FACULTY OF ENGINEERING & INFORMATION TECHNOLOGY

Prospectus 2016

UNAM
UNIVERSITY OF NAMIBIA

FACULTY PROSPECTUS 2016

FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

NOTE

This Faculty Yearbook is valid for 2016 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 2016.

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 2016 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 at the beginning of 2016.

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

FIRST SEMESTER 2016

Mon 11 January 2016	**University Opens for 2016 Academic Year**
Mon 18 Jan – Fri 22 Jan	On-Line Registration: Senior Engineering Students
Thu 21 January	**Academic staff members resume office duties**
Fri 22 January	Registration of First Year Engineering Students at Jose Eduardo Dos Santos Campus
Fri 22 January	Management Meeting: Faculty of Engineering & IT (9:00)
Wed 20 Jan – Sat 23 Jan	Orientation of First Year Engineering Students at Jose Eduardo Dos Santos Campus
Mon 25 January	**Lectures commence for FIRST SEMESTER for all Engineering Students**
Wed 27 January	Commencement Meeting for all Staff and Students at 14h00 in the Auditorium
Tue 22 March	1st SEMESTER BREAK STARTS
Wed 23 March	Faculty Board Meeting – Faculty of Eng. & IT (Curriculum changes & new programmes) (09:00)
Tue 29 March	LECTURES RESUME AFTER 1ST SEMESTER BREAK
Wed 20 April	Management Meeting – Faculty of Eng. & Info Tech (09:00)
Thu 05 May	**Lectures end for FIRST SEMESTER for all Engineering Students**
Mon 09 May	1st Semester Exams commence (Semester I modules) all Engineering Students
Fri 20 May	1st Semester Exams end (Semester I modules) for Senior Engineering Students
Fri 20 May	**End of FIRST SEMESTER for Senior Engineering students**
Mon 23 May	Industrial Attachment commences for Senior Engineering Students (six weeks)
Wed 01 June	Regular Exams end (Semester I modules) for First Year Engineering Students
Mon 13 June – Fri 17 June	Supplementary/Special Examinations for First Year Engineering Students
Mon 20 June - Fri 24 June	Industrial Attachment visits
Mon 27 June – Fri 01 July	**UNAM Mid-Year Recess**
Fri 01 July	Industrial Attachment ends for Senior Engineering Students

SECOND SEMESTER 2016

Mon 04 July – Fri 08 July	Supplementary/Special Examination for Engineering Senior students
Wed 06 July	Faculty Management Meeting – Faculty of Eng. & Info Tech (09:00)
Mon 11 July	**Lectures commence for SECOND SEMESTER for all Engineering Students**
Wed 20 July	Faculty Board Meeting – Faculty of Eng. & IT (Examiners and Moderators) (09:00)
Mon 22 August	2nd Semester BREAK starts
Mon 29 August	Lectures resume after 2nd Semester Break
Wed 05 October	Faculty Management Meeting – Faculty of Eng. & Info Tech (09:00)
Fri 21 October	**Lectures end for SECOND SEMESTER**
Tue 25 October	Regular Exams commence (Sem. II & Double modules)
Fri 11 November	Regular Examinations end (Sem. II & Double modules)
Mon 21 Nov – Fri 25 Nov	Supplementary/Special Examinations for all affected students
Fri 18 November	**End of SECOND SEMESTER**
Wed 14 December 2016	Academic Year ends and University closes (Until 11 January 2017)

2017 ACADEMIC YEAR

11 January 2017	University opens (2017 academic year)
24 January 2017	Academic staff members resume office duties

DUE DATES FOR THE 2016 ACADEMIC YEAR

(i)   GENERAL

Last day for appeals (Sem 2 & Double modules – Reg & Supp/Spec exams of Nov 2015)..22 Jan
Last day for application of retention of continuous assessment (CA) mark &
Promotion Exam...29 Jan
Last day for application for exemption(s)..29 Jan
Last day for Late Registration (*Late fee payable*)..05 Feb
Last day for approval of exemption(s) ....05 Feb
Last day for approval of retention of continuous assessment mark and Promotion Exam...05 Feb
Last day for approval of module(s) & qualification changes...05 Feb
Last day for change of offering types at Regional Centres (Semester 1 modules) ....29 Apr
Last day for Appeals (Semester 1 modules (Reg & Supp/ Spec Exams of June 2016)..22 Jul
Last day to submit outstanding documentation ....19 Aug
Last day to change offering types at Regional Centres (Semester 2 modules)..16 Sep
Last day to cancel enrolment …………………………………………………………………………………... 23 Sept
Last day to submit Theses and Dissertations for examinations…………   ………………………………….. 30 Oct

(ii)   CANCELLATIONS
Semester 1 modules
Last day to cancel Semester 1 modules……………………………………...06 May

Semester 2 modules
Last day to cancel Semester 2 modules………………………………………………………………… ....23 Sept

Double modules (A double module normally extends over one academic year)
Last day to cancel Double modules…………………………………………………………………………….. ....23 Sept

(iii)   FINANCE
Semester 1 modules
Last day to cancel with 100 % credit……………………………………………………………………... ....04 March
Last day to cancel with 50 % credit…………………………………………………………………………………………...15 April

 Semester 2 modules
Last day to cancel with 100 % credit…………………………………………………………………...•   .... 05 August
Last day to cancel with 50 % credit………………………………………………………………………….   .... 24 August

Double modules (a double module normally extends over one academic year)
Last day to cancel with 100 % credit……………………………………………………………………………… ....04 March
Last day to cancel with 50 % credit.………………………………………………………………………………………...03 June
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2015 ACADEMIC YEAR: UNAM MAIN
SEMESTER 1

11January	University opens
18 January - 03 February	Annual Registration
21 January	Academic staff resumes office duties
01 February	Lectures commence for FIRST SEMESTER
22 March	1st Semester break starts
29 March	Lectures resume after 1st Semester break
06 May	Lectures end for FIRST SEMESTER
10 May	Regular Examinations commence (Semester I modules)
01 June	Regular Examinations end
13 June - 17 June	Supplementary/Special Examinations
17 June	End of 1st Semester
27 June - 01 July	Mid-year recess

SEMESTER 2

11 July	Lectures commence for SECOND SEMESTER
22 August	2nd Semester break starts
29 August	Lectures resume after 2nd Semester break
14 October	Lectures end for SECOND SEMESTER
18 October	Regular Examinations commence (Semester 2 & Double modules)
11 November	Regular Examinations end
21 November - 25 November	Supplementary/Special Examinations
25 November	End of 2nd Semester
16 December	Academic Year ends & University closes (until 11 January 2017)
11 January 2017	University opens (2017 academic year)
24 January 2017	Academic staff resumes office duties

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)		
		Tel:	(+264 65) 232 4001
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
		Fax:	(+264 65) 232 4085
Human Resources Officer	Mrs. 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	Mrs Tekla Ndevashiya	*Tel:*	(+264 65) 232 4107
Student Support Officer	Mrs. Lovisa Amon	*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:

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University of Namibia, Engineer. Jose Eduardo Dos Santos Campus
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P. O. Box 3624 Ongwediva Namibia

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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)

DEPARTMENT OF INDUSTRIAL AND WORKSHOP TRAINING

B. NATURE OF THE CURRICULUM OF BACHELOR OF SCIENCE IN ENGINEERING

B.1. INTRODUCTION

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

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 2016

(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.

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[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

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed at least 102 Credits (**67%** of the total 152 Credit in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

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

A student must have passed at least 102 Credits (67% of the total 152 Credit in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

3. Bachelor of Science in Electrical Engineering (Honours)

A student must have passed at least 102 Credits (67% of the total 152 Credit in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

4. Bachelor of Science in Mechanical Engineering (Honours)

A student must have passed at least 102 Credits (67% of the total 152 Credit in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

5. Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed at least 102 Credits (67% of the total 152 Credit in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

6. Bachelor of Science in Mining Engineering (Honours)

A student must have passed at least 102 Credits (67% of the total 152 Credit in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

C.8.3 SECOND YEAR TO THIRD YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student **must** have passed all 152 credits prescribed in the First Year. In addition, the student must have passed at least 118 credits of Year 2 (78% of the total 152 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

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

A student **must** have passed all 152 credits prescribed in the First Year. In addition, the student must have passed at least 112 credits of Year 2 (78% of the total 144 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

3.   Bachelor of Science in Electrical Engineering (Honours)

A student **must** have passed all 152 credits prescribed in the First Year. In addition, the student must have passed at least 118 credits of Year 2 (78% of the total 152 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

4.   Bachelor of Science in Mechanical Engineering (Honours)

A student **must** have passed all **152** credits prescribed in the First Year. In addition, the student must have passed at least **112** credits of Year 2 (78% of the total 144 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

5.   Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed all 152 credits prescribed in the First Year. In addition, the student must have passed at least 112 credits of Year 2 (78% of the total 144 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

6.   Bachelor of Science in Mining Engineering (Honours)

A student **must** have passed all **152** credits prescribed in the First Year. In addition, the student must have passed at least **108** credits of Year 2 (78% of the total 140 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

C.8.4 THIRD YEAR TO FOURTH YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student **must** have passed all 152 credits prescribed in the Second Year. In addition, the student must have passed at least 108 credits of Year 3 (78% of the total 140 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

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

A student **must** have passed all 144 credits prescribed in the Second Year. In addition, the student must have passed at least 115 credits of Year 3 (78% of the total 148 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

3.   Bachelor of Science in Electrical Engineering (Honours)

A student **must** have passed all 152 credits prescribed in the Second Year. In addition, the student must have passed at least 108 credits of Year 3 (78% of the total 140 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

4.   Bachelor of Science in Mechanical Engineering (Honours)

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

5.   Bachelor of Science in Metallurgical Engineering (Honours)
A student **must** have passed all **144** credits prescribed in the Second Year. In addition, the student must have passed at least **114** credits of Year 3 (78% of the total 148 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed.

6.   Bachelor of Science in Mining Engineering (Honours)
A student **must** have passed all **140** credits prescribed in the Second Year. In addition, the student must have passed at least **118** credits of Year 3 (78% of the total 152 credits in Year 3) to be able to register for Fourth Year courses. If any of the failed courses is a Pre-requisite for a Fourth Year course, then the candidate cannot register for the affected Fourth Year course until the Pre-requisite is passed

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C.9.   MAXIMUM NUMBER OF CREDITS PER YEAR

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1. Bachelor of Science in Civil Engineering (Honours)

First year: 152 credits

Second year: 186 credits (152 credits of second year plus 34 credits of first year)

Third Year: 174 credits (140 credits of third year plus 34 Credits of second year)

Fourth Year: 172 credits (140 credits of fourth year plus 32 Credits of third year)

Fifth Year: 112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

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

First year: 152 credits

Second year: 178 credits (144 credits of second year plus 34 Credits of first year)

Third Year: 180 credits (148 credits of third year plus 32 Credits of second year)

Fourth Year: 174 credits (140 credits of fourth year plus 34 Credits of third year)

Fifth Year: 112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

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3.   Bachelor of Science in Electrical Engineering (Honours)

First year: 152 credits

Second year: 186 credits (152 credits of second year plus 34 Credits of first year)

Third Year: 174 credits (140 credits of third year plus 34 Credits of second year)

Fourth Year: 172 credits (140 credits of fourth year plus 32 Credits of third year)

Fifth Year: 112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

4.   Bachelor of Science in Mechanical Engineering (Honours)

First year: 152 credits

Second year: 178 credits (144 credits of second year plus 34 Credits for first year)

Third Year: 176 credits (144 credits of third year plus 32 Credits for second year)

Fourth Year: 176 credits (144 credits of fourth year plus 32 Credits for third year)

Fifth Year: 114 credits (80% of 144 Year 4 credits) – for those who do not complete in 4 years.

5.   Bachelor of Science in Metallurgical Engineering (Honours)

First year: 152 credits

Second year: 178 credits (144 credits of second year plus 34 Credits for first year)

Third Year: 180 credits (148 credits of third year plus 32 Credits for second year)

Fourth Year: 174 credits (140 credits of fourth year plus 34 Credits for third year)

Fifth Year: 112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

6.   Bachelor of Science in Mining Engineering (Honours)
First year: 152 credits

Second year: 174 credits (140 credits of second year plus 34 Credits for first year)

Third Year: 184 credits (152 credits of third year plus 32 Credits for second year)

Fourth Year: 174 credits (140 credits of fourth year plus 34 Credits for third year)

Fifth Year: 112 credits (80% of 140 Year 4 credits) – for those who do not complete in 4 years.

C.10. MINIMUM REQUIREMENTS FOR RE-ADMISSION

1. Bachelor of Science in Civil Engineering (Honours)
A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- o   At least **50** credits by the end of the first year (at least **33%** of total credits in Year 1).
- o   At least **120** credits of Year 1 (80% of Year 1) plus **60** credits of Year 2 (40% of Year 2) by the end of the second year.

- o   All **152** prescribed Year 1 credits plus at least **120** credits of Year 2 (80% of Year 2) plus at least **56** credits of Year 3 (40% of Year 3) by the end of the third year.

- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus **112** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

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

A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- o   At least **50** credits by the end of the first year (at least **33%** of total credits in Year 1).
- o   At least **120** credits of Year 1 (80% of Year 1) plus **58** credits of Year 2 (40% of Year 2) by the end of the second year.
- o   All **152** prescribed Year 1 credits plus at least **114** credits of Year 2 (80% of Year 2) plus at least **58** credits of Year 3 (40% of Year 3) by the end of the third year.
- o   All **152** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus **118** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

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

A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- o   At least **50** credits by the end of the first year (at least **33%** of total credits in Year 1).
- o   At least **120** credits of Year 1 (80% of Year 1) plus **60** credits of Year 2 (40% of Year 2) by the end of the second year.
- o   All **152** prescribed Year 1 credits plus at least **120** credits of Year 2 (80% of Year 2) plus at least **56** credits of Year 3 (**40%** of Year 3) by the end of the third year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus **112** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

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

A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- o   At least **50** credits by the end of the first year (at least 33% of total credits in Year 1).
- o   At least **120** credits of Year 1 (80% of Year 1) plus **58** credits of Year 2 (40% of Year 2) by the end of the second year.
- o   All **152** prescribed Year 1 credits plus at least **114** credits of Year 2 (80% of Year 2) plus at least **58** credits of Year 3 (40% of Year 3) by the end of the third year.
- o   All **152** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus **114** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **86** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

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

A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- o   At least **50** credits by the end of the first year (at least 33% of total credits in Year 1).
- o   At least **120** credits of Year 1 (80% of Year 1) plus **58** credits of Year 2 (40% of Year 2) by the end of the second year.
- o   All **152** prescribed Year 1 credits plus at least **114** credits of Year 2 (80% of Year 2) plus at least **58** credits of Year 3 (40% of Year 3) by the end of the third year.
- o   All **152** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus **118** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

6.   Bachelor of Science in Mining Engineering (Honours)A student will not be re-admitted into the Faculty of Engineering and IT if he/she has not earned:
- o   At least **50** credits by the end of the first year (at least 33% of total credits in Year 1).
- o   At least **120** credits of Year 1 (80% of Year 1) plus **56** credits of Year 2 (40% of Year 2) by the end of the second year.
- o   All **152** prescribed Year 1 credits plus at least **112** credits of Year 2 (80% of Year 2) plus at least **60** credits of Year 3 (40% of Year 3) by the end of the third year.
- o   All **152** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus **120** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o   All **152** prescribed Year 1 credits plus all **152** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

C.11.   CRITERIA FOR GRADUATION

A student can graduate with the degree of **Bachelor of Science in Engineering (Honours)** in a given discipline only if he/she has earned the **584 NQF Credits** prescribed in the curriculum and has successfully completed **all three Industrial Attachment** sessions. The specified minimum NQF Credits include 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
TEGW3590 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
TEGR3761 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:
o   Apply effective reading skills
o   Employ effective writing skills
o   Demonstrate general speaking skills
o   Demonstrate general listening skills
o   Demonstrate effective study skills

Issue date: September 2015
Next Revision: September 2019

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

Issue Date:	September 2015
Next Revision:	September 2019

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:
- o represent information using Venn diagrams
- o represent information using equations
- o find the intersection and the union of two sets as well as the complement of a subset of a set
- o decompose a fraction into partial fractions
- o simplify and factorize algebraic expressions and solve linear and quadratic equations and inequalities
- o find the domain and the range of a function as well as the pre-image of a set
- o find the composition of two functions
- o apply the factor and the remainder theorem
- o able to find partial sums and the sums of geometric and arithmetic sequences

Issue Date:	January 2013
Next Revision:	January 2017

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

Issue Date:	January 2013
Next Revision:	January 2017

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:
- o Employ units, do unit conversions and use of significant figures.
- o Solve problems regarding one and two dimensional kinematics.
- o Solve problems regarding the dynamics of linear motion via Newton's laws.
- o Solve problems regarding the dynamics of linear motion using energy methods.
- o Solve simple problems in rotational kinematics and dynamics.
- o Solve basic problems in statics and Newtonian gravitation.
- o Solve problems using the principles of fluids.
- o Solve basic problems regarding heat and gasses.
- o Demonstrate entry-level general laboratory skills including elementary data analysis.

Issue Date:	January 2013
Next Revision:	January 2017

SEMESTER 2

Module Title:	**ENGLISH FOR ACADEMIC PURPOSES**
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:
- o   Apply academic and formal writing conventions within the context of their studies
- o   Integrate advanced reading strategies in reading an academic context.
- o   Employ oral and presentation skills in an academic context.
- o   Employ academic listening techniques in an academic context.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**CONTEMPORARY SOCIAL ISSUES**
Code	UCSI3580
NQF	5
Contact Hours	1 Contact hours per week for 28 weeks
Credits	8
Assessment	Continuous Assessment (100%). 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:
- o   check whether a function is injective and to find the inverse function
- o   find the limit of a function at a point and a limit involving infinity
- o   find the derivative of exponential and polynomial functions
- o   solve problems involving rates of change
- o   sketch a graph of a function using sign tables
- o   find an area of a region under a graph

Issue Date:	January 2013
Next Revision:	January 2017

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

Issue Date:	September 2015
Next Revision:	September 2019

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

Issue Date:	January 2013
Next Revision:	January 2017

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

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

Learning Outcomes: Upon completion of this module, the student is expected to:
- o   Solve problems on electric and magnetic fields
- o   Sketch electric circuits and solve problems on capacitors and resistors
- o   Discuss and solve problems in geometrical optics, radioactivity and sound.
- o   Prepare and perform experiments related to the contents of the module.

Issue Date:	January 2013
Next Revision:	January 2017

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

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

Learning Outcomes: On completing the module students should be able to:
- o   Distinguish between hardware and software
- o   Describe and compare computer Performance
- o   Discuss health, safety & environment impact in computing
- o   Discuss security and copyright issues
- o   Use a word processor to create, edit and format documents
- o   Insert different types of objects on to a word document
- o   Use the mail merge features
- o   Use a spread sheet to create, edit and format workbooks
- o   Use formulae and functions to perform calculations
- o   Create different types of objects on to a worksheet
- o   Use a presentation software to create, edit and format a presentation file
- o   Insert different types of objects on to a presentation
- o   Manipulate a presentation file
- o   Use a web browser to navigate the Internet/web
- o   Use email software to send and receive messages with attachments
- o   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 – 152 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3561	5	8	None
1	*Physics for Physical Sciences* I	SPHY3511	*5*	16	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	*5*	12	*None*
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**72**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Fundamentals of Electrical Engineering	TEGT3542	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 – 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	**TCME3521** TEGT3561
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Introduction to Engineering Geology	TMNE3621	6	8	**None**
1	Strength of Materials I	TCVM3621	6	8	**TEGT3592**
1	Fluid Mechanics	TMEE3611	6	16	**TEGT3592**
Total Credits Semester III				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE &CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3592** TEGT3671
2	Building Materials	TCVI3612	6	16	**TEGS3591**
2	Soil Mechanics	TCVD3682	6	12	**TEGT3592**/ TMNE3621
2	Infrastructure Planning and Design I	TCVI3622	6	8	None
2	Surveying for Engineers	TCVE3642	6	8	**TEGM3591**
2	Strength of Materials II	TCVM3662	6	8	**TCVM3621**
2	Industrial Attachment I	TEGT3600	6	-	None
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN CIVIL ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Experimental and Research Methods	TEGR3761	7	8	TEGS3691
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Hydrology for Engineers	TCVD3741	7	8	**TMEE3611**
1	Theory of Structures	TCVS3791	7	12	**TCVM3662**
1	Infrastructure Planning and Design II	TCVD3721	7	8	TCVI3622
1	Geo-technical Engineering	TCVG3711	7	16	**TCVD3682**/ TCVD3662
1	Construction Management	TCVS3721	7	8	None
Total Credits Semester V				**68**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Hydraulics and Hydro-Engineering	TCVD3712	7	16	**TMEE3611/ TEGT3641**
2	Urban Water Systems	TCVD3782	7	12	**TCVI3622/** TCVD3741
2	Reinforced and Pre-stressed Concrete Design	TCVC3792	7	12	**TCVS3791**
2	Design of Steel and Timber Structures	TCVS3762	7	8	**TCVS3791**
2	Transport Planning and Traffic Engineering	TCVT3792	7	12	TCVI3622
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Research Proposal	TCVR3792	7	4	TEGR3761
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

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	TEGT3742
1	Project Management	TEGM3881	8	12	TEGT3761
1	Structural Engineering	TCVS3811	8	16	TCVS3761/ TCVD3792
1	Road Pavement and Geometric Design	TCVD3871	8	16	**TCVD3682**
1	Railways and Public Transport Systems	TCVD3881	8	12	**TCVD3682**
1	Wastewater and Solid Waste Management	TCVI3881	8	12	TCVD3782/ **TCVI3622**
Total Credits Semester VII				76	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Research Project	TCVR3892	8	30	All 3rd Year Modules
2	Civil Engineering Design Project	TCVD3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Course Lines and planes:: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. **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**. Introduction to complex numbers.:**definition, addition, subtraction, multiplication, division of complex numbers. Demoivres' theorem .**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, the chain rule, differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, 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
- Manipulate sequence and series of numbers
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- . Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3561
NQF Level	5
Contact Hours	**2**L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%(minimum of 2 tests and 4 drawing assignments) , Examination 40% (1 x 2 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.

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

Revision 2:	August 2015
Next Revision:	August 2019

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

Contents: Units, significant figures & 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 2015
Revision:	January 2019

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

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 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 2015
Next Revision:	September 2019

Module Title:	**WORKSHOP PRACTICE**
Code	TEGW3590
NQF Level	5
Contact Hours	2h Lectures + 4h Practical Sessions per week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

Learning Outcomes: Upon completion of this course, students should be able to:
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.

Describe the general operation of air-conditioning and refrigeration systems.

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Classification of engineering materials: metals, ceramics, plastics, composites. Competition among materials, future trends of material usage. **Structure of materials**: Atomic structure; Bragg's law, electronic configuration, atomic bonding. Crystalline structure; amorphous structure, crystallographic planes and directions, Miller indices. Structure-property relationships. **Crystalline imperfections and diffusion**: Point defects, metallic solid solutions, line defects, slip systems, diffusion in solids. **Solidification and Microstructure:** Nucleation from the liquid state, inoculation, grain growth and grain size, development of microstructure, practical preparation of microsections. **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 ferrous and non-ferrous alloy systems. **Heat Treatment**: Annealing, normalizing, quench hardening, tempering. Solid solution hardening, strain hardening (cold working), annealing and recrystallization, precipitation hardening. **Properties of Materials:** Overview of electrical, optical and thermal properties of materials. **Mechanical properties**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, fatigue test, creep. **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: On completing the course students should be able to:
- Distinguish between different classifications of engineering materials
- Competently describe the electronic and crystalline structure of materials with associated imperfections
- Demonstrate an understanding of solidification and generation of microstructure in metallic materials
- Describe the formation of alloys and associated microstructures using binary equilibrium phase diagrams
- Describe the various procedures for heat treatment of ferrous and non-ferrous metals and alloys
- Distinguish between various properties of materials with special emphasis on mechanical properties and testing
- Describe the processes of corrosion and oxidation and the techniques used to control corrosion and degradation..

Revision 1:	September 2015
Next Revision:	September 2019

Module Title	**CONTEMPORARY SOCIAL ISSUES**

Code UCSI3580
NQF 5
Contact Hours 1 Contact hours per week for 28 weeks
Credits 8
Assessment Continuous Assessment (100%). 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, with special reference to their sexual behaviour and to inculcate the primacy of moral reasoning in their social relations and their academic lives. In achieving the above aim, the following values and approaches will inform the CSI: Material will be presented on an integrative basis, stressing the interconnections amongst ethics, moral reasoning, citizenship, leadership, and values and approaches that direct to responsible social behaviour. Special emphasis will be placed on the construct of citizenship and its relation to democracy and the common good. Critical transformative theory will under gird the content of CSI. After completion of the CSI students will be empowered in the domains of human sexuality, reproductive health, democracy, the environment, sustainable development, and responsible leadership. Flexible modes of assessment may be harnessed and students are required to sign the class attendance list each time after a class session. Compulsory attendance required.

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

- Practice ethical reasoning
- Demonstrate knowledge to make informed decisions as responsible citizens
- Empower themselves to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship and give back such values to the community, nation, and world
- Sensitise towards the meaning of values and morals and how they affect the attitudes of individuals and groups toward population issues
- Recognise the need of balance between freedom and responsible behaviour
- Discuss stewardship/custodianship of the environment and sustainability of ecosystem services

Explain how human activities affect the environment and the sustainability of ecosystem services.

Issue Date: September 2012
Next Revision: September 2016

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments), 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. **Integration techniques**: integration by parts, integration by trigonometric substitution; Reduction formula, integration by partial fractions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length etc.…. **Differential equations**: Meaning of solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Power series**: radius and interval of convergence. **Power series representation of functions:** Taylor and Maclaurin series. Binomial theorem. Power series solutions of second order ordinary differential equations with variable coefficients. Introduction to Bessel's equation and Bessel functions. **Complex functions**: Cauchy -Riemann equations.

