculations related to grade and recovery
- Demonstrate an understanding of pre-treatment processes done to concentrated ores
- Demonstrate an understanding of types of smelting processes
- Demonstrate an understanding of leaching and recovery of metals
- Design simple extractive metallurgy flowsheets.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	INTRODUCTION TO MINERALOGY
Code	TMLE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT 3421 Fundamentals of Engineering

Content: Ore genesis and mineral identification. Application of microscopy, image analysis, XRD, modal analysis and mineralogical textures to characterise ores and minerals.

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

- Demonstrate an understanding of the origin and placement of important ores
- Demonstrate an understanding of the analytical methods used to analyse mineral and to apply them
- Apply the analytical methods to analyse minerals and ores
- Demonstrate an understanding of the limitations of the analytical techniques
- Be able to identify common minerals

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER SCIENCE FOR METALLURGISTS
Code	TMLE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Module Description: 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.

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

- Demonstration and application of the selected high level language to perform relevant engineering calculations
- Demonstration of the limitations of the calculating technique

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TECE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Contents: Introduction to electrical machinery*:* review of magnetic circuits, 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***:* 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, semi-conductor operation of induction machines, energy recovery techniques.

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

- Describe the principle of operation of electrical machinery
- Describe the principle of operation of DC machines such as DC motors, generators, drives etc
- Describe the principle of operation and applications of transformers and AC windings
- Describe the principle of operation and applications of three-phase induction machines

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress and strain, shear stress and strain, thermal stress and strain. **Analysis of stress and strain.** Plane stress and plane strain. **Bending:** Revision of shear force/bending moment distributions, bending stress. Symmetrical and unsymmetrical bending. Inelastic bending. Residual stresses.**Transverse shear**: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **Torsion:** Torsion of circular sections, solid non-circular shafts, Thin-walled tubes. **Combined Loading**: bending and direct stresses, bending and torsional stresses. **Transformation of stresses and strains**. Mohr's circle.

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

- Demonstrate the application of Hooke's Law to normal and shear stresses.
- Analyse stresses and strains in two and three dimensions with cases of plane stress and plane strain.
- Analyse bending stresses in beams under symmetrical and unsymmetrical loading.
- Solve problems involving shear stresses and shear flow in beams.
- Analyse stresses and strains in circular shafts and tubes subjected to torsion.
- Analyses cases of combined loading involving bending, direct and torsional stresses.
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle.

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title:	**SOLIDIFICATION, HEAT TREATMENT AND MICROSTRUCTURE**
Code	TMLE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3562 Materials Science

Content: The solidification process. Development of a microstructure. Modification of microstructure. The cast structure. Segregation. Single crystals. The development of microstructure during solidification. Diffusion. Binary phase diagrams. The Fe-Fe_3C equilibrium system. Heat treatment of plain carbon steels. Isothermal and continuous cooling transformations. Surface engineering. Heat treatment of alloy steels. Hardenability. Jominy end-quench test. Recovery, recrystallization and grain growth. Precipitation hardening.

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

- Demonstrate an understanding of the origins and development of microstructures.
- Sketch and explain typical binary phase diagrams including the Fe-Fe_3C diagram.
- Demonstrate an understanding of the manipulation of microstructure by thermo and thermo-mechanical methods.
- Demonstrate an understanding of heat treatment procedures for carbon and alloy steels.
- Describe the heat treatment of cold worked materials by recovery and recrystallization.
- Illustrate the process of precipitation hardening of non-ferrous alloys.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**METALLURGICAL THERMODYNAMICS II**
Code	TMLP3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SCHM3512 Chemistry 1B
Co-requisite(s)	TMLX3692 Metallurgical Thermodynamics I

Content: Phase equilibria: Phase rule and equilibrium diagrams. Free energy composition relationship. Unary, binary and ternary phase diagrams. Equilibrium path of crystallisation. Various types of invariant reactions. **Electrochemistry:** The relationship between chemical and electrical driving forces, the electromotive force (emf). Nature of electrolytes, transference numbers and mobilities. Thermodynamics of electrolytes. The effect of concentration on emf. Formation cells, concentration cells and transference. Electrode potentials. The electrochemical series. The Pourbaix diagram. Chemistry of aqueous solutions. Fused salt electrolysis.

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

- Describe and apply the phase rule in analysing phase equilibria
- Interpret and apply phase diagrams
- Demonstrate an understanding of the relationship between chemical and electrical driving forces
- Describe and apply Pourbaix diagrams
- Apply thermodynamics to solve relevant engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PYROMETALLURGY
Code	TMLX3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMLX3692 Metallurgical Thermodynamics I TMLE3692 Process Engineering for Metallurgists II

Content: Ferrous: Introduction to the iron making blast furnace; raw materials; fuels; reactions and products; design; refractories, cooling systems. Steel making processes: open hearth, bottom blown and top blown converters; electric arc and secondary steelmaking; slag systems**. Non-Ferrous:** pre-treatment processes: roasting, calcination, sintering, pelletising. Smelting unit processes; reduction smelting, sulphide smelting, converting, refining and fused salt electrolysis. **Applications**: production of copper, zinc, aluminium, tin, lead, magnesium, and ferroalloys. Impact of pyrometallurgy on society and environment.

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

- Demonstrate an understanding of the pyrometallurgical processes for iron making and steel making.
- Apply thermodynamics and kinetics principles to solve high temperature processing problems.
- Demonstrate an understanding of the various pre-treatment and smelting unit processes.
- Describe pyrometallurgical methods of extracting non-ferrous metals and illustrate them with appropriate flowsheets.
- Demonstrate an understanding of the impacts of pyrometallurgical processes on society and the environment.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MATERIALS TECHNOLOGY
Code	TMLP3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3hour paper)
Pre-requisite(s)	TEGT3562 Materials Science MLE3661 Properties of Materials

Content: Classification of steels and cast irons: plain carbon, alloy and stainless steels. Grey, nodular and austempered ductile cast irons. **Non-ferrous alloys**: copper, aluminium, titanium, nickel and their alloys. Introduction to Metal Casting technology: Moulds and moulding processes; Patterns and pattern making; gating; Metal melting and pouring. **Forming technologies; Elastic and plastic behaviour of materials;** hot and cold forming. Technologies of rolling, forging, extrusion, wire drawing. Calculations involving forces applied and dimensional changes. Polymer and plastic processing, properties and applications. Introduction to welding processes. **Particulates and near-net-shape processing**: Powder production; compaction; sintering; secondary and finishing operations. Ceramic and composite materials processing, properties and applications.

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

- Distinguish various classes of steels and cast irons and their uses.
- Describe the characteristics and uses of non-ferrous metals and alloys based on aluminium, copper, nickel and titanium.
- Describe metal casting processes and basic foundry operations for ferrous and non-ferrous metals.
- Describe elastic and plastic behaviour of materials and its application to metal rolling, forging, extrusion and drawing.
- Solve problems involving dimensional changes in different forming processes.
- Demonstrate knowledge of polymer and plastic processing and properties.
- Demonstrate knowledge of particulate materials processing by mechanical and thermo means.
- Demonstrate knowledge of processing and application of ceramics and composites.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	NON DESTRUCTIVE TESTING OF MATERIALS
Code	TMLP3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3562 Materials Science

Contents: **Theory and application** of Non Destructive Testing (NDT) methods such as the Liquid Penetrant Method, Magnetic Particles, Ultrasonic Flaw Detectors, X-ray Radiography, Gamma (γ) ray Radiography, Eddy Current Testing and other electrical methods in **testing, flaw detection and integrity checking of engineering materials**. Laboratory exercises on some of these methods. National and International Standards on NDT methods.

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

- Describe the various techniques of non-destructive testing applicable to engineering materials and engineering components and structures
- Demonstrate practical knowledge of some non-destructive testing techniques in a laboratory environment.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	RATE PROCESSES I
Code	TMLX3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMLE3621 Chemistry for Metallurgists

Content: Principles of Metallurgical kinetics; reaction rates and mechanisms, homogeneous and heterogeneous systems. **Fluid flow**: Differential equations of flow and their applications, Turbulent flow. . **Momentum transfer**: material and energy balance in fluid flow. **Viscosity and flow characteristics of liquids**. **Heat transfer**: principles of heat transfer; heat transfer mechanisms; heat transfer with change of phase.

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

- Demonstrate an understanding of the principles of metallurgical kinetics
- Perform calculations on temperature and concentration gradients and reaction times
- Perform calculations related to turbulent flow of fluids
- Demonstrate an understanding of the concept of viscosity in fluid dynamics
- Demonstrate an understanding of the principles of momentum transfer
- Demonstrate an understanding of the different modes of heat transfer

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ECONOMICS
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. **Introduction to budgeting. Introduction to marketing.** Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**HYDROMETALLURGY I**
Code	TMLX3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMLE3692 Process Engineering for Metallurgists II
Co-requisite(s)	TMLP3721 Metallurgical Thermodynamics II

Content: Leaching of ores and concentrates. Thermodynamics aspects of leaching. Electrochemical considerations in leaching. Construction and application of Pourbaix diagrams. Various leaching processes. Separation of leach solutions. Electrolytic processes for the recovery and purification of metals; Faraday's Laws of electrolysis.

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

- Demonstrate an understanding of the principles of hydrometallurgy
- Demonstrate and understanding of application of thermodynamic principles in leaching processes
- Describe the various leaching methods and criteria for selecting them
- Demonstrate an understanding of the solid liquid separation methods
- Demonstrate an understanding of the processes of electro-winning and electro-refining

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**RATE PROCESSES II**
Code	TMLX3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLE3641 Process Engineering for Metallurgists 1
Co-requisite(s)	TMLX3761 Rate Process I

Content: Mass Transfer: Mass transfer by convection, mass transfer models and correlations. **Rate phenomena application**: Treatment of heat, mass and momentum transfer problems in metallurgical engineering by interaction of chemical kinetics and transport processes. Topo-chemical reactions. Reactions with diffuse phase boundaries. Flow behaviour and reaction systems in metallurgical processes; Solid-solid, solid-liquid, solid-gas, liquid-liquid, liquid-gas and solid-liquid-gas reaction systems. **Rate phenomena practice in metallurgical operations**: calcination, reduction smelting, refining of metals, flash reduction, continuous casting etc.

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

- Demonstrate an understanding of mass transfer modes and models
- Demonstrate an understanding of the different types of interface reactions
- Apply principles of chemical kinetics and transport phenomena to metallurgical processes
- Solve process and materials related problems using rate phenomena principles.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CRYSTAL STRUCTURE AND ANALYSIS
Code	TMLP3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMLE3791 Solidification, Heat Treatment and Microstructure

Content: Crystal structures: Application of crystallography, point groups and space groups to understand the structures of different phases and the reciprocal lattice. Use of stereographic projections to analyse deformation in cubic materials. Relation of defects in crystals and texture to the properties of metals. **Analytical techniques:** Evaluation and application of optical microscopy, X-ray diffraction, scanning electron microscopy (SEM) and transmission electron microscopy (TEM), including EDS, to analyse and characterise microstructure. Description of techniques to analyse textures. Application and understanding of these techniques to materials characterisation together with specialist techniques. Introduction to scanning probe microscopy such as STM and AFM. **Computer applications:** software for analysing and characterising microstructure and texture.