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
- Apply the power series techniques to solve second order odes with variable coefficients
- Apply and solve engineering problems using Bessel's functions

Classify complex functions

Revision 1:   September 2015
Next Revision: September 2019

Module Title	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Code	TEGT3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100%
Pre-requisite(s)	None

Content: 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, Kirchhoff'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 2:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2015
Revision:	January 2019

Module Title:	**ENGINEERING MECHANICS I**
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports); 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, Analysis of frames and machines.

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.

Revision 2: September 2015
Next Revision: September 2019

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

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

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

- 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 2015
Revision: January 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 6*0% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)*
	Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE

Content: **Structure of materials**: 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 2015
Next Revision: September 2019

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation, Jacobian matrices. **Applications**: optimization on surfaces , constrained optimization . **Integral Transforms**: Laplace Transforms(LT) with applications to differential equations. Introduction to Fourier series. Fourier Transforms. Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.**Analytic functions**: Cauchy's theorem, Cauchy's integral formula, Taylor series, singular points, poles. Laurent series, Residue theorem and evaluation of complex integrals.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

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

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: On completing the course 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 2015
Next Revision:	September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
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 C programing language.

Learning Outcomes: On completing the course 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 simple C programs

Revision 1:	September 2015
Next Revision:	September 2019

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

Content: Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; Creating objects; Drawing with precision; Controlling the drawing display; **Editing methods**; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; **Managing content with AutoCAD design Centre**; Creating a layout to plot; Plotting your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course 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
- Appreciate basic queuing theory

Issue Date 2:   September 2015
Revision: September 2019

Module Title:	**INTRODUCTION TO ENGINEERING GEOLOGY**
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	None

Content: Mineralogy: **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
- Relate the nature of the interior of the earth and the plate tectonic theory
- Describe weathering processes and soil formation processes
- Discuss key aspects of geo-hydrology
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Revision 2:   September 2015
Next Revision: September 2019

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

Content: Basic concepts: Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams. **Stress and strain:** Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke's Law; Modulus of Elasticity; Normal stress and strain; Poisson's ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson's ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants. **Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems:** Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars. **Geometrical characteristics of plane sections:** Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem. **Bending:** Shear force and bending moment diagrams. **Bending and shear stresses in beams:** Theory of beam bending; Section modulus; Composite beams; Shear stress distribution due to bending. **Simple Torsion:** Pure torsion of circular bars; Shear stress and shear strain in shafts, Torsional rigidity; Torsion of hollow shafts. **Stresses in thin cylinders and spheres:** Thin cylindrical and spherical shells subjected to internal pressure; Hoop stress and longitudinal stress.

Learning Outcomes: Upon completion of this module, students should be able to:
* Demonstrate the application of Hooke's Law to normal and shear stresses.
* Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
* Calculate geometrical characteristics of plane sections.
* Draw bending and shear force diagrams in beams.
* Employ bending and shear stresses in beams.
* Solve problems involving shear stresses and shear flow in beams.
* Calculate stresses and strains in circular shafts subjected to torsion.
* Relate stresses in thin cylinders and spheres subjected to internal pressure.

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**FLUID MECHANICS**
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Introduction to fluid mechanics; properties of fluids (density, viscosity, vapour pressure); fluid equilibrium; units. **Fluid Statics**: The governing differential equations; pressure distributions, manometric pressure measurement; fluids in relative equilibrium (constant acceleration); forces on submerged surfaces; buoyancy. **One-dimensional flows with inertia**: 1-D mass conservation; 1-D momentum conservation (Bernoulli equation); total head diagrams; free liquid jets; flow measurement. **Hydraulic systems**: Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram); general loss coefficients; **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.
* Categorize one-dimensional mass and momentum conservation and applications of Bernoulli's equation
* Demonstrate skills for flow measurements
* Solve 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 2: **August 2015**
Next Revision: **August 2019**

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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Applications of 2nd order 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. **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. **Multiple Integrals**: 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 and boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. **Difference equations**: modeling with difference equations, methods of solution to first and second order difference equations. Basic computing in numerical methods (using Matlab or any other suitable program)

Learning Outcomes: On completing the course 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
- Aapplications such as Matlab, Mathematica, Maple, C++ etc

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**BUILDING MATERIALS**
Code	TCVI3612
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGS3591 Materials Science

Content: Overview of engineering properties, and test methods, and specifications for materials used in constructed facilities. **Aggregates:** physical and mechanical properties of aggregate properties affecting performance of concrete and bitumen mixtures such as, mineralogy, gradation, shape, strength, etc**. Concrete:** Cement production, hydration of cement, concrete mixture design, fresh and cured properties, concrete testing, grades of concrete, and concrete for special applications. **Masonry:** production and testing of cement bricks, cement paste, and cement motors. 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. **Steel:** Properties of carbon steel; selection and testing of structural and reinforcing steels, steels for concrete reinforcement, steel corrosion and ways of preventing corrosion. **Wood**: Mechanical properties of wood, effects of moisture on mechanical properties, wood safety -pyrosis (burning of wood) and pyrosis prevention. **Bitumen technology:** mechanical behavior of bitumen, penetration grading method, viscosity grading method and Superpave design, and bitumen mixture design methodologies. **Other materials**: Aluminium, polymers, and composites. **Professional Development**: laboratory report writing, presentation skills, team work activities.

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

Revision 2:	August 2015
Next Revision:	August 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- Identify composition and properties of common minerals and rocks
- Relate different soils and their strength
- Describe soil parameters and frictions
- Interpret elasto-plastic phenomena
- Explain Mohr and Coulomb approaches
- Discuss consolidation, model stresses and anisotropy with respect to soil mechanics
- Discuss geo-hydrology and groundwater flow

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**INFRASTRUCTURE PLANNING AND DESIGN I**
Code	TCVI3622
NQF Level	6
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	(TEGT3592 Engineering Mechanics I, TMNE3621 Introduction to Engineering Geology)

Content: Infrastructure planning: demographics; urbanization/urban planning; demand for infrastructure; cost and affordability; standards; social aspects and participatory approaches; land-use and infrastructure interaction: demand-driven approaches and development impact approaches. **Physical infrastructure**: Introduction to common infrastructure services for water, hydrology, transportation, buildings, wastes, urban and the built environment. **Civil engineering standards:** Civil engineering drawings, Codes and good practices. **The general planning and design process**: scenario planning, task scheduling, multi-tasking, forecasting. Presentation of reports with relevant technical specifications; creative thinking techniques, engineering methodology; modelling; system analysis; decision-making. **Environmental management:** the role of the civil engineers in environmental problem solving; sustainable development; agenda 21 and global environmental issues and problems; our common future growth versus development; population growth dynamics; tragedy of the commons; environmental problems as externalities; government intervention in environmental problem solving; environmental quality criteria and standards; environmental laws and regulations; integrated pollution control. **Systems approach**: system dynamics and feedback loops; modelling environmental systems through life-cycle assessment, decision making strategies and the environment.

Learning Outcomes: Upon completion of this module, students should be able to:
- Correlate population growth with development trends
- Apply the methodology used in infrastructure planning
- Paraphrase physical infrastructure
- Interpret civil engineering drawings
- Elaborate on the role of civil engineers in environmental problem solving
- Categorise planning and environmental laws and regulations
- Critique techniques for environmental impact assessment

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**SURVEYING FOR ENGINEERS I**
Code	TCVE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Introduction to surveying: theory of measurement errors; surveying instrumentation; observation and reduction of observations; levelling, taping and electronic distance measurement; setting out; longitudinal and cross sections; cut and fill and mass haul diagrams; areas and volumes; coordinate system use of hand-held and GPS survey systems. **Surveying calculations**: joins, polars; intersections; traverse; resections; triangulation; tri-lateration; tri-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:
- Overview surveying and its applications to engineering
- Distinguish the various techniques and tools used in practical surveying
- Match GPS survey systems
- Apply surveying calculations to an engineering problem
- Interpret contour and surface modelling software in surveying exercises

Revision 1:	September 2011
Next Revision:	September 2015

Module Title:	**STRENGTH OF MATERIALS II**
Code	TCVM3662
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TCVM3621 Strength of Materials I

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

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

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

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT I**
Code	TEGT3600
NQF Level	6
Total Hours	Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite	TEGW3590 Workshop Practice

Module Description: **:** During Industrial Attachment I, students will work under company supervision at the level of **Technician Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- 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: 2	September 2015
Next Revision:	September 2019

SEMESTER 1

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGR3761
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%); Lab 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: On completing the course 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 dataApply statistical tools to analyse data.

Revision 2:   August 2015
Next Revision: August 2019

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

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

Learning Outcomes: On completing the course students should be able to:
- 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 2:   August 2015
Next Revision: August 2019

Module Title	HYDROLOGY FOR ENGINEERS
Code	TCVD3741
NQF Level	7
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment:	Continuous 50% assignments, 2 Tests; Examination 50% (1 x 2 hours paper)
Pre-requisite(s)	TMEE3611 Fluid Mechanics

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

Learning Outcomes: Upon completion of this module, students should be able to:
- Summarise the hydrological cycle and describe methods for determination of evaporation and transpiration.
- Distinguish modelling floods and measuring stream flow.
- Discuss the processes that lead to soil erosion and sediment production.
- Discuss methods for flow measurement and hydrological modelling. Demonstrate knowledge of water quality control and quality assurance systems.

Revision 2: August 2015
Next Revision: August 2019

Module Title:	THEORY OF STRUCTURES
Code	TCVS3791
NQF Level	7
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment:	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	TCVM3662 Strength of Materials II

Content: Review of statics: Principle of indeterminacy and static stability of plane frames and trusses. Analyses of statically determinate beams; Truss analysis using method of joint resolution and method of sections. **Analysis of statically indeterminate structures: Force Method –** method of consistent deformations; **Displacement Method** – slope-deflection method and Hardy Cross moment distribution method. Analysis of two-hinged parabolic arches. **Influence lines for statically determinate structures:** Influence lines for beams and trusses. **Influence lines for statically indeterminate structures:** Beams and frames; Mueller-Breslau's principle. **Elastic instability:** Determination of critical loads of struts; Stability functions for axially loaded beams and frames. Southwell's Plot for the determination of critical buckling parameters. **Analysis of plates and simple shells. Introduction to matrix methods of structural analysis:** Flexibility and stiffness methods. **Introduction to structural dynamics:** Dynamic analysis. **Limit state design philosophy:** Ultimate limit states (ULS) and serviceability limit states (SLS) as applied to structural steelwork and reinforced concrete structures.

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

Revision 2: August 2015
Next Revision: August 2019

Module Title:	INFRASTRUCTURE PLANNING AND DESIGN II
Code	TCVD3721
NQF Level	7
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TCVI3622 Infrastructure Planning and Design I

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

Learning Outcomes: Upon completion of this module, students should be able to:
- Discuss the principles of forecasting and evaluation techniques
- Discuss decision support and decision making processes
- Explain techniques for environmental impact assessment
- Categorize techniques and tools of remote sensing
- Appraise computer applications for spatial analysis and evaluation (GIS)

Revision 2: August 2015

Next Revision: August 2019

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

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. Application of Simulation software.

Learning Outcomes: On completing the course students should be able to:
- Discuss properties and classification of soils and rocks
- Illustrate parameters used to represent shear strength and bearing capacity of soils
- Discuss the distribution of stresses in soils and rocks using elastic theory
- Demonstrate design principles for foundations
- Apply design principles of retaining walls with respect to respective earth pressures on structures
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Revision 2:	September 2015
Next Revision:	September 2019

Module Title	CONSTRUCTION MANAGEMENT
Code	TCVS3721
NQF Level	7
Contact Hours	**2**L + 1T or 1PS/Week
NQF Credits	8
Assessment:	Continuous 100% (Two Written Tests (50%); Written Reports (25%); Other Assignments (25%))
Pre- requisite(s)	None

Content: Project estimating and scheduling: principles of estimating and scheduling for the construction industry, engineer's preliminary and final estimates' quantity take off and cost and duration of major items related to a construction project, using manual and computer techniques. **Programming methods and work control**: methods and quantitative tools used to effectively plan, organize, and control construction projects: PERT, CPM, project planning Grant's diagram. **Bill of quantities**: Legislation for works contracts, tender document preparation, and tender evaluation. **Interpreting Engineering Drawings**: ability to convert engineering drawings into bill of quantities. **Work safety**. **Quality control** principles.

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

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

Revision 2: September 2015
Next Revision: September 2019

SEMESTER 2

Module Title:	**HYDRAULICS AND HYDRO-ENGINEERING**
Code	TCVD3712
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3641 Engineering Mechanics II, TMEE3611 Fluid 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, 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. Damper systems. Flow through spillways and stilling basins. Disturbed flows (bridges and culverts) **Basic design of hydraulic structures**: Spillways, stilling basins, weirs, culverts, dams, reservoirs, canals, irrigation schemes. Overview inland navigation.

Learning Outcomes: On completing the course students should be able to:
- Illustrate fluid properties and applications of Bernoulli equation to fluids
- Distinguish the characteristics of laminar flow and turbulent flow in fluids
- Compare the flow characteristics in pipes and channels
- Analyse basic fluid machinery including systems with pumps and pipe networks
- Discuss basic features of pipeline network design
- Discussr basic principles of pump design
- Explain characteristics of flows over free surfaces, including flows in spillways and stilling basins
- Discuss the characteristics of flows under bridges and in culverts
- Design common hydraulic structures such as culverts, dams, canals etc.
- Elaborate the basic principles of coastal engineering

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Water Supply: Importance of water supply to communities, water demand, water drawing; elevation, adduction, storage legislation and codes. **Distribution network:** Design and construction of pipelines, water facilities in buildings, unaccounted for water and leakage control. **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. **Urban drainage:** wastewater sources, variations, combined and separate collection systems, vacuum collectors. **System simulation:** Application of Simulation software to basic Water supply and Drainage networks.

Learning Outcomes: Upon completing the course students should be able to:
- Outline water supply systems and codes pertaining to water supply.
- Classify design and construction of water distribution networks.
- Categorise water quality determinants, water quality monitoring and standard.
- Determining techniques and instrumentation for water quality control.
- Summarise water quality control, quality assurance systems and leakage control.
- Discuss design and analysis of urban drainage systems and networks
- Outline computer simulations of water and wastewater networks

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Concept of reinforced concrete. Review of the physical and mechanical properties of concrete and reinforcing bars. Fundamentals of design process. Actions on structures. Material selection. Building regulations and codes of practice. Design philosophies. Elastic and limit state designs. Limit state design: bending, shear, twisting, buckling, deflection, cracking. **Design of reinforced concrete structural elements:** slabs (solid slabs, flat slabs, hollow slabs, ribbed slabs), beams, columns and foundations. Introduction to computational software packages. **Introduction to pre-stressed concrete design**, serviceability maximum stresses on pre-stressed steel bars, Loss of pre-stress force.

Learning Outcomes: On completing the course students should be able to:
- Carry out stress analysis of steel-reinforced concrete elements
- Apply design codes for steel-reinforced concrete structures
- Apply limit state philosophy to the design of reinforced concrete structures
- Formulate characteristic and design features of common structural members
- Use computational software packages in the analysis and design of reinforced concrete elements
- Solve general principles of design of pre-stressed concrete structures.

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Steel and timber constructions in engineering. Limit state philosophy and design in steel. Elastic and plastic moment design. Design of structural elements in steel and connections and joints. Limit state philosophy and design in timber. Elastic methods and design in timber. Design of structural elements in timber and timber connectors.

Learning Outcomes: On completing the course students should be able to:
- Recognize design features for steel structures and timber structures
- Discuss the limit-state design of structural steel members
- Design structural steel and timber elements, and their connections and joints

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**TRANSPORT PLANNING AND TRAFFIC ENGINEERING**
Code	TCVT3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	**TCVI3622 Infrastructure Planning and Design I**
Co-requisite(s)	TCVD3721 Infrastructure Planning and Design II

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

Learning Outcomes: On completing the course students should be able to:
- Apply transportation engineering principles for streets and highways with emphasis on the safe and efficient operation of roadway intersections
- Discuss road traffic and transport planning
- Correlate road safety management with traffic engineering
- Discuss main features of transport economy.
- Illustrate quantitative and computerized techniques for planning, designing, and operating transportation systems.

Revision 2:	September 2015
Next Revision:	September 2019

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: On completing the course students should be able to:
- Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
- Distinguish the methods used to carry out feasibility studies
- Develop a business plan relating to an engineering endeavor
- Separate the concepts of motivation, competencies, innovation and product marketing
- Relate the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Revision 2:	September 2015
Next Revision:	September 2019

Module title:	**RESEARCH PROPOSAL**
Code	TCVR3792
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)	TEGR3761 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 course students should be able to:
- Present their research proposal in a seminar
- Produce an acceptable typed and bound research proposal

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

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

Revision 2: September 2015
Next Revision: September 2019

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 100%
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: engineering societies and registration procedure for different engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**
Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.
Learning Outcomes: On completing the course students should be able to:
- Identify the role of various engineering disciplines and societies
- Paraphrase the importance of engineering professional ethics and its enforcement by the regulating bodies
- Illustrate the use of engineering codes and standards
- Justify general knowledge of procedural law, law of contracts, commercial law and employment law
- Relate laws of arbitration
- Classify technology policy on the acquisition of technological know-how
- Summarise the strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**PROJECT MANAGEMENT**
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 50% (2 assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.
Learning Outcomes: On completing the course students should be able to:
- Recognise 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
- Demonstrate knowledge of the principles of managing medium to large scale engineering projects
- Hypothesize the principles of managing community-based development projects
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**STRUCTURAL ENGINEERING**
Code	TCVS3811
NQF Level	8
Contact Hours	**4**L + 1T/Week
NQF Credits	16
Assessment	Continuous 50% (2 assignments, 2 Tests) making **30%,** presentation (**10%**) and report (**10%**; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TCVS3761 Design of Steel and Timber Structures, TCVC3792 Reinforced and Pre-stressed Concrete Design

Content: Relationship between architectural forms and structural systems. Composite design and construction in steel and reinforced concrete. Plastic methods of structural analysis: Beams and frames. **Limit analysis for slabs:** Yield line analysis and the simple strip method for slabs. **Structural analysis and design of buildings:** Gravity loads; Lateral loads. Lifts, shafts, and shear walls. **Introduction to computational packages:** ANSYS, SAP, ETABS, STAD.Pro, etc. **Overview of special structures:** Design of retaining walls; Water tanks and reservoirs. Modern structural systems. Introduction to industrialized building systems**. Layout and topologies for bridges.** Drawings of a bridge project. Bridge foundations. Bridge trusses. Suspended bridges.

Learning Outcomes: On completing the course students should be able to:
- Discuss main features of design of steel and concrete composite members
- Use plastic methods to design steel beams and frames
- Analyse building frames subjected to gravity, lateral or gravity and lateral loads
- Discuss modern structural systems in buildings and the concept of industrialised building systems
- Compare structures of buildings
- Interpret various layouts and topologies for bridges and illustrate them with engineering drawings
- Apply computational software packages in the analysis and design of structures.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**ROAD PAVEMENT AND GEOMETRIC DESIGN**
Code	TCVD3871
NQF Level	8
Contact Hours	**4**L + 2Tor 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) Examination 50% (1 x 3 hour paper
Co-requisite(s)	TCVD3682 Soil Mechanics

Content: Design of Urban and Rural Roads: geometrical design, junctions, traffic calming, capacity, location and design; rural and urban at-grade intersection design; grade separations; interchanges; parking lots and terminals. **Pavement Design**: Pavement Type, Stress, strain and deflection, Traffic volume and load, Materials for road construction, soil stabilization, structural pavement design, design of surface treatment, gravel roads, and maintenance and rehabilitation. **Road Construction Materials**: Road construction technology. **Drainage**: drainage installations for roads.

Learning Outcomes: On completing the course students should be able to:
- Discuss main features of design of steel and concrete composite members
- Use plastic methods to design steel beams and frames
- Analyse building frames subjected to gravity, lateral or gravity and lateral loads
- Discuss modern structural systems in buildings and the concept of industrialised building systems
- Compare structures of buildings
- Interpret various layouts and topologies for bridges and illustrate them with engineering drawings
- Apply computational software packages in the analysis and design of structures.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**RAILWAYS AND PUBLIC TRANSPORT SYSTEMS**
Code	TCVD3881
NQF Level	8
Contact Hours	**3**L + 1Tor 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) Examination 50% (1 x 3 hour paper
Pre-requisite(s)	TCVD3682 Soil Mechanics

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

Learning Outcomes: Upon completion of this module, students should be able to:
- Discuss the main features of railway transport systems
- Elaborate on the infrastructure, general layouts and geometry of railway lines.
- Outline properties and stabilization methods for soils suitable for railway lines
- Develop basic designs of railway lines, passenger platforms and traffic control
- Evaluate motorized public transport systems
- Outline the key features of the design, layout and safety of aerodromes

Revision 2:   September 2015
Next Revision: September 2019

Module title:	**WASTEWATER AND SOLID WASTE MANAGEMENT**
Code	TCVI3881
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hours paper)
Co-requisite(s)	TCVD3782 Urban Water Systems
Pre-requisite(s)	TCVI3622 Infrastructure Planning and Design I

Content: **Wastewater Management**: Available technologies. Theory and basic design of processes for wastewater treatment. Sludge treatment and disposal, process train selection. Linking source water quality to process design: principles, experimental and pilot plant studies, design criteria, parameters for design of treatment processes. Legislation and codes. Rural, semi-urban, domestic and industrial sewerage. **Solid Waste Management:** Characterization of solid wastes, sources, quantities, characteristics. Solid waste collection and transportation systems, ultimate disposal systems. Design of landfills: site selection, environmental impact assessment of waste disposal. Treatment of solid waste for energy production. Production of biogas from semi-solid waste.

Learning Outcomes: On completing the course students should be able to:
- Discuss methods and technologies used in wastewater treatment.
- Identify parameters for design of wastewater treatment, sludge treatment and disposal.
- Discuss legislation and codes of practice for wastewater treatment.
- Elaborate the characteristics of solid wastes and techniques for solid waste management.
- Correlate solid waste disposal systems with the design of landfills.
- Combine life-cycle assessment and material flow analysis in solid waste management.
- Appraise solid waste treatment including biogas production from waste.

Revision 2:   September 2015
Next Revision: September 2019

SEMESTER 2

Module title:	**RESEARCH PROJECT**
Code	TCVR3892
NQF Level	8
Contact Hours	17.5 hours of Research Work per week (17.5 hours x 16 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation
NQF Credits	30
Assessment:	Continuous 100% Two Seminar Presentations (**30%**); Final Oral Presentation of Dissertation (**20%**); Final Written Dissertation (**50%**)]
Co-requisite(s)	TCVR3792 Research Proposal

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
- 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 2: September 2015
Next Revision: September 2019

Module Title:	**CIVIL ENGINEERING DESIGN PROJECT**
Code	TCVD3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Module Description: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
- Identify 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.
- Illustrate 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 2: September 2015
Next Revision: September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. 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

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

- Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
- Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Discuss the role of engineers in the management and organization of engineering enterprises
- Discuss in details the main technical activities undertaken during the attachment

Revision 2: September 2015
Next Revision: September 2019

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

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

H.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.

H.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	TEGT3561	5	8	None
1	*Physics for Physical Sciences* I	SPHY3511	5	16	None
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	5	12	None
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**72**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	*Physics for Physical Sciences* II	SPHY3512	5	16	SPHY3511
2	Fundamentals of Electrical Engineering	TEGT3542	5	8	None
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	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	TEGT3542
1	Analogue Electronics I	TETE3691	6	12	**TEGT3542**
	Software Engineering	TCEE3661		8	**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	Applied Electromagnetics	TTCE3622	6	8	**SPHY3512**
2	Signals and Systems	TTCE3692	6	12	TEGT3671
2	Measurements and Instrumentation	TETA3622	6	8	TEGT3542
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Computer Programming	TCMS3692	6	12	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	TEGW3590
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Experimental and Research Methods	TEGR3761	7	8	**EGS3691**
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	Telecommunication Principles	TTCE3741	7	8	**TEGT3542** TTCE3692
1	Programmable Electronics Design	TETD3791	7	12	TETD3692
1	Microprocessor Systems	TCEE3791	7	12	**TETD3692**
Total Credits Semester V				**72**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Embedded Systems Design I	TETD3792	7	12	**TETD3692** TCEE3791
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Electronics Product Development	TCEE3782	7	8	TEGT3761
2	Digital Communication	TTCD3792	7	12	TETA3791 TETD3692
2	Operating Systems	TCME3792	7	12	**EGS3691** TTCE3741
2	Database Systems	TCMS3792	7	12	TCEE3791
2	Research Proposal	TCER3792	7	4	TCME3521
2	Industrial Attachment II	TEGT3700	7	-	TEGT3741
Total Credits Semester VI				**76**	

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	TEGT3742
1	Project Management	EGM3881	8	12	**TEGT3761**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Digital Signal Processing	TCEE3831	8	16	**TTCE3692**
1	Embedded Systems Design II	TETD3831	8	16	**TETD3792**
1	Wireless Communication	TCEW3891	8	12	**TTCE3741** TTCD3792
Total Credits Semester VII				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Research Project	TCER3839	8	30	All 3rd Year Modules
2	Design Project	TCEE3890	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**

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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Course Lines and planes:vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. **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**. Introduction to complex numbers.:**definition, addition, subtraction, multiplication, division of complex numbers. Demoivres' theorem .**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, the chain rule, differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, 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
- Manipulate sequence and series of numbers
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	ENGINEERING DRAWING
Code	TEGT3561
NQF Level	5
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%(minimum of 2 tests and 4 drawing assignments) , Examination 40% (1 x 2 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.

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

Revision 2: August 2015
Next Revision: August 2019

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

Contents: Units, significant figures & 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 2015
Revision: January 2019

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

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 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 2015
Next Revision:	September 2019

Module Title:	WORKSHOP PRACTICE
Code	TEGW3590
NQF Level	5
Contact Hours	2h Lectures + 4h Practical Sessions per week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

Learning Outcomes: Upon completion of this course, students should be able to:
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.
Describe the general operation of air-conditioning and refrigeration systems.