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

- Demonstrate an understanding of different basic crystal structures
- Demonstrate an understanding of the representation of crystals
- Relate crystal structure to properties of materials
- Apply stereographic projections to derive active slip systems
- Describe and apply different analytical techniques involving X-rays and electrons to identify crystal structures
- Demonstrate an understanding of the limitations of the analytical techniques
- Apply computer software in the analysis and characterization of microstructures.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENERGY AND THE ENVIRONMENT
Code	TMLP3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLX3692 Metallurgical Thermodynamics I, TMLE3692 Process Engineering for Metallurgists II

Content: Fossil fuels: Fuels and their classification; Combustion of fuels; Hazardous substances emissions; alternative energy sources. **Energy:** Energy conversion and conservation; Energy balances. **Environmental Engineering:** 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: Upon completion of this module, students should be able to:

- Distinguish various fuels used in the Metallurgical Industry
- Demonstrate an understanding of the various methods of energy conservation and recovery
- Discuss the impact of metallurgical processes on the environment
- Apply relevant techniques to reduce the impact of hazardous substances on the environment
- Demonstrate an understanding of the health and safety issues, and relevant legislation governing metallurgical industries locally and regionally
- Demonstrate an understanding of the concept of sustainability

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PROCESS AND MATERIALS DESIGN
Code	TMLP3732
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLE3692 Process Engineering for Metallurgists II
Co-requisite(s)	TMLP3791 Materials Technology

Module Description: Formal lectures on design related topics of a general nature such as costing, specification, alternatives and brainstorming as well as lectures tailored to the design task at hand. Design tasks to be completed by students working in groups. Verbal presentations by students at various stages of the design. Feedback by students on presentations and brainstorming. Present final design both verbally and on paper in a competent manner. Familiarization with aspects of professional conduct and Occupational Health and Safety Act.

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

- Apply process engineering and materials engineering principles to design metallurgical processes
- Demonstrate the importance of costing of metallurgical processes
- Demonstrate the implications and application of Occupational Health and Safety Act in the design process
- Design a process or plant for a specific metallurgical operation and present it to an engineering audience.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis.**

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN METALLURGICAL ENGINEERING

OPTION 1: EXTRACTIVE METALLURGY

SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PARTICULATE SYSTEMS
Code	TMLX3811
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLE3692 Process Engineering for Metallurgist II

Content: Techno-economic aspects of mineral processing. Characterisation of particulate materials: quantitative description of particle size, nominal diameters, types of distributions for particle populations as a function of their physical properties (size, grade, relative density, extent of liberation. Influence of various forces (fluid drag, gravity, magnetic, electrostatic) on motion and fracture of particles, particle/particle effects. Application of the above to formulation on models for comminution, flotation, gravity separation, electrostatic and magnetic separation of particles. Material and metal balance of multi stream unit operations. Theories of thickening and filtration. Heat and water balance of solid-liquid recovery systems. Application of the above in design of process requirements and in design of experimental programmes. Laboratory work illustrating value and limitations of experimental work aimed at obtaining design parameters. Reporting on laboratory investigations. Case studies on complete mineral processing routes for diamond, gold and uranium ores.

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

- Demonstrate an understanding of the Techno-economic aspects of mineral processing
- Demonstrate an understanding of the nature and behaviour of particulate materials
- Apply appropriate methods to size particulate materials
- Demonstrate an understanding of the influence of different forces on the movement and fracture of particles
- Design experimental programmes to evaluate important parameters in minerals processing
- Report on the techniques, results and limitations of the different available processes
- Design specific operations for the processing of a given ore body

Revision 1: September 2011
Next Revision: September 2015

Module Title:	NON-FERROUS PYROMETALLURGY
Code	TMLN3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3hour paper)
Pre-requisite(s)	TMLX3791 Pyrometallurgy I

Content: Mixing in reactors, thermodynamic and kinetic concepts**.** Non-metallic melts (slag theory). Slag and matte production. Slag blowing. **Furnaces and their classifications:** matte, converters, electric furnaces. Refractories for pyrometallurgy furnaces. Distillation of metals. Development and application of flows sheets in non-ferrous metal extraction focussing on Base metals (Ni-Cu-Pb-Zn-Co system) and Ferro-alloys.

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

- Demonstrate an understanding of the effect of different parameters on pyrometallurgical metal extraction
- Demonstrate an understanding of the effect of slag-matte parameters on pyrometallurgy processes
- Demonstrate an understanding of the operation of different furnaces and the criterion of choosing them
- Outline the aspects considered in choosing refractory materials for pyrometallurgical furnaces
- Design specific processes for the treatment of ores and concentrates
- Analyse full-scale pyrometallurgical operations

Revision 1: September 2011
Next Revision: September 2015

Module Title:	METALLURGY OF IRON AND STEEL
Code	TMLN3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMLX3791 Pyrometallurgy I

Content: Mechanism of iron ore reduction; high temperature reactions and adiabatic flame temperature**. Blast furnace operations:** burden properties; sinter production and properties**.** Modelling of blast furnace; mass and heat balance. Alternative iron making methods. **Steel making**: Principle reactions in steel making. Deoxidation and alloying. Gaseous and non-gaseous inclusions. Steel making processes. Steel casting. Aspects of stainless steel production. Refractories for iron and steel furnaces and ladles. Scrap metal operations. **Economic and environmental aspects of iron and steel making**. Application of computer software in mass and heat balance of iron and steel making processes.

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

- Demonstrate an understanding of the principles iron ore reduction
- Demonstrate an understanding of the blast furnace production of iron
- Demonstrate an understanding of alternative iron making methods
- Demonstrate an understanding of the principles of steel making and various methods of their application
- Carry out basic calculations relating to the iron making and conversion to steel
- Demonstrate an understanding of stainless steel production and its limitations
- Demonstrate an understanding of the techno-economic and environmental aspects of iron and steel making
- Apply relevant computer software to solve heat and mass balance problems in iron and steel making

Revision 1: September 2011
Next Revision: September 2015

Module Title:	HYDROMETALLURGY II
Code	TMLN3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMLX3722 Hydrometallurgy I

Content: Thermodynamics of aqueous systems; complex formation, equilibria, E_h-pH diagrams for various systems**. Kinetics of heterogeneous reactions. Precipitation processes for metal separation and recovery from solution.** Carrier phase separations (adsorption, IX, SX). **Reactor design and** development of models for leaching, and extraction. Models are used for analysis and design of full scale hydrometallurgical operations. Case studies on hydrometallurgical extraction of gold, uranium and copper.

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

- Demonstrate an understanding of the effect of thermodynamics and kinetics in leaching and precipitation processes
- Demonstrate an understanding of the effect of different parameters on metal ions in solution
- Demonstrate an understanding of carrier phase separation methods and their optimisation
- Design specific processes for the treatment of particular pulps
- Model different phase separation mechanisms for multistage operations
- Analyse full-scale hydrometallurgical operations

Revision 1: September 2011
Next Revision: September 2015

Module Title:	PROCESS CONTROL
Code	TMLC3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLP3732 Process and Materials Design

Content: Control objectives (stability, optimisation and safety) and methodology for control system design. Industry-wide conventions and terminology for effective multidisciplinary communication. Mathematical modelling of processes. Block diagrams. Stability criteria, feedback controller design for Single Input Single Output (SISO) systems. Extensions to multivariable systems. Cascade, feed-forward model-based and other specialised control systems. Digital simulation of dynamic systems.

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

- Demonstrate an understanding of objectives and industrial conventions of process control
- Recommend appropriate instrumentation to effect process control in a given system
- Model different processes, and undertake simulations under different conditions
- Demonstrate an understanding of specialised control systems

Revision 1: September 2011
Next Revision: September 2015

Module title:	RESEARCH PROPOSAL
Code	TMLR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1 September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TMLR3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TMLR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	METALLURGICAL DESIGN PROJECT
Code	TMLD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place twice by their Lecturers.

Revision 1: September 2011
Next Revision: September 2015

OPTION 2: PHYSICAL METALLURGY

SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STRUCTURE AND PROPERTIES OF MATERIALS
Code	TMLP3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLE3791 Solidification Heat Treatment and Microstructure TMLP3791 Materials Technology

Content: Dislocation theory: Effect of dislocations on mechanical properties. Relationship of dislocations, stacking faults, grain boundaries and second phase particles on strengthening. Effect of different types of interface. **Phase Transformations:** Role of diffusion, nucleation and growth on solid state transformations. Mechanisms and kinetics of phase transformations (especially in steels). **Strengthening Mechanisms in Alloys:** Alloying additions (especially for steels). Improvement of mechanical properties by work-hardening, solid solution strengthening, dispersion strengthening and grain size. Effects of metastable precipitates (especially in aluminium-based alloys). Phase proportions and morphology (especially for titanium-based alloys). **Composites:** Application of general principles and mechanisms of strengthening of composites to design the structure and processing, taking fracture mechanisms into account. Relation of matrix and fibre/particle properties to manufacturing techniques and optimisation of the processing. Typical failure mechanisms. Optimisation of process and properties of hard metals through understanding the microstructure. **Ceramics:** Processing considerations. Effect of purity and grain size. Examples of different ceramics and their failure mechanisms. **Polymers:** Application of knowledge of structures, types (elastomers, thermoplastics and thermosets), components (fillers, plasticisers), shaping methods, and failure mechanisms to understand and utilise materials. Application of computer software (CaRIne) to aide understanding of three-dimensional crystal structures of metallic and ceramic materials.

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

- Demonstrate an understanding of the effect of dislocation in strengthening of materials
- Demonstrate an understanding of the effect of phase transformations in the strengthening of materials, especially in steels, aluminium alloys
- Demonstrate an understanding of the effects of microstructural morphology (such as grain size and particle distribution) on properties
- Demonstrate an understanding of how composites function and calculate mechanical properties for composites
- Demonstrate an understanding of the effect of processing on the properties of ceramics and recommend processing routes for specified ceramics
- Demonstrate an understanding of the available strengthening mechanisms in polymers and their different failure modes

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CORROSION AND WEAR
Code	TMLE3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLP3721 Metallurgical Thermodynamics II

Content: Understanding and use of general corrosion theory, including electrochemistry, thermodynamics and kinetics. Identification of different corrosion forms and passivity, and a knowledge of the fundamental mechanisms involved in each case, as well as application of corrosion principles in the understanding of the corrosion situations. Experience in various corrosion testing methods. Design against corrosion by using cathodic and anodic protection, material selection, application design, environmental control and surface treatments. Understanding tribological principles: friction, wear and wear mechanisms and lubrication. Application of various aspects of surface engineering such as surface modifications and surface coatings.

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

- Identify the common corrosion processes
- Demonstrate an understanding of the principles of electrochemistry and corrosion
- Recommend processes to reduce or avoid corrosion
- Identify the different wear mechanisms
- Demonstrate an understanding of the interplay between abrasive and wear in specific environments
- Recommend processes to reduce wear

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FRACTURE MECHANICS
Code	TMLP3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMLP3791 Materials Technology TMLP3741 Non Destructive Testing of Materials

Content: Brittle Fracture and Ductile Failure: Factors that influence fracture, ductile-to-brittle transition, fractographic features associated with brittle fracture and ductile failure. Microstructural effects on toughness. **Linear Elastic Fracture Mechanics**. Role of stress concentrations. Energy approach to fracture. Stress intensity factors. Crack tip plasticity. **Elastic Plastic Fracture Mechanics. Fatigue Failure:** Fatigue mechanisms in metals and non-metallic materials, fractographic features of fatigue, fatigue in welded structures, designing against fatigue. Importance of design detailing. **Failure analysis:** Importance of analysing failure, causes of failure, typical failure analysis case studies, non-destructive inspection in failure analysis.

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

- Discuss the causes of brittle fracture and ductile failure and characteristic features of these failure modes
- Identify the probable mode of failure from fractographic inspection of failed components
- Demonstrate knowledge of Linear Elastic Fracture Mechanics and Elastic Plastic Fracture Mechanics
- Discuss mechanisms of fatigue failure and fractographic features of fatigue in materials and in welded structures.
- Demonstrate knowledge of designing against fatigue and design detailing.
- Discuss causes of failure and principles of failure analysis
- Demonstrate knowledge of application of non-destructive inspection in failure analysis

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CARBON ENGINEERING
Code	TMLP3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMLP3792 Energy and the Environment
Co-requisite(s)	TMLP3742 Crystal structure and analysis

Content: Allotropy in Carbon: graphite structure and properties, diamond structure and properties. **Coal and Coke:** characteristics, uses, availability, international market trends. **Carbon fibres**: manufacture, characteristics, properties and uses. Carbon fibres for composite applications. **Carbon nanotubes**: science behind carbon nanotubes, manufacture, characteristics, properties and uses.

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

- Distinguish between graphite and diamond from their structure and characteristics
- Describe characteristics and uses of carbon fibres with emphasis on composite reinforcement
- Describe characteristics and uses of carbon nanotubes with emphasis on industrial applications

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FORMING AND WELDING PROCESSES
Code	TMLP3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLE3791 Solidification, Heat Treatment and Microstructure; TMLP3791 Materials Technology

Content: Casting as a forming process; gating and feeding systems. Metal fluidity. Design of castings. Casting defects. Important casting processes including continuous casting. **Lab exercises** on casting simple components. Use computer software in designing castings. **Mechanical forming of materials**; Yield phenomena: aging; role of carbon, nitrogen and other alloying elements; texture and grain structure. Hot and cold forming. Formability. Wire drawing. Extrusion. Rolling. Deep drawing. Forging. Defects in wrought metals. **Welding processes**; control and practical applications. Pool interactions. Residual stresses. **Weld metallurgy**. Weld defects. Designing against failure of welds.

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

- Demonstrate familiarity to the common welding processes
- Specify welding processes for specific operations
- Demonstrate an understanding of the metallurgical effects of welding on different alloys
- Demonstrate familiarity with the common casting and mechanical forming processes
- Demonstrate appreciation for the mechanical properties of castings
- Demonstrate an understanding of the interplay between hot and cold processes and product processes
- Specify mechanical forming processes and heat treatments to generate specific properties

Revision 1:	September 2011
Next Revision:	September 2015

Module title:	RESEARCH PROPOSAL
Code	TMLR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMER3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TMLR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**METALLURGICAL DESIGN PROJECT**
Code	TMLD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

N. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

N.1. DEGREE NAME: Bachelor of Science in Mining Engineering (Honours) 19BMNE

N.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.

N.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 – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	*TEGT3521*	*5*	*8*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	*UCSI3580*	*5*	*8*	*None*
Total Credits Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credits Semester II				**80**	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN MINING ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGM3592 **TEGM3591**
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Engineering Mechanics II	TEGT3641	6	**8**	TEGT3592
1	Introduction to Mining Engineering	TMNE3661	6	8	**TEGT3521**
1	Computer Aided Drawing	TEGT3661	6	8	TCME3521 **TEGT3591**
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Statistics for Engineers	TEGS3691	6	12	TEGT3571
Total Credits Semester III				**68**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGT3671**
2	Structural Geology	TMNE3622	6	8	TMNE3621
2	Thermo Fluids	TMNE3632	6	16	**SCHM3512**
2	Engineering Materials	TMEM3622	6	8	TEGT3562
2	Electrical Machines & Drives	TECE3622	6	8	**TEGT3541**
2	Surveying for Engineers	TCVE3642	6	8	**TEGM3591**
2	Strength of Materials	TMEE3622	6	8	**TEGT3592**
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**72**	

YEAR 3 OF BSc IN MINING ENGINEERING – 148 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Hydrogeology	TMNU3761	7	8	**TEGT3672** TMNE3622
1	Excavation Engineering	TMNE3711	7	16	**TMNE3661**
1	Mine Equipment and Machinery	TMNS3791	7	12	**TMNE3661**
1	Mine Ventilation and Climate Control	TMNU3741	7	8	TMNE3632
1	Mine Management Principles	TMNS3721	7	8	TEGT3521
1	Soil and Rock Mechanics	TMNU3791	7	12	**TMNE3621**
Total Credits Semester V				**72**	

YEAR 3 OF BSc IN MINING ENGINEERING – Semester 2

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Experimental and Research Methods	TEGT3762	7	8	**TEGS3691**
2	Surface Mining	TMNS3762	7	8	TMNE3711 TMNS3791
2	Mine Surveying	TMNU3722	7	8	TCVE3642
2	Computer Applications in Mining	TMNU3792	7	12	**TEGT3661** **TCME3621**
2	Mineral Processing	TMNS3742	7	8	**TMNE3661**
2	Technical Valuation	TMNU3742	7	8	EGS3691
2	Mine Design I	TMNS3712	7	16	**TEGS3691** TMNS3791
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**76**	

YEAR 4 OF BSc IN MINING ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Mine Safety, Health and Environment	TMNU3821	8	8	**TMNU3741** TMNS3762
1	Mine Design II	TMNU3841	8	8	TMNS3712
1	Underground Mining	TMNU3811	8	16	**TMNE3711** TMNS3762
1	Rock Engineering	TMNS3861	8	8	**TMNU3791**
1	Financial Valuation	TMNS3821	8	8	**TMNU3742** **TEGT3761**
1	Coal Mining	TMNE3841	8	8	**TMNE3711**
1	Research Proposal	TMNR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Research Project	TMNR3892	8	30	All 3rd Year Mod TMNR3891
2	Mining Design Project	TMND3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

TOTAL CREDITS FOR BSc IN MINING ENGINEERING (HONOURS) **584**

N.4. DETAILED COURSE CONTENT FOR BSc IN MINING ENGINEERING (HONOURS)

YEAR 1 OF BSc IN MINING ENGINEERING

SEMESTER I

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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 & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	WORKSHOP PRACTICE
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100%[Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Revision 1: **September 2011**
Next Revision: **September 2015**

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems .Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information
- Describe the principles of a transformer and the basic AC generator and DC motors
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date: September 2012
Next Revision: September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Solve calculus problems using integration by parts and the reduction formula technique
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1st order and 2nd order differential equations
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1: September 2011
Next Revision: September 2015

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%, 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 the 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 2009
Next Revision: January 2013

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

Content: Statics: 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. Analysis of frames and machines. **Virtual work**.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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 2009
Next Revision: January 2013

YEAR 2 OF BSc IN MINING ENGINEERING
SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	INTRODUCTION TO ENGINEERING GEOLOGY
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Module Description: 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:

- Describe composition and properties of common minerals and rocks
- Describe the nature of the interior of the earth and the plate tectonic theory
- Describe weathering processes and soil formation processes
- Demonstrate basic knowledge of geo-hydrology

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	INTRODUCTION TO MINING ENGINEERING
Code	TMNE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521Fundamentals of Engineering

Content: Introductory concepts: Role of mining in human civilisation; Mining terminology applied in surface and underground mining and mineral processing; stages in the life of a mine**. Minerals and ores**. Mineral deposits. The economic significance of the Namibian Mining Industry. **Structure of the Namibian Mining Industry**. Drilling equipment, tunnelling, and explosives and magazines. Shallow and deep mining. Blasting and loading equipment. **Rock transportation systems and their applications**. Diamond and Gold mining technologies and methods. **Introduction to mine safety**, mine ventilation, use of explosives and accessories, strata control. Environmental considerations. **Mine visits**.

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

- Demonstrate an understanding of basic mining terminologies
- Demonstrate knowledge of the Namibian mining industry and Namibian mineral deposits
- Describe various mining methods and mining equipment
- Describe various mine transportation methods
- Demonstrate knowledge of mine safety and mine environmental issues

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Contents: Probability: 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; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations: Modelling** with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**STRUCTURAL GEOLOGY**
Code	TMNE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNE3621 Introduction to Engineering Geology

Module Description: 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: Upon completion of this module, students should be able to:

- Describe processes leading to the formation of folds and faults
- Describe ore forming processes and the classification of ore deposits
- Demonstrate knowledge of the world's major ore deposits
- Demonstrate knowledge of African geology
- Interpret geological maps

Revision 1: September 2011
Next Revision: September 2015

Module Title:	THERMO FLUIDS
Code	TMNE3632
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SCHM3512 Chemistry 1B

Contents: 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. **Application of first law to flow processes;** continuity equation, 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. 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; flow measurement. **Hydraulic systems**: Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram); general loss coefficients; elementary analysis of fluid machinery; interaction of pump in system; pipe networks (simple branching circuits, single node reservoir systems, Hardy Cross method for pipe reticulation systems). **Laminar viscous flow**: Differential equations of motion; torsional viscometer; applications (flow with pressure gradient between parallel plate, pipe and channel flows, damper systems).

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

- Describe the first law of thermodynamics and its applications to non-flow and flow processes
- Describe the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
- Describe and quantify the properties of working fluids
- Interpret and use thermodynamic property diagrams
- Describe the equation of state of a perfect gas

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING MATERIALS
Code	TMEM3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3562 Materials Science

Content: Properties of materials: Review of mechanical properties. Thermal properties. Practical methods of determining mechanical properties. **Classification of steels and cast irons**: plain carbon, alloy and stainless steels. Grey, nodular and austempered ductile cast irons. **Technical heat treatment of steels**: annealing, normalizing, quench hardening, tempering, austempering, martempering. Hardenability; Jominy end-quench test. Other strengthening methods: solid solution hardening, strain hardening, cold working, annealing and recrystallization, precipitation-hardening. **Non-ferrous alloys**: copper, aluminium, titanium, nickel and their alloys. **Non-metallic materials:** engineering polymers and plastics, composites, introduction to ceramics.

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

- Demonstrate an understanding of the various mechanical and thermal properties of materials.
- Describe methods of determining mechanical properties.
- Distinguish between various classes of steels and cast irons and their uses.
- Demonstrate knowledge of the various techniques used to harden and strengthen metallic materials.
- Describe the characteristics and uses of non-ferrous metals and alloys based on aluminium, copper and titanium.
- Describe the characteristics and uses of non-metallic materials such as plastics, composites and ceramics.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TECE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Contents: Introduction to electrical machinery*:* review of magnetic circuits, 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***:* 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, semi-conductor operation of induction machines, energy recovery techniques.

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

- Describe the principle of operation of electrical machinery
- Describe the principle of operation of DC machines such as DC motors, generators, drives.
- Describe the principle of operation and applications of transformers and AC windings
- Describe the principle of operation and applications of three-phase induction machines

Revision 1: September 2011
Next Revision: September 2015

Module Title	SURVEYING FOR ENGINEERS
Code	TCVE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

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-lateration; tri-highting; 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:

- Demonstrate knowledge of the overview of surveying and its applications to engineering
- Describe the various techniques and tools used in practical surveying
- Demonstrate knowledge of GPS survey systems
- Demonstrate knowledge of surveying calculations
- Use contour and surface modelling software in surveying exercises

Revision 1: September 2011
Next Revision: September 2015

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress and strain, shear stress and strain, thermal stress and strain. **Analysis of stress and strain.** Plane stress and plane strain. **Bending:** Revision of shear force/bending moment distributions, bending stress. Symmetrical and unsymmetrical bending. Inelastic bending. Residual stresses.**Transverse shear**: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **Torsion:** Torsion of circular sections, solid non-circular shafts, Thin-walled tubes. **Combined Loading**: bending and direct stresses, bending and torsional stresses. **Transformation of stresses and strains**. Mohr's circle.

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

- Demonstrate the application of Hooke's Law to normal and shear stresses.
- Analyse stresses and strains in two and three dimensions with cases of plane stress and plane strain.
- Analyse bending stresses in beams under symmetrical and unsymmetrical loading.
- Solve problems involving shear stresses and shear flow in beams.
- Analyse stresses and strains in circular shafts and tubes subjected to torsion.
- Analyses cases of combined loading involving bending, direct and torsional stresses.
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle.