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Classification of engineering materials: metals, ceramics, plastics, composites. Competition among materials, future trends of material usage. **Structure of materials**: Atomic structure; Bragg's law, electronic configuration, atomic bonding. Crystalline structure; amorphous structure, crystallographic planes and directions, Miller indices. Structure-property relationships. **Crystalline imperfections and diffusion**: Point defects, metallic solid solutions, line defects, slip systems, diffusion in solids. **Solidification and Microstructure:** Nucleation from the liquid state, inoculation, grain growth and grain size, development of microstructure, practical preparation of microsections. **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 ferrous and non-ferrous alloy systems. **Heat Treatment**: Annealing, normalizing, quench hardening, tempering. Solid solution hardening, strain hardening (cold working), annealing and recrystallization, precipitation hardening. **Properties of Materials:** Overview of electrical, optical and thermal properties of materials. **Mechanical properties**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, fatigue test, creep. **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: On completing the course students should be able to:
- Distinguish between different classifications of engineering materials
- Competently describe the electronic and crystalline structure of materials with associated imperfections
- Demonstrate an understanding of solidification and generation of microstructure in metallic materials
- Describe the formation of alloys and associated microstructures using binary equilibrium phase diagrams
- Describe the various procedures for heat treatment of ferrous and non-ferrous metals and alloys
- Distinguish between various properties of materials with special emphasis on mechanical properties and testing
- Describe the processes of corrosion and oxidation and the techniques used to control corrosion and degradation..

Revision 1:   September 2015
Next Revision: September 2019

Module Title	**CONTEMPORARY SOCIAL ISSUES**

Code   UCSI3580
NQF   5
Contact Hours   1 Contact hours per week for 28 weeks
Credits   8
Assessment   Continuous Assessment (100%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite   None

Content: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students, with special reference to their sexual behaviour and to inculcate the primacy of moral reasoning in their social relations and their academic lives. In achieving the above aim, the following values and approaches will inform the CSI: Material will be presented on an integrative basis, stressing the interconnections amongst ethics, moral reasoning, citizenship, leadership, and values and approaches that direct to responsible social behaviour. Special emphasis will be placed on the construct of citizenship and its relation to democracy and the common good. Critical transformative theory will under gird the content of CSI. After completion of the CSI students will be empowered in the domains of human sexuality, reproductive health, democracy, the environment, sustainable development, and responsible leadership. Flexible modes of assessment may be harnessed and students are required to sign the class attendance list each time after a class session. Compulsory attendance required.

Learning Outcomes: Upon completion of this module, students should be able to:
- Practice ethical reasoning
- Demonstrate knowledge to make informed decisions as responsible citizens
- Empower themselves to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship and give back such values to the community, nation, and world
- Sensitise towards the meaning of values and morals and how they affect the attitudes of individuals and groups toward population issues
- Recognise the need of balance between freedom and responsible behaviour
- Discuss stewardship/custodianship of the environment and sustainability of ecosystem services
- Explain how human activities affect the environment and the sustainability of ecosystem services.

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% (minimum 2 tests and 4 assignments), 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. **Integration techniques**: integration by parts, integration by trigonometric substitution; Reduction formula, integration by partial fractions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length etc…. **Differential equations**: Meaning of solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Power series**: radius and interval of convergence. **Power series representation of functions:** Taylor and Maclaurin series. Binomial theorem. Power series solutions of second order ordinary differential equations with variable coefficients. Introduction to Bessel's equation and Bessel functions. **Complex functions**: Cauchy -Riemann equations.

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
- Apply the power series techniques to solve second order odes with variable coefficients
- Apply and solve engineering problems using Bessel's functions
- Classify complex functions

Revision 1:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2015
Revision:	January 2019

Module Title	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Code	TEGT 3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100%
Pre-requisite(s)	None

Content: 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, Kirchhoff'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 2:	September 2015
Next Revision:	September 2019

Module Title:	**ENGINEERING MECHANICS I**
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); 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, Analysis of frames and machines.

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.

Revision 2:	September 2015
Next Revision:	September 2019

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

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

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

- 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 2015
Revision:	January 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 6*0% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)*
	Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE

Content: **Structure of materials**: 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 2015
Next Revision:	September 2019

YEAR 2 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation, Jacobian matrices. **Applications**: optimization on surfaces , constrained optimization . **Integral Transforms**: Laplace Transforms(LT) with applications to differential equations. Introduction to Fourier series. Fourier Transforms. Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems. **Analytic functions**: Cauchy's theorem, Cauchy's integral formula, Taylor series, singular points, poles. Laurent series, Residue theorem and evaluation of complex integrals.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
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 C programing language.

Learning Outcomes: On completing the course 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 simple C programs

Revision 1:	September 2015
Next Revision:	September 2019

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

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: On completing the course 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 2015
Next Revision: September 2019

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

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

Learning Outcomes: On completing the course 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
- Appreciate basic queuing theory

Issue Date 2: September 2015
Revision: September 2019

Module Title	**ELECTRIC CIRCUIT ANALYSIS I**
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%(assignments, 2 Tests) , Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3542 Fundamentals of Electrical Engineering

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

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

Issue Date 2:	September 2015
Revision:	September 2019

Module Title	**ANALOGUE ELECTRONICS I**
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%(assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3542, 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: On completing the course students should be able to:
o Discuss the atomic structure of semiconductor materials
o Discuss the construction and operation of semiconductor diodes.
o Analyse and design diode based circuits.
o Discuss the construction of BJT transistors
o Analyse and design BJT transistor amplifier and switching circuits
o Discuss the construction of FET transistors
o Analyse and design FET biasing circuits
o Discuss the internal circuitry for op-amps
o Discuss the operation of op-amps
o Analyse and design basic op-amp circuits
o Use EDA software to analyse electronic circuits..

Issue Date 2:	September 2015
Revision:	September 2019

Module Title	**SOFTWARE ENGINEERING**
Code	TCEE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCME3621 Computer Science for Engineers

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

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

Issue Date 2:   September 2015
Revision: September 2019

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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Applications of 2nd order 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. **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. **Multiple Integrals**: 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 and boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. **Difference equations**: modeling with difference equations, methods of solution to first and second order difference equations. Basic computing in numerical methods (using Matlab or any other suitable program)

Learning Outcomes: On completing the course 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
- Aapplications such as Matlab, Mathematica, Maple, C++ etc

Revision 2:	August 2015
Next Revision:	August 2019

Module Title	**APPLIED ELECTROMAGNETICS**
Code	TTCE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	SPHY3512 Physics for Physical Sciences II

Content: Review of Vector Algebra: Classification of vector fields. **Electrostatics**: Coulomb Law & Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equations for static EM fields. Electric potential. **Electric Field in Material Space**: 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; 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 for time varying fields; Application of Ampere's Law Magnetic Flux Density; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices; Magnetic Torque and Movement; Magnetization in Materials. Magnetic Boundary Conditions. Inductor and Inductance; Magnetic Energy.

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

Revision 2:	August 2015
Next Revision:	August 2019

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

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

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

Revision 2: August 2015
Next Revision: August 2019

Module Title	**MEASUREMENTS AND INSTRUMENTATION**
Code	TETA3622
NQF Level	**6**
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGT3542 Fundamentals of Electrical Engineering** 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 (including high frequency signals), Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Introduction to Programmable Logic Controllers (PLCs).

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

Revision 2: August 2015
Next Revision: August 2019

Module Title	DIGITAL ELECTRONICS
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETE3691 Analogue Electronics I

Content: : Fundamental Digital concepts: Logic levels, number systems and digital codes. **Combinational Logic:** logic gates, Boolean algebra, logic simplification, combinational logic functions (including arithmetic circuits, encoders and decoders, multiplexers and demultiplexers, comparators, parity checkers and generators). **Sequential Logic:** latches flip-flops, counters, shift registers. **Design of Digital Systems**. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.
Learning Outcomes: On completing the course students should be able to:
- 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
- Discuss and analyse the internal circuitry of different logic family technologies.
- Design interfaces between circuits of different logic families.

Revision 2:   August 2015
Next Revision: August 2019

Module Title	COMPUTER PROGRAMMING
Code	TCMS3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100%
Co-requisite(s)	TCME3621 Computer Science for Engineers

Content: Problem Solution and Software Development: Top-down stepwise refinement approach. **Structured Programming:** variables and constants; comments, input and output and file management. Elements of data structures. **C Declarations, Expressions and Operators**: Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Enums and Structs. **Selection Structures**. Using if statements; the Nested if; the switch statement; the Conditional Operator; the Logical AND; the Logical OR. Selection with Structure Fields. **Repetition Structures**. The **while** loop; Writing typical Loops; The for Loop; Nested Loops; Using Loops with Structure Fields. **Arrays, Strings, and Pointers**: Arrays; Storing Values in Arrays; Accessing and Using Array Values; Creating Arrays of Structure Objects; Using Strings; Pointers in C. The **C Functions**: Functions definition; Functions declaration; Functions calling; Functions arguments; Recursion and Recursive Functions to Sort a List. **Object Oriented Programming: Classes**. Creating Classes; Encapsulating Class Components; Implementing Class Functions; Using Static Class Members; Polymorphism. **Advanced Topics**: Class Features and Design Issues; Friends and Overloading Operators; Overloading Functions; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; Using Enumerators;
Learning Outcomes: On completing the course students should be able to:
- Apply problem solving techniques to computational and engineering problems.
- Design and present algorithms for solving given problems using flowchart or pseudo code.
- Develop structured programs in C programming language.
- Use pointers effectively
- Describe concept of object-oriented programming.
- Work with object oriented concepts and terminologies such as Abstraction and Abstract Data Types, Classes, Objects, Methods, Encapsulation, Inheritance, and Polymorphism.
- Demonstrate the programming methodology in object-oriented programming and write and successfully run a program in C++
Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**INDUSTRIAL ATTACHMENT I**
Code	TEGT3600
NQF Level	6
Total Hours	Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite	TEGW3590 Workshop Practice

Module Description: **:** During Industrial Attachment I, students will work under company supervision at the level of **Technician Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
- Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- 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: 2   September 2015
Next Revision: September 2019

YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGR3761
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%); Lab 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: On completing the course 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 dataApply statistical tools to analyse data.

Revision 2:   August 2015
Next Revision: August 2019

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

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

Learning Outcomes: On completing the course students should be able to:
- 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 2:   August 2015
Next Revision: August 2019

Module Title	**ELECTRIC CIRCUIT ANALYSIS II**
Code	TECE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**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: On completing the course 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 2: August 2015
Next Revision: August 2019

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, feedback transistor based oscillator circuits including high frequency circuits design principles), Power Supplies, Power electronics devices and applications.

Learning Outcomes: On completing the course students should be able to:
- 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 2: August 2015
Next Revision: August 2019

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TTCE3692 Signals and Systems
Pre-requisite(s)	**TEGT3542 Fundamentals of Electrical Engineering**

Content: **Review of signal models and analysis**: Periodic and non-periodic signals; transform theorems and power spectra. **Basic notions and definitions**: Bandwidth, Baseband, Broadband, Narrowband and Wideband**,** Full vs. Half Duplex**,** Analogue vs. Digital transmission**,** Connection Oriented vs. Connectionless Communication**,** Circuit Switching vs. Packet Switching**,** Switching vs. Routing**,** Local Area vs. Wide Area Networks**,** The PSTN vs. the Internet; Radio Spectrum. **Noise**: Noise sources, noise figure and noise temperature; noise models. **Components of a Communication System:** communication channels and their characteristics such as bandwidth, channel capacity**,** distortion, noise and other impairments. Standards Organizations. **Analog modulation Technique**: Amplitude Modulation, Double Sideband Suppressed Carrier, Single Sideband, Vestigial Sideband; Frequency Modulation, Phase Modulation; comparison of angle and linear modulation systems. **Introduction to Analogue Pulse modulation Techniques**: Amplitude shift keying, phase-shift keying and frequency-shift keying. **Multiplexing techniques**: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM), PCM, WDM. Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication.

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

Revision 2:	August 2015
Next Revision:	August 2019

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%)
Co-requisite(s)	TETD3692 Digital Electronics

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

Learning Outcomes: On completing the course students should be able to:
- 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 2:	August 2015
Next Revision:	August 2019

Module Title	**MICROPROCESSOR SYSTEMS**
Code	TCEE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TETD3692 Digital Electronics

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

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

Learning Outcomes: On completing the course students should be able to:
- 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 2:   August 2015
Next Revision: August 2019

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: On completing the course 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 endeavor
- 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 2:	August 2015
Next Revision:	August 2019

Module Title	**EMBEDDED SYSTEMS DESIGN I**
Code	TETD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TCEE3791 Microprocessor Systems
Pre-requisite(s)	TETD3692 Digital Electronics

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

Learning Outcomes: On completing the course students should be able to:
- Differentiate between microcomputers, microprocessors and microcontrollers.
- Discuss different types of microcontroller architectures.
- 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 2:	August 2015
Next Revision:	August 2019

Module Title	**COMPUTER NETWORKS**
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite	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 and troubleshooting. **Network security**: Threats, secret-key crypto, public key Algorithms, intrusion detection, authentication systems, Kerberos, email security (PGP, S/MIME), firewalls, WWW security.

Learning Outcomes: On completing the course students should be able to:
- 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.
- Independently study and make a presentation on one emerging network technology.