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN MINING ENGINEERING

SEMESTER 1

Module Title:	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. Introduction to budgeting. Introduction to marketing. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title	**HYDROGEOLOGY**
Code	TMNU3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50%; (1 x 2 hour paper)
Pre-requisite(s)	TEGT3672 Engineering Mathematics IV
Co-requisite(s)	TMNE3622 Structural Geology

Content: 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 & optimum pumping rates; solute transport in aquifers: diffusion; advection; dispersion; retardation; sorption reactions; redox reactions; cation exchange; carbonate dissolution & precipitation reactions. **The advection-dispersion equation**; mass transport with reaction; first order kinetic reactions; equilibrium sorption reactions. **Groundwater flow modelling**: types of groundwater flow models; governing equations; numerical and analytical techniques; conceptual model design; boundary conditions; initial conditions; steady state and transient simulations; model calibration; sensitivity analysis; predictive modelling; finite difference and finite element models; different types of computer codes. **Contaminant hydrogeology**: contaminant plumes; fluid tracer tests; multiphase fluid systems. **Groundwater and ore deposits**: roll-front uranium deposits; saline soils and evaporates; groundwater exploration and management; groundwater resource evaluation and budgets; conjunctive use of groundwater and surface water; groundwater pollution processes.

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

- Demonstrate understand of the mechanics of groundwater recharge and its analysis.
- Describe the theory of aquifer hydraulics and be able to model underground aquifers and evaluate them.
- Describe reactions governing underground solutions
- Describe the effect of groundwater and its pumping on underground openings.
- Design pumping systems and sequences for underground mining purposes.
- Demonstrate methods of controlling and predicting contamination levels of underground water by minerals and other solutions.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	EXCAVATION ENGINEERING
Code	TMNE3711
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMNE3661 Introduction to Mining Engineering

Content: Powering systems: Fundamentals of powering systems for machines: electrical, pneumatic, hydropower 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 drum shearers, tunnel and shaft borers, rotary drilling. **Mechanics of impact breaking.** Application in terms of machine design, operation and impact breaking machines for hard rock tabular mining.
Rock drilling and explosives: Principles of rock drilling, percussive drilling, rotary drilling, drilling machines and consumables, drilling cost. History, classification and composition of explosives, chemical and physical characteristics, 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:** Stoping practice, sequential firing, ring blasting, development and shaft sinking. **Surface mining blasting:** practical applications: bench blasting, initiation patterns, drilling patterns, ground vibrations and air blast.

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

- Describe various powering systems used in the mining industry
- Describe the various techniques of mechanical excavation of rock and earth matter
- Demonstrate knowledge of the mechanics of impact breaking of solid materials
- Demonstrate knowledge of rock drilling and use of explosives in mining
- Describe various rock breaking and blasting techniques
- Demonstrate knowledge of blasting techniques for underground and surface mining

Revision 1: September 2011
Next Revision: September 2015

Module Title	MINE EQUIPMENT AND MACHINERY
Code	TMNS3791
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TMNE3661 Introduction to Mining Engineering

Content: 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**: (a) Conveyor systems: conventional, cable belt, pipe conveyor, high angle conveyors, calculation of power requirements and carrying capacity of belts. (b) Chairlifts. (c) Underground scraper winch systems and loaders. (d) Railway tramming systems for rock, men and material. (e) Loading machines: rope shovels, hydraulic mining shovels, bucket excavators and draglines, dredges, front end loaders, trackless load haul dump units. **Selected topics**: (a) Off highway haul trucks and traceless haul trucks. (b) Mine water distribution service, collection, treatment, storage and pumping. (c) Pneumatic conveying of solids in pipelines. (d) Underground powered supports and coal cutters.

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

- Demonstrate an understanding and knowledge of modern mining machinery and mine transportation systems
- Design and select appropriate underground mining machinery equipment and systems for loading and hauling
- Analyse and control haulage operations (belt conveyors, hoists, trucks, railways)
- Describe fluid power systems in mining (hydraulics, pumps, piping networks, compressors, pneumatic equipment).
- Describe electrical systems (electrical machinery, distribution networks, controls) as used in mining operations
- Describe the principles of materials handling and power system consideration and performance

Revision 1: September 2011
Next Revision: September 2015

Module Title	MINE VENTILATION AND CLIMATE CONTROL
Code	TMNU3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	TMNE3632 Thermofluids

Content: Ventilation: air availability in mines, determination of quantities of air required in the mines, presence of other gases. Mechanics of fluids, Bernoulli equation, airflow in airways, ventilation networks, regulators, booster fans, fan characteristics, fans in series and parallel. Different ventilation systems. Application of ventilation software. **Deep level mining climate control**: Psychrometry, heat, acclimatization, refrigeration, cooling plant, cooling towers, spray chambers, ice plant. **Typical ventilation systems** in a coal mine, gold mine and uranium mine.

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

- Demonstrate an understanding determination air quantity required in mines
- Describe and apply the principles of fluid flow to ventilation systems.
- Describe and apply fan behaviour to ventilation systems.
- Design a ventilation system for a mine.
- Describe environmental hazards found in mines and outline the control measures that detect, monitor, minimise and/or manage these hazards.
- Describe typical ventilation systems in selected mines such as coal, gold and uranium mines.

Revision 1: September 2011
Next Revision: September 2015

Module Title	MINE MANAGEMENT PRINCIPLES
Code	**TMNS3721**
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2hours paper
Pre-requisite(s)	TEGT3521Fundamentals of Engineering

Content: Management Principles: History of management theory; managerial conceptual thinking; management work within the business. Organizing and determinants of organization. Planning and organisation 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.

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

- Demonstrate knowledge of general management principles
- Demonstrate an understanding of planning an organisation of mines
- Sketch a simple organisation chart of a mine
- Describe techniques of time management
- Demonstrate knowledge of industrial relations and legislation pertaining to the mining industry.
- Describe principles and functions of risk management
- Demonstrate knowledge of the Mine Health and Safety Act.

Revision 1: September 2011
Next Revision: September 2015

Module Title	SOIL AND ROCK MECHANICS
Code	TMNU3791
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	TMNE3621 Introduction to Engineering Geology

Content: Simple soil properties; classification of soils and rocks. Soil profiles, site exploration, drilling and sampling. Compaction of soils, shear strength, settlement, bearing capacity, slope stability, 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: Upon completion of this module, students should be able to:

- Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
- Demonstrate knowledge of the strength and deformation characteristics of rock masses
- Describe useful mechanical properties of rock masses
- Describe failure criteria for rocks and rock masses

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis.**

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data

Revision 1: September 2011
Next Revision: September 2015

Module Title:	SURFACE MINING
Code	TMNS3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNE3711 Excavation Engineering, TMNS3791 Mine Equipment and Machinery

Content: Introduction to open-pit mining; factor affecting the selection of open pit mining; **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; 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 & purchase; type life; cycle times. Practical exercises.

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

- Demonstrate a clear understanding of surface mining technologies (open pit) and their design and operations
- Design of granite quarries for production of aggregates and dimension stones
- Design layouts for strip mining of coal and include important economic and environmental considerations
- Describe the technology for marine mining and include important economic and environmental considerations

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MINE SURVEYING
Code	TMNU3722
NQF Level	7
Contact Hours	2L + 1T or 1 PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCVE3642Surveying for Engineers,

Content: Mine surveying: introduction to the importance of mine surveying in the efficient and safe running of a mine; principles of surveying and mine surveying. **Surveying 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 plans**. 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 & 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: Upon completion of this module, students should be able to:

- Describe principles of surveying as applied to mines
- Demonstrate knowledge of producing and analysing plans, maps and photographs of mines
- Demonstrate knowledge of interpreting map projections, geometrical constructions and diagonal scales
- Demonstrate ability to work with rectangular and polar coordinates for contours and cartographic sections
- Demonstrate detailed knowledge of underground mine surveying methods
- Analyse and interpret mine surveying data for decision making
- Demonstrate practical knowledge of surveying in the field
- Analyse map projections and interpret mine surveying data

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COMPUTER APPLICATIONS IN MINING
Code	TMNU3792
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3661 Computer Aided Drawing; TCME3621 Computer Science for Engineers

Module Description: 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 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: Upon completion of this module, students should be able to:

- Demonstrate application of Computer Aided Drawing in the mining industry
- Demonstrate knowledge of GIS, Contouring packages and MATLAB in the mining industry
- Demonstrate knowledge and application of mining software like Surpac, MinSched and others.
- Demonstrate knowledge of computer applications for mine design.

Revision 1: September 2011
Next Revision: September 2015

Module Title	MINERAL PROCESSING
Code	TMNS3742
NQF Level	7
Contact Hours	**2**L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper
Pre-requisite(s)	TMNE3661 Introduction to Mining Engineering

Content: Comminution: role of comminution. Comminution laws. Basic principles of crushing and crushing equipment; grinding and grinding equipment. Screening and sieve analysis. Classification .**Concentration**: gravity concentration and equipment, magnetic and electrostatic separation and equipment, floatation: principles, **Solid and Liquid separation**: sedimentation, thickening and filtration. Basic flowsheet design for selected minerals coal preparation, heavy sands processing etc. **Basic Extractive Metallurgy:** pyrometallurgy, hydrometallurgy, electrometallurgy.

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

- Demonstrate an understanding of the role of comminution in liberation of minerals
- Demonstrate an understanding of the processes involved in size reduction of minerals
- Describe the principles of concentrating valuable minerals
- Demonstrate an understanding of the principles involved in solid-liquid separation
- Design simple flowsheets for mineral processing
- Demonstrate an understanding of the basic methods of extracting metals from concentrated ores.

Revision 1: September 2011
Next Revision: September 2015

Module Title	TECHNICAL VALUATION
Code	TMNU3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Statistical valuation methods: Overview of descriptive statistics; inference from normal distributions, estimation of mean and standard deviation, confidence levels on parameters, hypothesis testing. Student's T and F-ratio's tests, correlation and regression methods, tests of significance, multivariate regression and trend surface analysis, inference from lognormal distributions, estimation of mean and confidence levels. Grade/tonnage curves. **Geo-statistical valuation methods**: inverse distance techniques, calculation and modelling of semi-variograms, estimation of unknown values, ordinary and universal rigging, volume/variance relationships. **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: Upon completion of this module, students should be able to:

- Demonstrate an understanding of statistical valuation methods and how to apply them
- Demonstrate an understanding of the various methods of geo-statistical valuation in the mining context
- Apply geo-statistical methods in the valuation of mines

Revision 1: September 2011
Next Revision: September 2015

Module Title	MINE DESIGN I
Code	TMNS3712
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	EGS3691 Statistics for Engineers
Co-requisite(s)	TMNS3791 Mine Equipment and machinery

Module Description: 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 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.

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

- Demonstrate knowledge of surface mining systems
- Determine the working platform and optimum depth
- Design a surface mine e.g. a granite quarry
- Design and construct explosive magazines magazine

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN MINING 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice
- Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MINE SAFETY, HEALTH AND ENVIRONMENT
Code	TMNU3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMNU3741 Mine Ventilation and Climate Control
Co-requisite(s)	TMNS3762 Surface Mining

Content: Mine Safety and Health: Safety organization in mines; causes of mine accidents; accident statistics and records keeping; industrial hygiene; basic first aid; analysis of health and safety problems in the Namibian mining industry. **Mine environment**: Mine dust, mine gases, mine fires, mine water, noise, illumination, mine air, radioactive and toxic substances. Health, safety and environmental issues in the mining of radioactive substances like uranium. **Mine Communication. Mine Law and Regulations**: Mining and the environment; mining legislation. Minerals (Prospecting and Mining) Act; mineral rights. **Environmental issues**: Environmental Impact Assessment (EIA); pollution control; rehabilitation, mine closure. **Case Studies**: Typical case studies on health and safety problems in mines.

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

- Demonstrate knowledge of safety and health issues at the mine and how to control them
- Demonstrate knowledge of environmental issues of mining projects and how to control them
- Describe various techniques used in mine communication
- Demonstrate basic knowledge of legal aspects of mining safety and the environment as stipulated in the Minerals (Prospecting and Mining) Act
- Demonstrate basic knowledge of mineral rights and the general mine law
- Describe procedures for carrying out environmental impact assessment (EIA) of mine projects

Revision 1: September 2011
Next Revision: September 2015

Module Title:	MINE DESIGN II
Code	TMNU3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%Examination 50% (1 x 2 hours paper)
Co-requisite(s)	TMNS3712 Mine Design I

Module Description: Opening of mineral deposits during the design of mine. Factors to be considered during the location of shafts .Shaft selection and location. Shaft design and construction. Development of mine fields (levels, panels, combined methods etc). Design of different underground mining methods for different types of deposits. Design of ventilation system in an underground mine. Design of supports system, wood nut, and bolt and steel arch supports. Design of ventilation systems. Application of software packages to mine design.

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

- Demonstrate an understanding of location of a shaft during the opening of a mine
- Design or select an appropriate method of development of a mine
- Design support systems in an underground mine
- Design of ventilation system of a typical underground mine
- Apply software packages in mine design

Revision 1: September 2011
Next Revision: September 2015

Module Title	UNDERGROUND MINING
Code	TMNU3811
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TMNE3711 Excavation Engineering
Co-requisite(s)	TMNS3762Surface Mining

Content: Historical and present-day methods of exploitation of hard rock mineral deposits; selection of mining techniques; location of shafts. Shaft sinking; shaft station layouts. Major development layout; level, horizon and panels methods of development. Conventional and specialised development. Mining systems. Methods of extraction of deposits, short-walls and long-walls mining systems. Mine design parameters. Mining processes in underground operations. **Mechanization of operations and special technologies**. Design: practical design exercises for exploiting tabular ore deposits. **Exploitation of massive ore bodies**: open stopping, room and pillar mining, cut and fill stopping, shrinkage mining, post pillar cut and fill mining, block caving, continuous block caving, forced caving, sublevel caving, sundry mining methods. **Trackless mining**: selection and operation of underground trackless equipment for massive mining. Practical design exercise.

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

- Demonstrate an understanding of shaft locations
- Demonstrate an understanding of mine development methods
- Design and select mining methods and specify parameters for safe underground extraction
- Describe different design techniques and mechanical technologies used in massive mining
- Demonstrate an understanding of the mining systems and factors to be considered for safe working environment.

Revision 1: September 2011
Next Revision: September 2015

Module Title	ROCK ENGINEERING
Code	TMNS3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	TMNU3791 Soil and Rock Mechanics

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

- Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
- Demonstrate knowledge of the strength and deformation characteristics of rock masses
- Describe useful mechanical properties of rock masses
- Describe failure criteria for rocks and rock masses

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FINANCIAL VALUATION
Code	TMNS3821
NQF Level	8
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMNU3742 Technical Valuation, TEGT3761 Fundamentals of Economics

Content: 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.

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

- Demonstrate an understanding of financial management and financial analysis principles
- Describe various funding sources and funding mechanisms for mines
- Describe current trends in the metals and minerals markets
- Demonstrate a clear understanding of the applications of financial analysis in mining project
- Apply financial analysis in the decision making process

Revision 1: September 2011
Next Revision: September 2015

Module Title:	COAL MINING
Code	TMNE3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMNE3711 Excavation Engineering;

Content: Coal mining methods: the safe and efficient exploitation of underground coal deposits by means of board and pillar, pillar extraction, rib-pillar, short wall, long wall and specialized thick- and thin-seam techniques. **Coal mining equipment**, panel design and production potential. **Coal as a commodity**: coal quality, coal utilization and marketing. **Design**: geological modelling of a coal deposit from borehole longs, market identification, plant design, mine design, layout scheduling and financial valuation of a coal mine.

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

- Understand the different methods of coal mining
- Select appropriate coal mining equipment; plan mine layouts and describe coal treatment
- Use appreciate computer software for geological modelling of coal deposits
- Design a coal mine and coal plant and carry out scheduling and financial valuation

Revision 1: September 2011
Next Revision: September 2015

Module title:	RESEARCH PROPOSAL
Code	TMNR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1 September 2011
Next Revision: September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMNR3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	**Continuous 100%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TMNR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**MINING DESIGN PROJECT**
Code	TMND3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015

CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN TELECOMMUNICATION ENGINEERING (HONOURS)

O.1. DEGREE NAME: Bachelor of Science in Telecommunication Engineering (Honours) 19BTCE

O.2 AIM

The curriculum for the degree of Bachelor of Science in Telecommunication Engineering (Honours) aims at producing Graduate Engineers with knowledge and skills in telecommunication engineering, and who can competently work in telecommunication systems design and applications, microwave Communication, satellite communication, television and radio broadcast, telephone/mobile communication, wireless networking and related service industries.

O.3 CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Telecommunication 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 TELECOMMUNICATION ENGINEERING - 156 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGP3590	5	4	None
1	*Fundamentals of Engineering*	*TEGT3521*	*5*	*8*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	*Contemporary Social Issues*	*UCSI3580*	*5*	*8*	*None*
Total Credits Semester I				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Materials Science	TEGT3562	5	8	None
2	Physics *for Physical Sciences* II	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3519*	*5*	*16*	*None*
Total Credit Semester II				**80**	

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 TELECOMMUNICATION ENGINEERING – 144 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	**TEGT3541**
1	Analogue Electronics I	TETE3691	6	12	**TEGT3541**
Total Credits Semester III				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE**&CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Signals and Systems	TTCE3692	6	12	TEGT3671
2	Applied Electromagnetics	TTCE3622	6	8	**SPHY3512**
2	Telecommunication Principles	TTCE3642	6	8	**TEGT3541**
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	**TEGP3590**
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN TELECOMMUNICATION ENGINEERING - 144 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Electric Circuit Analysis II	TECE3791	7	12	**TECE3691** TEGT3671
1	Analogue Electronics II	TETA3791	7	12	**TETE3691**
1	Measurements and Instrumentation	TETA3721	7	8	**TETE3691**
1	Radio Wave Propagation and Antennae	TTCR3791	7	12	TTCE3622
1	Telecommunication Switching and Network Systems	TTCC3791	7	12	**TEGS3691** TTCE3642
1	Digital Communication	TTCD3791	7	12	**TEGS3691** TTCE3642
Total Credits Semester V				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE**& CO-REQUISITE
2	Experimental and Research Methods	TEGT3762	7	8	**TEGS3691**
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Embedded Systems Design I	TETD3792	7	12	TETD3692
2	Radio Frequency and Microwave Engineering	TTCC3772	7	16	TTCR3791
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Telecommunication and Wireless Systems	TTCE3752	7	16	**TTCE3642** TTCD3791
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**68**	

YEAR 4 OF BSc IN TELECOMMUNICATION ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Project Management	TEGM3861	8	8	**TEGT3761**
1	Digital Signal Processing	TTCD3831	8	16	**TTCE3692**
1	Telecommunication Network Planning	TTCE3851	8	16	**TTCR3791** TTCE3752
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Radio Spectrum Management	TTCC3891	8	12	TTCE3752
1	Research Proposal	TTCR3891	8	4	TEGT3762
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE& CO-REQUISITE**
2	Research Project	TTCR3892	8	30	All 3rd Year Mod TTCR3891
2	Telecommunication Design Project	TTCD3892	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

TOTAL CREDITS FOR BSc IN TELECOMMUNICATION ENGINEERING (HONOURS) **584**

O.4 DETAILED COURSE CONTENT FOR BSc IN TELECOMMUNICATION ENGINEERING (HONOURS)

YEAR 1 OF BSc IN TELECOMMUNICATION ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

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. **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.

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

- Solve basic mathematics and engineering problems using vectors and matrices
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation and integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
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. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of civil engineering drawings.

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

- Competently use standard equipment for technical drawing
- Sketch engineering components free hand or with the aid of drawing equipment
- Present engineering components as drawings in orthographic and isometric projections
- Use sections, interpenetration and development to produce clear engineering drawings
- Produce parts drawings and assembly drawings of various engineering components
- Use codes of practice for mechanical engineering and civil engineering drawing

Revision 1: September 2011
Next Revision: September 2015

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

Content: Units, significant figures & scientific notation; vectors: properties, components, unit vectors, products; average & 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 & impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight & gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature & 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 gases.
- Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date: January 2009
Revision: January 2013

Module Title:	**COMPUTING FUNDAMENTALS**
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%; Examination 40% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Overview of **Windows Operating System** environment. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Other operating Systems** like Linux and MAC. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra, Fundamental logic circuits. Information representation in computers. **Computer Network Fundamentals.** Introduction to the **Internet and email. Introduction to web development tools.**

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**WORKSHOP PRACTICE**
Code	TEGP3590
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
NQF Credits	4
Assessment	Continuous: 100% [Practical Exercises (**70%**); Written Reports on the Various Workshops (**30%**)]
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components.

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

- Describe general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Fabricate a prescribed component using the principles of carpentry/woodwork.
- Make basic wall structures using brick work, cement and mortar.
- Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of a four-stroke internal combustion engine.
- Construct basic electric circuits and use then to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Historical perspective of engineering: Evidence of engineering practice through the ages in Africa, particularly in Namibia. Examples of African indigenous engineering processes and technologies. **Introduction to Engineering as a profession**. Common traits of good engineers; Engineering disciplines and engineering organizations. Engineering problems and fundamental dimensions. Engineering components and systems; Physical laws and observations in engineering; Basic steps involved in the solution of engineering problems. Engineering as a means to satisfy human needs. **Communication skills and presentation of engineering work**. Length and length-related parameters. Time and time-related parameters. Mass and mass related parameters. Force and force related parameters. Temperature and temperature related parameters. Electricity. Energy and power. Some common engineering materials. **Engineering codes and standards.** Engineering symbols and abbreviations.

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

- Apply fundamental dimensions to engineering problems solving
- Demonstrate an understanding of steps involved in engineering problem solving
- Clearly distinguish between the roles of the various engineering disciplines
- Identify general steps involved in engineering design and communication
- Perform basic operations with forces and their related parameters
- Distinguish between energy and power
- Identify general classes of engineering materials
- Use general engineering codes and symbols

Revision 1: September 2011
Next Revision: June2015

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Electrical Properties: the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Electric circuits:** Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an AC waveform, AC Resistive circuit, AC Capacitive circuit, ac Inductive circuit, Capacitive reactance, Inductive reactance, The series CR and LR circuits, Impedance of series CR and LR circuits, Impedance of a series LCR circuit. Parallel impedances, AC Power, Series resonance, Parallel resonance, mutual inductance: principles of a transformer and AC generator, DC motors. Elementary simple and three phase ac systems. Basics of circuit simulation using CAD software.

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

- Distinguish between real and ideal voltage and current source
- Competently describe the electrical properties of materials and their use
- State and apply the laws and rules of electrical circuit analysis including: Ohms law, Kirchhof's current and voltage laws, current and voltage division laws, superposition theorem, Norton and Thevenin theorems for problem solving
- Apply the principles of circuit analysis to series and parallel R,L,C circuits
- Practice circuit construction/assembling (interpreting schematics) and use multi-meters and RLC meters to perform electrical measurements and do basic troubleshooting
- Demonstrate the proper techniques for performing a range of measurements in an electric laboratory environment and be able to manipulate the measured data to derive supplementary information
- Describe the principles of a transformer and the basic AC generator and DC motors
- Use laboratory equipment proficiently
- Analyse and solve electric circuits using simulation software

Revision 1: September 2011
Next Revision: September 2015

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%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite	None

Module Description: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students. It offers on an integrative and inter-disciplinary basis the six broad themes on teaching and learning strategies; norms, rules, and contact; citizenship, democracy, and common good; ethics and responsible leadership; health and human sexuality, environment and sustainability as well as stressing the interconnectedness of such issues/themes. The course shall empower students to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship, including broadening the student's scope and understanding of the environment and sustainability of the ecosystem services and how humans influence these. Therefore, critical transformative theory will under gird the content of CSI. After completion students shall be empowered and prepared to enjoy productive, meaningful careers and lives that benefit a society that increasingly resembles a global community. Flexible modes of assessment may be harnessed and may be combined with in-situ visits to appropriate sites. Compulsory attendance required.