Revision 2:   August 2015
Next Revision: August 2019

Module Title	**ELECTRONIC PRODUCTS DEVELOPMENT**
Code	TCEE3782
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (Assignments 20%, Labs 30%, Mini Project 50%)
Co-requisite(s)	(TETD3692 Digital Electronics), (TETA3791 Analogue Electronics II)

Content: 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 course 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 2:   August 2015
Next Revision: August 2019

Module Title	DIGITAL COMMUNICATION
Code	TTCD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TTCE3642 Telecommunications Principles
Pre-requisite(s)	**EGS3691 Statistics for Engineers**

Contents: Digital communications concepts and terminology: Definition and elements of a digital communications system, comparison of analogue and digital communication systems. **Source Formatting:** The digital representation of data, sampling, quantization, pulse code modulation. Quantization noise, companding, standards for companding. Voice codecs and codec standards. **Multiplexing and multiple access schemes**: Frequency division, time division, and code division multiplexing. Comparison of frequency division and time division multiplexing. **Baseband Communication**: Basic lines codes, comparison and spectral estimation of line codes, coding standards for LAN and telecommunications networks. Baseband detection, error rate calculation. Intersymbol interference and equalization. Eye diagrams. Signal transmission, comparison of repeaters and regenerators. **Information Theory**: Definition of Information, entropy, conditional entropy and redundancy, entropy rate, channel capacity. **Source and Channel Coding**: Symbol source encoding, Speech coding, representation and analysis of codes, types of errors, Error control coding, Linear block codes, generator and parity check matrices, syndrome testing, typical linear block codes and their applications. Cyclic codes, polynomial representation of codes, convolutional codes, Turbo codes. **Data Transmission**: Baseband data transmission through a channel, intersymbol interference, baseband error probabilities, M-ary coding, channel capacity. **Receiver design**: General binary and M-ary signaling; Maximum-likelihood receivers; Performance in an AWGN channel.
Learning Outcomes On completing the course students should be able to:
- Discuss the difference between analogue and digital communication systems
- Describe source formatting, in particular, sampling, quantization, signal to quantization noise ratio
- Analyse and Design error correction codes and decoding techniques.
- Analyze and select digital communication techniques for band limited channels.
- Use simulation packages (e.g. MATLAB or equivalent) to evaluate the performance of various digital communications systems

Revision 2:	August 2015
Next Revision:	August 2019

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 and Overview: General overview of operating systems and basic concepts. **OS organization:** OS services, System calls, User interface, Shell command interpreter, OS design and implementation, Virtual machines. **Processes:** Process concept, Process state, Process management. **Threads**: Threads concept, Threads versus processes, P-Threads, Multi-threaded applications. **Scheduling:** Short-term CPU scheduling, Longer-term scheduling, Priority scheduling, Size-based scheduling. **Concurrency and Synchronization:** Concurrent processes, Contention, Synchronization issues, Critical sections. **Deadlocks:** Deadlock Deadlock detection and prevention. **Memory Systems:** Memory layout, Memory management, Hardware and software support for addressing, Segmentation versus paging. **Virtual Memory**: Virtual memory systems, Memory hierarchy, Hardware and software support, Page tables, Page faults and TLBs. **File System Interface**: File system concepts, File operations, Basic storage, File management issues. **File System Implementation:** File system design issues, Original Unix file system, Unix fast file system, Inodes, Caching, File system optimization. **Storage and I/O Systems:** Storage systems, Speed. Capacity, Reliability, RAID systems, Input/output. Memory-mapping**,** Peripheral devices, Networked I/O, Storage Area Networks.
Learning Outcomes On completing the course students should be able to:
- Discuss the core functionality of modern operating systems such as Windows and Unix based systems
- Discuss key concepts and algorithms in operating system implementations
- Investigate the kernel interface, files, processes, and inter-process communication for modern operating systems.
- Implement simple concepts of Operating Systems
- Write programs that interface to the operating system at the system-call level.

Revision 2:	August 2015
Next Revision:	August 2019

Module Title	DATABASE SYSTEMS
Code	TCMS3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Co-requisite(s)	(TCME3521 Computing Fundamentals)

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

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

Revision 2:	August 2015
Next Revision:	August 2019

Module title:	RESEARCH PROPOSAL
Code	TCER3792
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)	TEGR3761 Experimental and Research Methods

Content: 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 course students should be able to:
- Make a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

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

Revision 2: September 2015
Next Revision: September 2019

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 100%
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: engineering societies and registration procedure for different engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.

Learning Outcomes: On completing the course students should be able to:
- Identify the role of various engineering disciplines and societies
- Paraphrase the importance of engineering professional ethics and its enforcement by the regulating bodies
- Illustrate the use of engineering codes and standards
- Justify general knowledge of procedural law, law of contracts, commercial law and employment law
- Relate laws of arbitration
- Classify technology policy on the acquisition of technological know-how
- Summarise the strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

Revision 2:   September 2015
Next Revision: September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 50% (2 assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:
- Recognise 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
- Demonstrate knowledge of the principles of managing medium to large scale engineering projects
- Hypothesize the principles of managing community-based development projects
- 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 2:   September 2015
Next Revision: September 2019

Module Title	CONTROL ENGINEERING
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

Contents: Control Systems Basics: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems:** Laplace transform review**,** transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of electrical systems. **Control System Analysis:** system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques:** Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators.

Learning Outcomes: On completing the course students should be able to:
- 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.
- Use engineering software for modelling, analysis and design of control systems

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	DIGITAL SIGNAL PROCESSING
Code	TCEE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (2 Assignments and 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite	TTCE3692, Signals and Systems;

Contents: Introduction: Review of signal classes and the sampling theorem, overview of analog-to- digital and digital-to-analog conversion. **Discrete-Time Signals and System**s: Analysis of discrete-time linear time-invariant (LTI) systems, difference equations, implementation. **The z-Transform**: definition, properties, rational z-transforms, inverse of z-transform, analysis of LTI systems in the z-domain. **Frequency-Domain Analysis**: Discrete-time Fourier transform (DTFT), frequency response of LTI systems, frequency selective filters, inverse systems and deconvolution **Sampling and Reconstruction**: Discrete-time processing of continuous-time signals, quantization errors, sampling of bandpass signals. **DFT and FFT**: Discrete Fourier Transform, complexity of filtering, radix-2 fast Fourier transform. **Implementation of Discrete-Time Systems**: Structures for the realization of discrete-time systems, FIR systems, IIR systems, representation of numbers. **Digital Filter Design**: General considerations, symmetric and antisymmetric FIR filters, FIR filter design using windows, IIR filter design by using bilinear approximation. **Applications to audio, image and video processing**.

Learning Outcomes: Upon completing the course students should be able to:
- Discuss the fundamental concepts of DSP
- Apply mathematical and basic science tools in analysis of discrete signals and systems
- Apply mathematical and basic science tools for signal processing
- Design, implement and test digital filters.
- Develop audio and video systems incorporating DSP algorithms

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**EMBEDDED SYSTEMS DESIGN II**
Code	TETD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 100%
Pre-requisite(s)	TETD3792 Embedded Systems Design I

Contents: Embedded systems design methodology; Embedded C programming (using AVR compiler or equivalent**):** C versus Assembly, header files, variables, constants, data types, type casting, operators (including bitwise operators), expressions, control statements. Built-in and user defined functions, (including prototyping and declaration. Pointers and arrays, structures and unions. Accessing different memory types. Timers and interrupts**; Advanced Applications:** e.g. ADC, PWM stepper motor control, USB applications, Serial Peripheral Interface (SPI) (e.g. SD card) applications, UART applications (including communication with PCs and AT based modems and devices), EEPROM usage, state machines; **Advanced embedded systems programming concepts:** processes, tasks, device drivers; **Embedded Systems Performance:** optimisation and algorithmic efficiency (memory and speed), levels of optimisation, embedded systems performance analysis, power consumption optimisation. Optimisation trade-offs. Mini group projects.

Learning Outcomes: On completing the course students should be able to:
- 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
- Execute micro-controller based individual and/or group projects effectively.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**WIRELESS COMMUNICATION**
Code	TCEW3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (2 Assignments and 2 Tests), Examination 50% (1 x 3 hour paper)
Co-requisites	TTCD3792 Digital Communication
Pre-requisites	**TTCE3741 Telecommunication Principles**

Contents: Radio transmission: Propagation models, ground wave, space wave, ionospheric propagation, interference, noise analysis, Doppler effect. **Multiuser Communication**: Multiuser communication techniques, access techniques, interference mitigation techniques. **Mobile Telephony**: Telephone systems, frequency reuse technique, cellular architecture, handover techniques, mobility management. **Satellite Communication**: Geometry, transmission and access technique, radio sub systems, link design, network, application. **Mobile Communications Systems**: GSM, UMTS and LTE Network. Wireless Local Area Network: IEEE802.11, Bluetooth and IEEE802.15.4 based sensor networks. Individual students project on selected topics in wireless communication.
Learning Outcomes: On completing the course students should be able to:
- Discuss the Architecture and operation of wireless communications networks
- Identify and discuss the fundamental operational and design problems of wireless communication systems
- Apply basic techniques to design point to point wireless links and basic communication systems
- Discuss network planning in wireless communication
- Discuss basic technical standards related to 2G/3G/4G wireless systems
- Make a presentation on independently studied selected topic in wireless communication.

Revision 2:	September 2015
Next Revision:	September 2019

SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TCER3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	**Continuous 100%** Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s)	TCER3792 Research Proposal; All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

Module Title	DESIGN PROJECT
Code	TCEE3890
NQF Level	8
Contact Hours	Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
NQF Credits	34
Assessment	**Continuous 100%** [Two Seminar Presentations (30%); Oral Presentation of Design (20%); Final Design (50%)]
Co-requisite(s)	All third year modules

Content: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
- 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 2:	August 2015
Next Revision:	August 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. Module may be required before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

- Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
- Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Discuss the role of engineers in the management and organization of engineering enterprises
- Discuss in details the main technical activities undertaken during the attachment.

Revision 2: August 2015
Next Revision: August 2019

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	TEGT3561	5	8	None
1	*Physics for Physical Sciences* I	SPHY3511	5	16	None
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	5	12	None
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**72**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	*Physics for Physical Sciences* II	SPHY3512	5	16	SPHY3511
2	Fundamentals of Electrical Engineering	TEGT3542	5	8	None
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 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 ELECTRICAL ENGINEERING - 152 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3592
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	TEGT3542
1	Analogue Electronics I	TETE3691	6	12	**TEGT3542**
1	Computer Aided Drawing	TEGT3661	6	8	TCME3521 **TEGT3561**
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	Applied Electromagnetics	TTCE3622	6	8	**SPHY3512**
2	Signals and Systems	TTCE3692	6	12	TEGT3671
2	Measurements and Instrumentation	TETA3622	6	8	TEGT3542
2	Digital Electronics	TETD3692	6	12	TETE3691
2	Electrical Machines	TECP3622	6	8	**TEGT3542**
2	Computer Programming	TCMS3692	6	12	TCME3621
2	Industrial Attachment I	TEGT3600	6	-	TEGW3590
Total Credits Semester IV				**76**	

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
1	Experimental and Research Methods	TEGT3741	7	8	**TEGS3691**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Electric Circuit Analysis II	TECE3791	7	12	**TECE3691** TEGT3671
1	Fundamentals of Power Systems	TECE3731	7	16	**TECE3691** TECE3791
1	Electrical Machines Analysis and Design	TECE3711	7	16	**TECP3622**
1	Power Electronics	TECC3791	7	12	TETE3691
Total Credits Semester V				**72**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	High Voltage Engineering	TECP3792	7	12	TECE3731
2	Computer Networks	TCMH3722	7	8	**TCME3521**
2	Power Transmission and Distribution	TECP3732	7	16	TECE3731 **TECP3622**
2	Electrical Engineering Design	TECE3762	7	8	TECE3731 TECE3711
2	Renewable Energy Technologies	TECC3792	7	12	**TEGT3542**
2	Research Proposal	TECR3792	7	4	TEGT3741
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**68**	

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	TEGT3742
1	Project Management	TEGM3881	8	12	**TEGT3761**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Computation Methods in Power Engineering	TECE3891	8	12	TECP3831 **TECE3731**
1	Power Systems Protection	TECP3831	8	16	**TECE3791**
1	Microprocessor & Programmable Logic Controllers	TECP3851	8	16	**TETD3692**
Total Credits Semester VII				**76**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE&CO-REQUISITE
2	Research Project	TECR3892	8	30	All 3rd Year Modules
2	Electrical Design Project	TECD3890	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 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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Course Lines and planes:: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. **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**. Introduction to complex numbers.:**definition, addition, subtraction, multiplication, division of complex numbers. Demoivres' theorem .**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, the chain rule, differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, 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
- Manipulate sequence and series of numbers
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- . Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3561
NQF Level	5
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%(minimum of 2 tests and 4 drawing assignments) , Examination 40% (1 x 2 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.

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

Revision 2:	August 2015
Next Revision:	August 2019

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

Contents: Units, significant figures & 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 2015
Revision:	January 2019

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

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 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 2015
Next Revision:	September 2019

Module Title:	WORKSHOP PRACTICE
Code	TEGW3590
NQF Level	5
Contact Hours	2h Lectures + 4h Practical Sessions per week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

Learning Outcomes: Upon completion of this course, students should be able to:
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.
Describe the general operation of air-conditioning and refrigeration systems.