Issue Date: September 2012
Next Revision: September 2016

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

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:

- Solve mathematical and engineering problems using partial differentiation
- Solve calculus problems using integration by parts
- Apply calculus to trigonometric functions to solve mathematical and engineering problems
- Solve engineering problems using 1st order and 2nd order differential equations
- Calculate eigenvalues and eigenvectors and relate them to engineering solutions
- Manipulate sequence and series of numbers
- Apply the binomial theorem in solving mathematical and engineering problems.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	**MATERIALS SCIENCE**
Code	TEGT3562
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	None

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Diffusion in solids**; Metals and alloys; **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. **The iron-iron carbide alloy system:** Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Mechanical properties**: Strength parameters, elastic stress-strain relationships, Hooke's Law, plastic stress-strain relationship, strengthening mechanisms, Hall-Petch equation. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Demonstrate an understanding of diffusion mechanisms in solids.
- Describe the formation of metals and alloys using binary equilibrium phase diagrams.
- Demonstrate an understanding of the various phase transformations in the Fe-Fe_3C phase system and associated microstructures.
- Describe various mechanical properties of materials and common strengthening mechanisms.
- Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation.

Revision 1:	September 2011
Next Revision:	September 2015

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%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for physical Sciences I

Content: 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 the 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 2009
Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for physical Sciences I

Content: Statics*:* 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. Analysis of frames and machines. **Virtual work**.

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

- Competently express force operations and force systems using vectors
- Define criteria for equilibrium of forces
- Produce a free body diagram from a specified engineering problem
- Analyse trusses using method of joints and method of sections
- Apply principles of static and kinetic friction in solving engineering problems
- Calculate and plot bending moment and shear force distributions in beams
- Apply the principle of virtual work in solving engineering mechanics problems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, 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 & Solubilty 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 the 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.

Revision 1: January 2009
Next Revision: January 2013

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: (60 %) 2 tests, Oral presentation, Academic Essay Writing, Extensive Reading Book Review. Examination: (40%) 1 x 3 hour examination paper)
Pre-requisite(s)	ULEG 2419, ULCE 3419

Content: Academic Listening, Comprehension and Note Taking, Basic Academic Skills, Academic Reading & 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:

- Demonstrate understanding of language print
- Practice effective writing skills
- Demonstrate official and basic academic speaking
- Demonstrate academic study skills

Issue Date: September 2011
Next Revision: September 2015

YEAR 2 OF BSc IN TELECOMMUNICATIONS ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Differential 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. **Transforms and Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series and Bessel functions. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd ordinary differential equations. An application of Fourier transforms to boundary value problems. **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. **Complex analysis**: Complex functions, derivatives, 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:

- Apply differential vector calculus to solve mathematical and engineering problems
- Use Laplace and Fourier transforms in solving differential equations
- Apply Bessel functions to solve engineering problems
- Apply functions of several variables in solving engineering problems
- Describe the basis for complex analysis in engineering problem solving
- Apply the residual theorem to engineering problems.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Particle Dynamics*:* Kinematics of particles: Laws of motion, displacement, velocity, acceleration. Rectilinear Motion, rectangular coordinates. Plane curvilinear motion: normal, tangential and polar coordinates. Constrained motion of connected particles. Motion relative to translating axes, Motion relative to rotating axes. General relative motion. Projectiles. Angular motion. **Kinetics of particles:** Newton's Second Law of Motion. Equations of motion and their solutions for rectilinear and plane curvilinear motion. Work-energy principle. Power and efficiency. Conservation of energy. Principle of linear impulse and momentum. Angular momentum. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work-energy principle. Impulse-momentum principle.

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

- Competently express motion of a body in terms of position, velocity and acceleration.
- Apply principles of kinematics and kinetics to describe motion and causes of motion.
- Use rectangular and curvilinear coordinates to solve dynamics problems.
- Analyse linear, angular, projectile and relative motion of particles and systems thereof.
- Apply equations of motion in rectilinear and plane curvilinear motion.
- Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
- Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite(s)	TCME3521 Computing Fundamentals

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 the **C++ Programming language**.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Demonstrate knowledge of MATLAB programming
- Create and use user-defined MATLAB functions
- Apply MATLAB programming for solving engineering problems
- Write programs using C++

Revision 1: September 2011
Next Revision: September 2015

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)	TEGT3591 Engineering Drawing
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3591 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:

- Competently use commands and symbols in the computer drawing environment.
- Create or use standard objects to make engineering drawings with AUTOCAD
- Merge text and dimensions with drawings generated from AUTOCAD
- Make layouts and plot drawings created by AUTOCAD

Revision 1: September 2011
Next Revision: September 2015

Module Title	STATISTICS FOR ENGINEERS
Code	TEGS3691
NQF Level	6
Contact Hours	**3**L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Probability: 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; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

- Describe the theory of probability
- Analyse data using probability distribution and densities
- Use the principles of sampling distribution to analyse data
- Apply linear regression and correlation to a set of data
- Apply analysis of variance to solve engineering problems
- Apply statistical methods in quality assurance
- Apply statistical methods in measuring reliability and life testing

Issue Date: January 2009
Revision: January 2013

Module Title	ELECTRIC CIRCUIT ANALYSIS I
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: Review of DC Circuits: Thevenin's and Norton's 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 behaviour 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. **Computer circuit analysis and simulation**

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

- Apply circuit theorems to simplify and find solutions to electrical circuits.
- Interpret, develop and design electrical engineering circuits
- Use computer simulation tools for electric circuit analysis and design
- Perform DC and AC power calculations including power factor correction;
- Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
- Analyze, simulate, and experimentally validate DC and AC circuits;

Revision 1: September 2011
Next Revision: September 2015

Module Title	ANALOGUE ELECTRONICS I
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3541, Fundamentals of Electrical Engineering

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

- Discuss the atomic structure of semiconductor materials
- Discuss the construction and operation of semiconductor diodes.
- Analyse and design diode based circuits.
- Discuss the construction of BJT transistors
- Analyse and design BJT transistor amplifier and switching circuits
- Discuss the construction of FET transistors
- Analyse and design FET biasing circuits
- Discuss the internal circuitry for op-amps
- Discuss the operation of op-amps
- Analyse and design basic op-amp circuits
- Use EDA software to analyse electronic circuits.

Revision 1: September 2011
Next Revision: September 2015

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Linear 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. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, Dirichrit 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. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, 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.

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	**SIGNALS AND SYSTEMS**
Code	TTCE3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: An introductory course covering the principles of signals and systems. The course combines lectures, MATLAB simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing. 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: Upon completion of this module, students should be able to:

- Analyse signals and systems in the time and frequency Domain.
- Classify signals and analyse their parameters.
- Discuss the operation and application of linear systems.
- Apply transformation techniques and various analysis approaches to signals and linear system.
- Design FIR and IIR filters.Carry out computer based simulations related to signals and systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	APPLIED ELECTROMAGNETICS
Code	TTCE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	SPHY3512 Physics for Physical Sciences II

Content: Review of Vector Algebra: Classification of vector fields. Electrostatic Fields: Coulomb Law & Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equation. Electric potential; relationship between E and V, Maxwell Equation. **Electric Field in Material Space**: Properties of materials, Convection and conduction current; Polarization in Dielectric; dielectric constant and strength; Continuity Equation and Relaxation Time; Boundary Conditions; Electrostatic Boundary-Value Problems; Poisson's and Laplace Equations; Electrostatic Boundary-Value Problems: Uniqueness Theorem, Procedure for solving Poisson's and Laplace equations, Resistance and Capacitance, Methods of Images **Magnetostatics**: Biot-Savart's Law; ampere Circuital Law-Maxwell Equation. Application of Ampere's Law Magnetic Flux Density-Maxwell Equation. Maxwell Equation for Static EM Fields; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices: Forces due to Magnetic Fields; Magnetic Torque and Movement. **Magnetic Forces, Material and Devices**: Magnetization in Materials. Magnetic Forces, **Material and Devices:** Magnetic Boundary Conditions. Magnetic Forces, **Material and Devices:** Inductor and Inductance; Magnetic Energy.

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

- Perform calculations involving electric and magnetic fields.
- Explain the theories and applications of electromagnetic fields and waves in engineering.
- Explain the physical meaning and significance of Maxwell's equations.
- Analyse electromagnetic and time varying fields and waves.
- Derive and apply equations related to static electromagnetic fields.
- Use Maxwell's equations to derive one law from another.

Revision 1: September 2011
Next Revision: September 2015

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3541 Fundamentals of Electrical Engineering

Content: **Basic notions and definitions**: radio spectrum, definitions and terminology: analog and digital systems; communication systems components, communication channels and their characteristics; bandwidth, Channel Capacity**,** distortion, noise and other impairments. 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. Standards Organisations.

Noise: Noise sources, noise figure and noise temperature; noise models. **Analog modulation and demodulation Technique**: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; Frequency discriminator and the envelope detector; AM and FM receiver; pre-emphasis and de-emphasis filtering; FM threshold effect; comparison of angle and linear modulation systems. **Multiplexing techniques**: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM). Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication. **Radio Propagation and antenna**.

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

- Explain the principles involved in the transmission and reception of information in a communication system.
- Discuss the architecture of a generic telecommunication systems
- Discuss and Analyse Analogue modulation process
- Discuss and analyse the effect of noise in communication systems
- Discuss and analyse the effect of radio wave propagation and antennae in a telecommunication system

Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication

Revision 1: September 2011
Next Revision: September 2015

Module Title	DIGITAL ELECTRONICS
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 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. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

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

- Discuss fundamental digital terminology.
- Perform different number systems and coding conversions.
- Describe the operation of different logic gates.
- Analyse and simplify logic equations
- Analyse and design different combinational logic circuits
- Analyse and design sequential logic circuits
- Compare the performance of different logic family devices
- Design and analyse internal circuitry of different logic families and interfaces between them.

Revision 1: September 2011
Next Revision: September 2015

Module Title	OBJECT ORIENTED PROGRAMMING
Code	TCME3692
NQF level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development. Top-down stepwise refinement approach. **Object Oriented Programming and C++**. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, producing output and providing input in a C++ program. Elements of data structures. **Evaluating C++ Expressions**. Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. **Selection Structures**. Using the **if** statement; the **Nested if**; the **switch** statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Statements**. 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; Using Pointers. **Using C++ Functions**. Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. **Using 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; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The **cin** and **cout** class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List. **Numerical Methods:** Finding Roots of Nonlinear Equations; Numerical Differentiation; Numerical Integration.

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

- Design and represent algorithm for solving given problems using flowchart or pseudo code.
- Describe concept of object-oriented programming.
- Use the top-down stepwise approach to solve engineering problems.
- Create structures and classes in respect of a particular problem
- Design the respective algorithm for the solution of the problem identified and document the design in standard UML 2.0 notation.
- Apply the problem solving techniques to computational and engineering problems.
- Apply object-oriented concepts such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism in C++ and/or other OOP language to design and implement successful programs

Revision 1: September 2011
Next Revision: September 2015

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	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Pre-requisite	TEGP3590 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 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 work places by their Lecturers at least once.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- Discuss the major industrial processes involved in a typical engineering activity associated with the students' discipline.
- Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: October 2012
Next Revision: September 2015

YEAR 3 OF BSc IN TELECOMMUNICATION ENGINEERING

SEMESTER 1

Module Title	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; 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, financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

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

- Discuss the fundamentals of microeconomics
- Discuss the fundamentals of macroeconomics
- Apply the fundamentals of financial accounting in an Engineering project
- Apply the principles of budgeting in an Engineering project
- Apply the principles of marketing an Engineering product

Revision 1: September 2011
Next Revision: September 2015

Module Title	**ELECTRIC CIRCUIT ANALYSIS II**
Code	TECE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TECE3691 Electric Circuit Analysis I
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Use of Laplace and Fourier transformations in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. One and two-port parameter presentations. Basics of network Synthesis

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

- Use principles and methods of analysis and modelling of electric circuits in the steady state.
- Apply Network theorems to the analysis of networks.
- Use of Laplace transformation and bode plots in circuit analysis
- Apply the concepts of frequency response, resonance, and network functions, two port networks including hybrid parameters.
- Synthesise network circuits to meet specifications

Revision 1: September 2011
Next Revision: September 2015

Module Title	ANALOGUE ELECTRONICS II
Code	TETA3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics

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 and feedback transistor based oscillator circuits), Power Supplies, Power electronics devices and applications.

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

- Model and analyse FETs based circuits
- Determine the frequency response of transistor based circuits
- Analyse and design op-amp and circuits
- Analyse and design different op-amp based circuits
- Analyse and design power amplifiers
- Analyse and design filter circuits
- Analyse and design oscillator circuits
- Analyse and design ADC and DAC circuits
- Analyse and design switching circuits employing basic power electronics components

Revision 1: September 2011
Next Revision: September 2015

Module Title	MEASUREMENTS AND INSTRUMENTATION
Code	TETA3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TETE3691 Analogue Electronics I

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, Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Data Acquisition systems.

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

- Explain different types and methods of measurement.
- Discuss static and dynamic characteristics of an instrument.
- Explain the importance of signal generators and signal analysers in measurements.
- Accurately measure electrical and non-electrical physical quantities.
- Classify, calculate errors and reduce them in measurements.
- Discuss the concept of instrument calibration.
- Explain the use of sensors and transducers.
- Practically measure different quantities and specify the errors associated with the measurements.
- Analyse and interpret measurement results.

Revision 1: September 2011
Next Revision: September 2015

Module Title	RADIO WAVE PROPAGATION AND ANTENNAE
Code	TTCR3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TTCE3622 Applied Electromagnetics

Content: Propagation: The radio Spectrum. Properties of EMW. The troposphere, The Ionosphere, Free space propagation, Propagation mechanism (ground wave propagation, Sky wave propagation Terrestrial line of sight propagation; direct, reflected and refracted waves; Fresnel zones). **Propagation in a mobile environment**: Mobile-radio signal environment, multipath effects, Statistical communication theory, Path loss over flat and hilly terrain. Basic propagation models, terrestrial and satellite fixed links, macrocells, shadowing, fast fading; microcells, picocells and megacells. Propagation modelling. **Antennas**: Basic antenna parameters: gain, effective aperture, radiation resistance, beam width, side lopes, impedance, polarization, bandwidth; Hertzian and half wave dipole, linear and loop antennas. Radiation pattern of a single antenna and arrays; Loop-type antennas; Dipoles and Yagi-Ud arrays. Introduction to antenna synthesis. Antenna measurements. **Frequency independent antennas**: equiangular and log-periodic principles with examples. **Medium wave broadcast antennas**: monopole and monopole arrays above perfect ground. **Short wave antennas**: International radio coverage/communications; Rhombic antennas/arrays: Dipole (curtain) arrays; Local coverage horizontal dipoles and Vee antennas.

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

- Discuss different mechanisms of radio wave propagation
- Describe propagation models for different propagation environments
- Model radio signal propagation issues and analyze their impact on communication system performance
- Discuss the basic antenna parameters and concepts of electromagnetic wave propagation as used in different communication systems
- Explain the principles of design and operation of antennae used in different communication systems.
- Design antennae for different communication systems.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	TELECOMMUNICATION SWITCHING AND NETWORK SYSTEMS
Code	TTCC3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	EGS3691 Statistics for Engineers;
Co-requisite(s)	TTCE3642 Telecommunication Principles

Content: Communication Networks - **Local and Wide Area Networks:** LAN Topologies**.** LAN Media Access Control techniques**.** LAN Standards**.** LAN Extension and Interconnection (Bridging, Switching, Routing)**.** Metropolitan Area Networks (MANs)**.** Wide Area Networks (WANs)**.** Virtual Private Networks (VPNs). **Public Switch Telephone Network (PSTN)**: Definitions and basic concepts, PSTN Infrastructure**,** Local Networks**,** Switching**,** Line Circuit Functions**,** Signalling System. Digital Subscriber Lines (xDSL) : Asymmetric DSL(ADSL); High-data-rate DSL (HDSL); Symmetric DSL (SDSL);Very High Speed DSL (VDSL); Integrated Services Data Network - ISDN and PABX, capacity of PSTN. **Converged Networks:** Applications: VoIP, FoIP, etc**.** Protocols: Packet Transport: IPv4, Ipv6, ICMP; Packet Routing: RIP, OSPF, BGP; End-to End Reliability: TCP, UDP. WAN Transport Considerations: IP over Serial Lines; IP over Frame Relay; IP over ATM; Voice over ATM. **Multiplexing**: FDM, TDM, CDM, OFDM, Synchronous TDM, Statistical TDM, network information theory, Intelligent Network. **Introduction to Switching and Networks**, the structure of switching centers, selectors and cross point matrices, blocking and none blocking networks. Local and trunk switching. Ethernet: Distributed Packet Switching for Local Computer Networks, Queueing in Networks, Single Stage Switching Systems, Multistage Switching Systems with Dynamic Routing, Multicast Switch Architectures with Dynamic routing (Asynchronous Transfer Mode **-** ATM Switch), Multistage Switching Systems with Static Routing, Unbuffered Switching Networks. Principles of traffic. Queuing theorems for circuit switching centres. Time division switching centres. Queuing systems and their measures of effectiveness, blocking in queuing systems.

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

- Analyze and compare the performance of traffic models
- Predict and plan telecommunication network for minimum total cost using teletraffic engineering techniques
- Analyse switching and transmission systems
- Discuss the operation of common communication networks and intelligent networks.

Revision 1: September 2011
Next Revision: September 2015

Module Tite:	DIGITAL COMMUNICATION
Code	TTCD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	EGS3691 Statistics for Engineers
Co-requisite(s)	TTCE3642 Telecommunications Principles

Content: Introduction: 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, quantisation, pulse code modulation. Quantisation noise, companding, standards for companding. Voice codecs and codec standards. **Multiplexing**: 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. Baseband detection, error rate calculation. Intersymbol interference and equalisation. Eye diagrams. Signal transmission. **Information Theory**: Definition of Information, entropy, conditional entropy and redundancy, entropy rate, channel capacity. **Source Coding**: Symbol source encoding, coding for data compression. Error control coding, representation and analysis of codes, types of errors. Linear block codes, generator and parity check matrices, syndrome testing, typical linear block codes and their applications. Cyclic codes, polynomial representation of codes. **Data Transmission**: Baseband data transmission through a channel, intersymbol interference, baseband error probabilities, Channel coding, channel capacity. Performance of communication over AWGN channels.

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

- Identify the main elements of a digital communications system.
- Analyse the different digital modulation techniques
- Analyse information content of information sources
- Analyse and Design error control codes and decoding techniques.
- Analyse and choose digital communication techniques for band limited channels.
- Use simulation packages (e.g. MATLAB or equivalent) to evaluate the performance of various digital communications coding systems

Revision 1:	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (30%); Written Assignments (30%); Research Proposal Seminar (20%); Data Analysis Reports (20%))
Pre-requisite(s)	EGS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis**.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Formulate a relevant research proposal and present it in seminars
- Apply statistical tools to analyse data.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [Two Written Tests (50%); Written Reports (25%); Other Assignments (25%)]
Co-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

Revision 1: September 2011
Next Revision: September 2015

Module Title	EMBEDDED SYSTEMS DESIGN I
Code	TETD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETD3692 Digital Electronics

Content: Computer Architecture: 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; **Microprocessor Fundamentals;** Basic Elements, Bus Structure. **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, etc.

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

- Discuss the general architecture for computers.
- Differentiate between microcomputers, microprocessors and microcontrollers
- Discuss different types of micro-controller architectures
- Discuss implementation and operation of different memories.
- Discuss bus structures in microprocessor based systems.
- Design, implement and analyse assembly programs for Atmel AVR and/or PIC microcontrollers.
- Develop microcontroller based applications employing digital electronics, analogue electronics and assembly language.
- Execute micro-controller based group projects effectively.

Revision 1: September 2011
Next Revision: September 2015

Module Title	RADIO FREQUENCY AND MICROWAVE ENGINEERING
Code	TTCC3772
NQF Level	7
Contact Hours	4L + 2T or 1PS/week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TTCR3791 Radio Wave Propagation and Antennae

Content: Introduction: Components of RF and microwave design, Behaviour of passive components, Propagation of guided waves. **Transmission lines and waveguides for RF**: Physical and electrical parameters of common coaxial lines and waveguides. Using Smith Chart for design, Microstripline circuits**;** Evaluation of attenuation constant for the rectangular waveguide. **Microwave antennas**: electromagnetic horns; reflector antennas; micro-strip antennas; phased arrays. Micro Strip Antenna. **Matching**: physical realization of reactive elements; E-H tuners; Quarter-wave transformers. Energy coupling into and out of waveguides. Passive devices; Active components; Transmission and reflection of guided waves. Scattering parameters. Frequency meters. Generation and processing. Transistor amplifiers, Oscillators, Mixers. Microwave integrated circuits. Parametric amplifiers; Masers; Lasers. **Measurements**: Frequency, wavelength, VSWR, reflection coefficient, attenuation and impedance; scattering parameters. Power measurements. Applications of microwaves in communication and industry. Effects of biological exposure to microwave radiation. Safety precautions. **Radar systems**: Radar equation and applications. Radar performance; pulse duration and pulse repetition frequency; Range and resolution; noise performance; Types of radar: Pulsed, MTI, CW, FM and mapping.

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

- Discuss the operation of components and devices used in RF & Microwave systems
- Describe the principles of design and operation of devices for generation & processing of RF signals at different power levels.
- Discuss the applications of RF & microwave systems in communication, control & instrumentation
- Discuss recent developments in broadband communications for voice, data and video communication requirements
- Design of Microwave antennae.

Revision 1: September 2011
Next Revision: September 2015

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3521 Computing Fundamentals

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, network security. **Network Management and Troubleshooting**.

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

- Discuss computer network layers
- Compare the OSI model and the TCP/IP model
- Understand the issues related to addressing between networks
- Identify common security risks for Internet-connected computers.
- Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
- Distinguish between the different threats to wireless network security and different types of security threats.
- Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.