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Classification of engineering materials: metals, ceramics, plastics, composites. Competition among materials, future trends of material usage. **Structure of materials**: Atomic structure; Bragg's law, electronic configuration, atomic bonding. Crystalline structure; amorphous structure, crystallographic planes and directions, Miller indices. Structure-property relationships. **Crystalline imperfections and diffusion**: Point defects, metallic solid solutions, line defects, slip systems, diffusion in solids. **Solidification and Microstructure:** Nucleation from the liquid state, inoculation, grain growth and grain size, development of microstructure, practical preparation of microsections. **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 ferrous and non-ferrous alloy systems. **Heat Treatment**: Annealing, normalizing, quench hardening, tempering. Solid solution hardening, strain hardening (cold working), annealing and recrystallization, precipitation hardening. **Properties of Materials:** Overview of electrical, optical and thermal properties of materials. **Mechanical properties**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, fatigue test, creep. **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: On completing the course students should be able to:
- Distinguish between different classifications of engineering materials
- Competently describe the electronic and crystalline structure of materials with associated imperfections
- Demonstrate an understanding of solidification and generation of microstructure in metallic materials
- Describe the formation of alloys and associated microstructures using binary equilibrium phase diagrams
- Describe the various procedures for heat treatment of ferrous and non-ferrous metals and alloys
- Distinguish between various properties of materials with special emphasis on mechanical properties and testing
- Describe the processes of corrosion and oxidation and the techniques used to control corrosion and degradation..

Revision 1: September 2015
Next Revision: September 2019

Module Title	**CONTEMPORARY SOCIAL ISSUES**

Code   UCSI3580
NQF   5
Contact Hours   1 Contact hours per week for 28 weeks
Credits   8
Assessment   Continuous Assessment (100%). Portfolio/Student's file (90%) and quizzes/tests (10%),
Prerequisite   None

CO ntent: This course, Contemporary Social Issues (CSI), encourages behavioural change among UNAM students, with special reference to their sexual behaviour and to inculcate the primacy of moral reasoning in their social relations and their academic lives. In achieving the above aim, the following values and approaches will inform the CSI: Material will be presented on an integrative basis, stressing the interconnections amongst ethics, moral reasoning, citizenship, leadership, and values and approaches that direct to responsible social behaviour. Special emphasis will be placed on the construct of citizenship and its relation to democracy and the common good. Critical transformative theory will under gird the content of CSI. After completion of the CSI students will be empowered in the domains of human sexuality, reproductive health, democracy, the environment, sustainable development, and responsible leadership. Flexible modes of assessment may be harnessed and students are required to sign the class attendance list each time after a class session. Compulsory attendance required.

Learning Outcomes: Upon completion of this module, students should be able to:
- Practice ethical reasoning
- Demonstrate knowledge to make informed decisions as responsible citizens
- Empower themselves to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship and give back such values to the community, nation, and world
- Sensitise towards the meaning of values and morals and how they affect the attitudes of individuals and groups toward population issues
- Recognise the need of balance between freedom and responsible behaviour
- Discuss stewardship/custodianship of the environment and sustainability of ecosystem services
- Explain how human activities affect the environment and the sustainability of ecosystem services.

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% (minimum 2 tests and 4 assignments), 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. **Integration techniques**: integration by parts, integration by trigonometric substitution; Reduction formula, integration by partial fractions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length etc…. **Differential equations**: Meaning of solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Power series**: radius and interval of convergence. **Power series representation of functions:** Taylor and Maclaurin series. Binomial theorem. Power series solutions of second order ordinary differential equations with variable coefficients. Introduction to Bessel's equation and Bessel functions. **Complex functions**: Cauchy -Riemann equations.

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
- Apply the power series techniques to solve second order odes with variable coefficients
- Apply and solve engineering problems using Bessel's functions
- Classify complex functions

Revision 1: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2015
Revision: January 2019

Module Title	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Code	TEGT 3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100%
Pre-requisite(s)	None

Content: 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, Kirchhoff'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 2:	September 2015
Next Revision:	September 2019

Module Title:	**ENGINEERING MECHANICS I**
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); 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, Analysis of frames and machines.

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.

Revision 2:	September 2015
Next Revision:	September 2019

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

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

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

- 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 2015
Revision:	January 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 6*0% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)*
	Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	**ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE**

Content: **Structure of materials**: 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 2015
Next Revision:	September 2019

YEAR 2 OF BSc IN ELECTRICAL ENGINEERING (HONOURS)

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TEGM3591 Engineering Mathematics I**
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation, Jacobian matrices. **Applications**: optimization on surfaces , constrained optimization . **Integral Transforms**: Laplace Transforms(LT) with applications to differential equations. Introduction to Fourier series. Fourier Transforms. Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.**Analytic functions**: Cauchy's theorem, Cauchy's integral formula, Taylor series, singular points, poles. Laurent series, Residue theorem and evaluation of complex integrals.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
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 C programing language.

Learning Outcomes: On completing the course 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 simple C programs

Revision 1:	September 2015
Next Revision:	September 2019

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

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: On completing the course 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 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course 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
- Appreciate basic queuing theory

Issue Date 2:	September 2015
Revision:	September 2019

Module Title	ELECTRIC CIRCUIT ANALYSIS I
Code	TECE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%(assignments, 2 Tests) , Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3542 Fundamentals of Electrical Engineering

Content: **Review of DC Circuits**: Thevenin's and Nortons theorems, superposition theorem, concept of input and output resistance of network, single port networks, two-port networks, KCL, KVL, electric power, energy sources, sources transformations, power transfer, maximum power transfer, current and voltage divider theorems, Mesh and Node analysis; D.C. power supplies and their industrial use. **Sinusoidal Steady State Analysis**: AC. behavior in R, L and C elements. Phasor analysis with complex algebra, two terminal networks - impedance, admittance susceptance and their real and imaginary parts. Resonance: series and parallel resonance, half power points, bandwidth, Power: instantaneous, average, power factor, active, reactive, complex, apparent power, Power triangle and power factor correction. **A.C. Circuit Analysis of Simple Networks**: Circuit theorems under a.c. conditions; Thevenin, Norton, and superposition theorems; KVL, KCL, loop/mesh and node analysis, maximum power transfer. **Transient Analysis**; Analysis of first order LR and RC circuits subjected to excitation of D.C., square pulse, sinusoidal sources and exponential sources. Interpretation of complementary function and particular integral. Analysis of second order RLC circuit subjected to step input and sinusoidal input. **Frequency Response Curves**: Resonance, series and parallel resonance, the concept of Q-factor, tuned circuits' frequency selective networks mutually-couple circuits.   Computer simulation tools. **Three Phase Circuits**: Concept of three-phase supply, phase diagrams for 3-phase circuits, balanced 3-phase supply, star and delta circuits, analysis of simple balance 3-phase circuits, power in three-phase circuits power measurement in three phase circuits. **Computer circuit analysis and simulation**
Learning Outcomes: Upon completion of this module, students should be able to:
o   Apply circuit On completing the course students should be able to:
o   Apply circuit theorems to simplify and find solutions to electrical circuits.
o   Interpret, develop and design electrical engineering circuits
o   Use computer simulation tools for electric circuit analysis and design
o   Perform DC and AC power calculations including power factor correction;
o   Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
o   Analyze, simulate, and experimentally validate DC and AC circuits;

Issue Date 2:	September 2015
Revision:	September 2019

Module Title	ANALOGUE ELECTRONICS I
Code	TETE3691
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%(assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3542 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: On completing the course students should be able to:
o   Discuss the atomic structure of semiconductor materials
o   Discuss the construction and operation of semiconductor diodes.
o   Analyse and design diode based circuits.
o   Discuss the construction of BJT transistors
o   Analyse and design BJT transistor amplifier and switching circuits
o   Discuss the construction of FET transistors
o   Analyse and design FET biasing circuits
o   Discuss the internal circuitry for op-amps
o   Discuss the operation of op-amps
o   Analyse and design basic op-amp circuits
o   Use EDA software to analyse electronic circuits..
Issue Date 2:	September 2015
Revision:	September 2019

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

Content: Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; Creating objects; Drawing with precision; Controlling the drawing display; **Editing methods**; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; **Managing content with AutoCAD design Centre**; Creating a layout to plot; Plotting your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Applications of 2nd order 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. **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. **Multiple Integrals**: 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 and boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. **Difference equations**: modeling with difference equations, methods of solution to first and second order difference equations. Basic computing in numerical methods (using Matlab or any other suitable program)

Learning Outcomes: On completing the course 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
- Aapplications such as Matlab, Mathematica, Maple, C++ etc

Revision 2:	August 2015
Next Revision:	August 2019

Module Title	**APPLIED ELECTROMAGNETICS**
Code	TTCE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/week
Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	SPHY3512 Physics for Physical Sciences II

Content: Review of Vector Algebra: Classification of vector fields. **Electrostatics**: Coulomb Law & Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equations for static EM fields. Electric potential. **Electric Field in Material Space**: 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; 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 for time varying fields; Application of Ampere's Law Magnetic Flux Density; Magnetic Scalar and Vector Potential, Magnetic Forces, Material and Devices; Magnetic Torque and Movement; Magnetization in Materials. Magnetic Boundary Conditions. Inductor and Inductance; Magnetic Energy.

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

Revision 2: August 2015
Next Revision: August 2019

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

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

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

Revision 2: August 2015
Next Revision: August 2019

Module Title	**MEASUREMENTS AND INSTRUMENTATION**
Code	TETA3622
NQF Level	**6**
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3542 Fundamentals of Electrical Engineering 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 (including high frequency signals), Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Introduction to Programmable Logic Controllers (PLCs).

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

Revision 2: August 2015
Next Revision: August 2019

Module Title	**DIGITAL ELECTRONICS**
Code	TETD3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TETE3691 Analogue Electronics I

Content: **Fundamental Digital concepts:** Logic levels, number systems and digital codes. **Combinational Logic:** logic gates, Boolean algebra, logic simplification, combinational logic functions (including arithmetic circuits, encoders and decoders, multiplexers and demultiplexers, comparators, parity checkers and generators). **Sequential Logic:** latches flip-flops, counters, shift registers. **Design of digital systems**. **Logic gate circuitry:** TTL, CMOS, ECL, logic levels, propagation delay, fan-out, power dissipation, noise margin, logic family interfacing.

Learning Outcomes: On completing the course students should be able to:
- 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
- Discuss and analyse the internal circuitry of different logic family technologies.
- Design interfaces between circuits of different logic families.

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**ELECTRICAL MACHINES**
Code	TECP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	TEGT3542 Fundamentals of Electrical Engineering

Content: Introduction to electrical machinery: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines**: Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers**: Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine)**: generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine:** introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, Special Cage Motors, induction regulators, **Single-Phase and Special-Purpose Motors** (e.g. Stepper motors, servo motors), Principles of Solid State Drives.

Learning Outcomes: Upon completion of this module, students should be able to:
- Demonstrate an understanding of 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
- Demonstrate an understanding of special-purpose motors and VSDs.

Revision 2: August 2015
Next Revision: August 2019

Module Title	COMPUTER PROGRAMMING
Code	TCMS3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100%
Co-requisite(s)	TCME3621 Computer Science for Engineers

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

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

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Total Hours	Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite	TEGW3590 Workshop Practice

Module Description: **:** During Industrial Attachment I, students will work under company supervision at the level of **Technician Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
- Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- 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: 2	September 2015
Next Revision:	September 2019

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING

SEMESTER 1

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGR3761
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%); Lab 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: On completing the course 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 dataApply statistical tools to analyse data.