Revision 1: September 2011
Next Revision: September 2015

Module Title	TELECOMMUNICATION AND WIRELESS SYSTEMS
Code	TTCE3752
NQF Level	7
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TTCE3642 Telecommunication Principles
Co-requisite(s)	TTCD3791 Digital Communications

Content: Wireless communication: Introducing Wireless, Frequency reuse, handoff, interference and system capacity, sectorization, cell splitting, spectral efficiency, trunking and grade of service. Design of point to point wireless links, link budget. Digital and quadrature modulation, error probability with additive Gaussian noise and flat Rayleigh fading, coherent and noncoherent (differential) detection. Frequency-Shift Keying, coherent and noncoherent demodulation, Minimum-Shift Keying, Gaussian MSK, power and bandwidth efficiencies, Spread spectrum signaling. Equalization techniques. Diversity combining techniques. Multiple access techniques. **Wireless communication systems**: Mobile technology evolution. Global System for Mobile Communications (GSM). ***CDMA:*** W-CDMA, EvDO, cdma2000. **Standards**: Wireless systems and standards (to include GSM, DECT, WLAN 802.11x, IS-95, WCDMA. and emerging systems). Wireless local Area networking: IEEE 802.11, Wireless Data Networks: General Packet Radio Service (GPRS) and EDGE**.** Broadband Technologies and systems**:** Wi-Fi and WiMax. **Optical communication systems**: Introduction to Optical Communication Systems; Optical Sources I: Light Emitting Diodes; Optical Sources II: Lasers and Fibre Amplifiers; The Optical Channel: Optical Fibres; Optical Detection I: Photodiodes; Optical Detection II: Receiver Noise; Digital Optical Fibre Communication Systems; Analogue Optical Fibre Communication Systems; Components for Optical Systems; Wavelength Division Multiplexing (WDM); Optical Networks; Nonlinear Effects on Optical Systems. **Radio broadcasting and TV broadcasting**: Analogue radio, FM radio, Analogue TV (PAL, SECAM). **Digital broadcasting Standards and systems**: Digital Radio (DAB), setting for Advanced TV, Digital Convergence, HDTV, Digital TV, EDTV, SFN and MFN. **Satellite Communication Systems**: **Introduction**: Basic concepts of satellite communications. **Orbits**: Overview of orbits; orbit dynamics and Keppler's laws; relative movement of two point bodies; orbital parameters; Earth-satellite geometry. Design of analogue and digital satellite link, fixed and on-demand assignment. Antennas and earth station technology, e.g. VSAT. Applications of satellite networks in connectivity, point to point and point to multipoint systems. Specific applications of satellites.

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

- Analyze the error probabilities for common modulation schemes
- Discuss and analyse how various signal processing and coding techniques combat channel uncertainties
- Distinguish the major cellular communication standards (1G/2G/3G systems)
- Simulate wireless networks and analyse the simulation results
- Design point to point wireless links
- Discuss the various Photonic components in optical communication systems.
- Apply fundamental principles & techniques of optical fibre systems
- Design various optical communication networks.
- Understand and describe the basic theories and principles in satellite communication systems.
- Analyze satellite communication systems.
- Design a satellite communication Link.

Revision 1: September 2011
Next Revision: September 2015

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

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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work places by their Lecturers at least once.

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

- Distinguish the roles of technologists and technicians in an industrial setting and describing the reporting channels.
- Describe the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Produce a report of the main technical activity undertaken during the attachment.

Revision: October 2012
Next Revision: September 2015

YEAR 4 OF BSc IN TELECOMMUNICATIONS 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 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3521 Fundamentals of Engineering
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis. **Labour laws**. Trade Union laws. **Intellectual property rights.**

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

- Discuss the elements of professional ethics in engineering and the role played by professional engineering societies
- Discuss the role of the environment in determining the nature and location of engineering projects
- Discuss safety and health issues at the work place
- Discuss strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools to measure the financial and social implication of HIV/AIDS on sector companies
- Discuss relevant labour laws pertaining to engineering practice

Discuss the role of intellectual property rights in the design and innovation process

Revision 1: September 2011
Next Revision: September 2015

Module Title	**PROJECT MANAGEMENT**
Code	TEGM3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: This course is designed to teach students the basic principles of project management. Topics will include project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Students will learn how to identify and schedule project resources, carry out resource allocation, create project flow charts, produce critical path planning and evaluate reports. Emphasis will also be on tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Important issues of staff selection and team management will also be covered. These learning objectives will be reinforced by a team project that allows students to apply the principles and use the tools they learned.

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

- Discuss the basic principles of project management and project implementation including the importance of project time management and performance
- Apply the processes, tools and techniques of project management in an engineering context
- Discuss the concepts of close-out phases of the project life cycle
- Integrate and balance overall project management functions and apply available software tools for project management

Revision 1: September 2011
Next Revision: September 2015

Module Title:	DIGITAL SIGNAL PROCESSING
Code	TTCD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TTCE3692 Signals and Systems;

Content: Discrete-Time Signals, Systems, & Transforms: Basic Sampling Theory and D/A Conversion; Discrete-Time Linear Systems; Autocorrelation; Cross-Correlation (VIP); Z Transform; Discrete-Time Fourier Transform; Frequency Selective Linear Filtering; Sampling and Reconstruction; Multirate DSP: Efficient Up-sampling/Down-sampling, Multi-Stage Interpolation, Digital Subbanding; Applications: CD Players, Cell Phones, wireless networks. **Digital Filter Design:** FIR Filters – Equiripple Designs; IIR Filters, Bilinear transformation, Frequency transformations. **Discrete Fourier Transform:** Definition and Properties; Fast Fourier Transform Algorithms: Divide and Conquer Approach, Radix-2 FFT; Sectioned Convolution**. Nonparametric methods of power spectrum estimation:** Discrete random processes; Estimation of autocorrelation sequence; Periodogram; Smoothed periodograms. **Model-Based Spectrum Estimation:** Autoregressive (AR) Modelling; Forward/Backward Linear Prediction; Levinson-Durbin Algorithm; Minimum Variance Method; Eigenstructure Methods I: MUSIC; Eigenstructure Methods II: ESPRIT; Applications in Speech Processing, Communications, and Acoustics. **Adaptive Signal Processing:** Applications: Equalization, etc; Adaptive Direct-Form FIR Filters – LMS; Adaptive Direct-Form FIR Filters – RLS

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

- Discuss the basic concepts of DSP
- Analyze discrete signals and systems, and their application in the design, implementation and testing of digital filters.
- Analyze linear and adaptive filter equalizers ,spectrum estimation
- Apply mathematical tools and computation methods for signal processing
- Develop audio and video systems incorporating DSP algorithms

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	TELECOMMUNICATION NETWORK PLANNING
Code	TTCE3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TTCR3791 Radio Waves Propagation and Antennae
Co-requisite(s)	TTCE3752 Telecommunication and Wireless Systems,

Content: This course provides an understanding of how to design and plan a high quality radio network using modelling techniques and simulation tools to predict coverage and to mitigate interference among systems within a shared geographical area. **Introduction**: Concepts of geographical coordinates and maps; Calculation of distance between two points on the earth surface. **Models**: Types of models: Deterministic and probabilistic models. Propagation models: Free Space, Statistical models (Okumura – Hata/COST – Hata, Longley-Rice, ITU models, etc.), Transmitter model including emission's mask, Receiver model including selectivity characteristics, Antenna model including vertical and horizontal patterns. Feeder model. **Data Bases**: Geographical data, Group, station data (coordinates, frequencies, antenna heights) and relevant equipment data (antenna diagram, receiver sensitivity and harmonic attenuation of the transmitter etc.). **Computation:** Deterministic and statistical methodologies for network analysis and planning. Coverage prediction (Field Strength, Signal Strength, Received Power, Transmission Loss, Signal-to-Interference Ratio, Min/Max Antenna Height etc.)**,** Interference, Collocated Interference. Link Performance: (link budget, fading margins and outage probabilities for radio links). **Network planning**: Point to point communication; mobile cellular network, Sound and Television Broadcasting using ITU recommended techniques. Comparison of some available network planning and optimization simulation packages. Build network scenarios using a network analysis, planning and optimization tool such as SEAMCAT or equivalent. Case study: GSM- and CDMA-networks. Notion of Network optimization.

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

- Differentiate between the different models used for simulation in the process of network planning
- Discuss the principles and techniques of communication systems simulation and its limitations
- Analyze and design telecommunication network using appropriate simulations packages.
- Carryout the planning of a mobile communication networks to function with acceptable QoS.

Revision 1:	September 2011
Next Revision:	September 2015

Module Title	CONTROL ENGINEERING
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

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 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. **Digital Control Systems:** modelling of digital computers, z-transforms, transfer functions, block diagram reduction, stability analysis, steady state errors, transient response in z-plane, gain design in z-plane, implementation of digital compensators.

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

- Discuss different control theory terminologies.
- Model basic electrical systems as a control systems or part of parts of control systems.
- Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control engineering.
- Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
- Model, Analyse and design basic digital control systems.
- Use engineering software for modelling, analysis and design of control systems

Revision 1: September 2011
Next Revision: September 2015

Module Title	RADIO SPECTRUM MANAGEMENT
Code	TTCC3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TTCE3752 Telecommunication and Wireless Systems

Content: Spectrum Management Fundamentals: Spectrum: An International Perspective**,** Major National Spectrum Management Directives/Laws, Organizational Structure and Processes**,** Spectrum Management Planning, Regulation and Policy Making, Development of a National Allocation Table**,** Frequency Assignment and Licensing, Radio Standards Specification and Equipment Authorization**,** Monitoring and Spectrum Enforcement, International and National Cooperation, Development of a Spectrum Management Organizational Structure**. Spectrum Planning:** Significance of Planning, Costs and Benefits**,** Planning Processes**,** Establishing Spectrum Planning Objectives**,** Elements to Consider**,** Spectrum Availability**,** Planning Options**,** Process Implementation**,** Consultative Approach**,** Analytical Approach**,** Scenario Approach. **Frequency Assignment and Licensing:** Assigning Frequencies to Radio Stations**,** Regulatory Aspects of the Frequency Assignment Process**,** Technical Aspects of the Frequency Assignment Process**,** Frequency Plans**,** Process Automation**,** Licensing**. Spectrum Monitoring, Inspection and Investigation:** Spectrum Monitoring as an Element of the Spectrum Management Process**,** Monitoring to Assist Frequency Assignment**,** Monitoring to Assess Spectrum Occupancy**,** Monitoring for Compliance with National Rules and Regulations**,** Monitoring Facilities Depending on a Frequency Band and Purpose**,** Automation of Monitoring**. Spectrum Economics:** Traditional Mechanisms of Financing Spectrum Management**,** National Budget Financing**,** Spectrum License and Usage Fees**,** Other Charges. **Measures of Spectrum Utilization and Utilization Efficiency:** Different Methods for Calculating Spectrum Utilization**,** Assessment of Economic Utilization of Spectrum**,** Applications**,** Spectrum Utilization of Satellite Systems**,** Measure of Spectrum Utilization Efficiency**,** Example of Spectrum Utilization Efficiency Calculations**,** Spectrum Quality Index (SQI)**,** Ratio of Spectrum Utilization Efficiencies, or Relative Spectrum Efficiency.

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

- Demonstrate an understanding of the role of statutory bodies in the regulation of conflict amongst communication providers.
- Demonstrate an understanding of the need for spectrum management
- Demonstrate an understanding of the various considerations in the process of Frequency Assignment
- Demonstrate understanding of developing a frequency plan for a communication network.

Revision 1: September 2011
Next Revision: September 2015

Module title:	RESEARCH PROPOSAL
Code	TTCR3891
NQF Level	8
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation (50%, Proposal (50%)]
Co-requisite(s)	TEGT3762 Experimental and Research Methods

Module Description 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. In the course of the semester, students will be required to present their Research Proposals in a Seminar to be arranged by their respective Heads of Departments. Towards the end of the semester, each student will submit a typed and bound Research Proposal.

Learning Outcomes: Upon completion of this module, each student should have:

- Made a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 1	September 2011
Next Revision:	September 2015

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TTCR3892
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%** [Seminar Presentation (30%); Final Oral Presentation of Dissertation (20%); Final Written Dissertation (50%)]
Co-requisite(s)	TTCR3891 Research Proposal; All third year modules

Module Description: 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: Upon completion of this module, students should be able to:

- Carry out a technological or engineering investigation.
- Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
- Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
- Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Revision 1: September 2011
Next Revision: September 2015

Module Title:	**TELECOMMUNICATION DESIGN PROJECT**
Code	TTCD3892
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgement 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: Upon completion of this module, students should be able to:

- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Demonstrate practical skills in the design of engineering components, assemblies and/or systems.
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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.
- 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.

Revision 1: September 2011
Next Revision: September 2015

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**.** Module may be required 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

Module Description: 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. During attachment, students will be visited at their work place by their Lecturers at least once.

Revision 1: September 2011
Next Revision: September 2015