Revision 2:	August 2015
Next Revision:	August 2019

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

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

Learning Outcomes: On completing the course students should be able to:
- 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 2:	August 2015
Next Revision:	August 2019

Module Title	ELECTRIC CIRCUIT ANALYSIS II
Code	TECE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**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: On completing the course 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 2: August 2015
Next Revision: August 2019

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
Pre-requisite(s	**TECE3691 Electric Circuit Analysis I**

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. **Power system structure, Electricity Generation:** Methods of generation – conventional (gas, thermal, hydro, and nuclear) and non-conventional. Electricity transmission systems: components and configurations, transmission system interconnection .**Transmission Lines:** Types of lines – overhead and underground, HVAC and HVDC - Line parameters (derivation of formulae and use of tables) - resistance, inductance, and capacitance, Line modelling (using line formulae and ABCD parameters) - short, medium and long Line performance – power flow, efficiency voltage regulation. Methods of voltage control and reactive   compensation, Electricity distribution systems: configurations and components. **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: On completing the course 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.
- Explain, and perform calculations related to various types of conventional and new energy sources for electricity generation.
- Demonstrate an understanding of power transmission lines design concepts.
- 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 2: August 2015
Next Revision: August 2019

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

Content: **Basic Machine Theory:** Emf generation in machines; distribution, coil span and winding factors; emf developed by distributed windings; development of rotating fields; torque developed; simple AC Windings, the per unit (pu) notation in power systems **Single and Three Phase Transformers:** Three Phase Transformer connections and phase shift; equivalent circuit; per unit notation and transformers in parallel. **Three-phase Synchronous Generators**: Construction, Field excitation systems. Principles of operation, armature reaction, no-load saturation curve. Equivalent circuit of a generator. Open and short circuit characteristics, generator on an isolated load, generator on an infinite bus, Developed power and torque .Induction Motor**: Three-phase Synchronous Motors:** Starting methods, equivalent circuit, motor on an infinite bus developed torque. **Three-phase Induction motors:** starting and running conditions Current and torque characteristics; rotor resistance variation and deep bar effects; methods of starting and speed control. **Electrical machine design and modelling :** Machine windings and winding design. Design of the magnetic circuit of electrical machines. Machine main dimensions, Machine design procedure, Design of dc machines, design of three-phase induction motors, design of synchronous machines, design of transformers. Development of models, Representation of multi-machine systems. Design Software and CAD simulations

Learning Outcomes: On completing the course students should be able to:
- Design and conduct experiments, as well as to analyse and interpret data.
- 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
- Demonstrate understanding of the electromechanical energy conversion process
- Design a system component of various electrical machines meet desired specifications within realistic constraints
- 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.
- Demonstrate an understanding of the operation of electrical machines in a power system network
- Apply Software Design tools

Revision 2:   August 2015
Next Revision: August 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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
- Analyze the steady state operating Characteristics of switching converters
- Illustrate the operation and apply power electronic devices in Linear dc power supplies
- Analyze the operation and application of switching converters in Switch mode power supplies
- Design and implement practical power electronics circuits
- Design and simulate simple converter circuits for particular applications

Revision 2:   August 2015
Next Revision: August 2019

SEMESTER 2

Module Title:	**ENTREPRENEURSHIP**
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** [2 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: On completing the course 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 endeavor
- 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 2: August 2015
Next Revision: August 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- Demonstrate an understanding of the generation of HV and high currents.
- Describe HV and high current measurement methods.
- Conduct selected HV and high current measurements.
- Describe the standard HV tests, and design the test generator circuits for ac, dc and impulse voltages (and currents).
- Demonstrate an understanding of overvoltage; types and causes where necessary

Revision 2:   August 2015
Next Revision: August 2019

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 and troubleshooting. **Network security**: Threats, secret-key crypto, public key Algorithms, intrusion detection, authentication systems, Kerberos, email security (PGP, S/MIME), firewalls, WWW security.

Learning Outcomes: On completing the course students should be able to:
- 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.
- Independently study and make a presentation on one emerging network technology.

Revision 2:   August 2015
Next Revision: August 2019

Module Title	**POWER TRANSMISSION AND DISTRIBUTION**
Code	TECP3732
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TECP3622 Electrical Machines**
Co-requisite(s)	(TECE3731 Fundamentals of Power systems)

Content: Power generation, transmission and distribution network architecture and composition, 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. Symmetrical components and fault calculations.

Learning Outcomes: On completing the course students should be able to:
- Demonstrate an understanding of electric power generation methods, distribution systems and equipment.
- Demonstrate an understanding of the principles of operation and applied design of bulk power distribution and transmission systems and substations
- Discuss the main issues concerning the design and performance of a large power networks
- 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 2:			August 2015
Next Revision:			August 2019

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 and Tests (30%); Project Presentation (20%); Lab Reports (20%)Project Presentation (20%); Lab Reports (20%)
Co-requisite(s)	TECE3711 Electrical Engineering machines Analysis & Design TECE3731 Fundamentals of Power Systems

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

Learning Outcomes: On completing the course students should be able to:
- Use both basic circuit theorems as well as more advanced circuit analysis methods
- Discuss basic concepts related to energy utilization, generation planning, tariff, power quality, energy efficiency, and demand side management.
- Perform component modeling and power system analysis using per unit system.
- Analyse and design Electrical circuits
- Use 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
- Make a presentation on electrical engineering design to demonstrate independent learning abilities

Revision 2:			August 2015
Next Revision:			August 2019

Module Title	RENEWABLE ENERGY TECHNOLOGIES
Code	TECC3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3542 Fundamentals of Electrical Engineering

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2: August 2015
Next Revision: August 2019

Module title:	RESEARCH PROPOSAL
Code	TECR3792
NQF Level	7
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment:	Continuous 100% [Seminar Presentation 50%, Proposal 50%)]. To pass this module a student should obtain a minimum final mark of 50%
Co-requisite(s)	TEGR3761 Experimental and Research Methods

Content: 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 course students should be able to:
- Present their Research Proposals in Seminars
- Produce acceptable typed and bound Research Proposals

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

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

Revision 2:   September 2015
Next Revision: September 2019

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 100%
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: engineering societies and registration procedure for different engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.

Learning Outcomes: On completing the course students should be able to:
- Identify the role of various engineering disciplines and societies
- Paraphrase the importance of engineering professional ethics and its enforcement by the regulating bodies
- Illustrate the use of engineering codes and standards
- Justify general knowledge of procedural law, law of contracts, commercial law and employment law
- Relate laws of arbitration
- Classify technology policy on the acquisition of technological know-how
- Summarise the strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 50% (2 assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Module Description: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:
- Recognise 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
- Demonstrate knowledge of the principles of managing medium to large scale engineering projects
- Hypothesize the principles of managing community-based development projects
- 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 2:	September 2015
Next Revision:	September 2019

Module Title	**CONTROL ENGINEERING**
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3671 Engineering Mathematics III

Contents: Control Systems Basics: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems:** Laplace transform review**,** transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of electrical systems. **Control System Analysis:** system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques:** Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators.

Learning Outcomes: On completing the course students should be able to:
- 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.
- Use engineering software for modelling, analysis and design of control systems

Revision 2:	September 2015
Next Revision:	September 2019

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%(assignments, 2 Tests) Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TECE3731 Fundamental of Power Systems**,
Co-requisite(s)	(TECP3831 Protection of Power 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-Seidel and Newton-Raphson methods. Computer-aided short circuit analysis of large systems; transient stability analysis; overvoltage calculations and power system protection. Power system stability and methods of improving stability, Application of software tools in modeling and simulation of power system networks (e.g.: CAD Electrical, MEP, DigiSilent, Power Factory, PSS, Power World and Herman–Beta Algorithm etc.).

Learning Outcomes: On completing the course students should be able to:
- Perform the power system analysis using software package.
- Use 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 to synthesize electrical power systems

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**POWER SYSTEMS PROTECTION**
Code	TECP3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TECE3791 Electric Circuit Analysis II**,

Content: **Faults and abnormal operating conditions, General philosophies of power system protection:** objectives of power system protection; Protective zones; primary and back-up protection; typical relay and circuit breaker connections; factors affecting the protection system; classification of relays and their operating characteristics; circuit breakers; isolators; switchgears and fuses, **Relay input sources:** current transformers; characteristics and performances of current transformers; voltage transformers; optical sensors**, Protection schemes:** overcurrent protection; directional and distance protection; differential protection**, Applications of protective schemes to power system equipment:** busbar protection; generator protection; transformer protection; transmission line protection; motor protection; pilot protection**, Power system stability considerations, Load shedding, Reclosing, Digital (numerical) protection, Distribution and protection systems.**

Learning Outcomes: On completing this course, students should be able to:
- Illustrate the operation of a modern electricity network, under both steady-state and fault conditions, and the techniques used for network analysis and design
- Describe the principles of switching and protection of power systems and components
- Describe the protection equipment used in the switching and protection of electrical power systems,
- Analyze the response of a power system to demand conditions and corrective measures for its control

Revision 2:   September 2015
Next Revision: September 2019

Module Title:	**MICROPROSSESSORS AND PROGRAMMABLE LOGIC CONTROLLERS**
Code	TECP3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TETD3692 Digital Electronics**

Content: Microprocessors: history, types of microprocessors, microprocessors fabrication process, cost of microprocessors. Microprocessor structures: registers, arithmetic and logic unit, control unit, internal bus. External buses: address bus, data bus, control bus, bus timing. Memory interfacing: memory map design, memory address decoder circuit. Input/output interfacing: port mapping, port address decoder circuit. Clock generator circuits. Interrupt mechanism: interrupt priority, non-maskable interrupt, maskable interrupt, interrupt modes. Execution cycle and execution time of instructions. Program execution time calculation. Translation of mnemonics to machine codes.
PLCs :Definition of PLCs, need for the PLCs and principles of operation, Ladder diagrams and the PLC, advantages of PLC base system over relay based system and Logic concepts, PLC Architecture: Processors, Power supply and Programing device. Memory systems and I/O interactions. Digital I/O modules, Analogue I/O Modules Special Functions I/O and serial communication interface. PLC Programming: Programming Languages, IEC Standard. PLC based system programing and implementation. PLC system documentation, PLC Process Applications: data measurement and transducers, output devices, process controllers and tuning. Installation and start-up procedures: PLC start-up and maintenance, PLC Selection.

Learning Outcomes: On completing the course students should be able to:
- 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.
- Describe the architecture and principles of operation of PLCs
- Demonstrate an understanding of IEC standard and languages
- Describe the PLC programing techniques and languages
- Design PLC Programs for PLC based control applications
- Program and troubleshoot the PLC based control systems

Revision 2:   September 2015
Next Revision: September 2019

SEMESTER 2

Module Title:	**ELECTRICAL RESEARCH PROJECT**
Code	TECR3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	**Continuous 100%** Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s)	TECR3792 Research Proposal; All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

Module Title	**ELECTRICAL DESIGN PROJECT**
Code	TECD3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	**Continuous 100%** Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s)	All third year modules

Content: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. Module may be required before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
- Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
- Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Discuss the role of engineers in the management and organization of engineering enterprises
- Discuss in details the main technical activities undertaken during the attachment.

Revision 2:	August 2015
Next Revision:	August 2019

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

J.1.   DEGREE NAME: Bachelor of Science in Mechanical Engineering (Honours)   19BMEE

J.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.

J.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 – 152 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3561	5	8	None
1	*Physics for Physical Sciences* I	SPHY3511	*5*	16	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	*5*	12	*None*
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**72**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Fundamentals of Electrical Engineering	TEGT3542	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 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** TEGT3561
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Strength of Materials I	TCVM3621	6	8	TEGT3592
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	Engineering Thermodynamics	TMED3642	6	8	SCHM3512
2	Mechanical Engineering Design I	TMEM3642	6	8	**TEGT3592**
2	Engineering Materials	TMEM3622	6	8	TEGS3591
2	Computer Programming	TCMS3692	6	12	TCME3621
2	Electrical Machines	TECP3622	6	8	**TEGT3542**
2	Measurements and Instrumentation	TETA3622	6	8	TEGT3542
	Industrial Attachment I	TEGT3600	6	-	**TEGW3590**
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 **TEGS3591**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Thermodynamics and Heat Transfer	TMER3791	7	12	TMED3642
1	Advanced Fluid Mechanics	TMER3721	7	8	**TMEE3611**
1	Mechanical Engineering Design II	TMER3781	7	12	TMEM3642
1	Experimental and Research Methods	TEGR3761	7	8	**TEGS3691**
1	Machine Tools	TMEM3721	7	8	**TEGT3592**
Total Credits Semester V				**68**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Mechanical Vibrations	TMER3762	7	8	**TEGT3641**
2	Computer Aided Engineering and Manufacturing	TMER3782	7	12	**TEGT3661**
2	Solid Mechanics	TMEM3772	7	16	**TEGT3592**
2	Fundamentals of Mechatronics	TMEM3742	7	8	TETA3622
2	Operations Management	TEGT3722	7	8	**TEGS3691**
2	Rigid Body Dynamics	TMED3762	7	8	**TEGT3641**
	Research Proposal	TMER3792		4	TEGT3741
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

YEAR 4 OF BSc IN MECHANICAL 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	TEGM3881	8	12	**TEGT3761**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	Renewable Energy	TMEE3841	8	8	**TMED3642**
1	Thermal Machines	TMEE3831	8	16	TMER3791
1	Fluid Machinery	TMEE3851	8	16	**TMEE3611**
1	Mechanical Engineering Design III	TMEM3821	8	8	**TMER3781**
Total Credits Semester VII				**80**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	
2	Research Project	TMER3892	8	30	All 3rd Year Modules TMER3792
2	Mechanical Engineering Design Project	TMED3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

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

J.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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Course Lines and planes:: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. **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**. Introduction to complex numbers.:**definition, addition, subtraction, multiplication, division of complex numbers. Demoivres' theorem .**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, the chain rule, differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, 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
- Manipulate sequence and series of numbers
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3561
NQF Level	5
Contact Hours	**2**L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%(minimum of 2 tests and 4 drawing assignments) , Examination 40% (1 x 2 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.

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

Revision 2: August 2015
Next Revision: August 2019

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

Contents: Units, significant figures & 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 2015
Revision: January 2019

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

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 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 2015
Next Revision:	September 2019

Module Title:	WORKSHOP PRACTICE
Code	TEGW3590
NQF Level	5
Contact Hours	2h Lectures + 4h Practical Sessions per week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

Learning Outcomes: Upon completion of this course, students should be able to:
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.
- Describe the general operation of air-conditioning and refrigeration systems.

Revision 2:	September 2015
Next Revision:	September 2019

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

Content: Classification of engineering materials: metals, ceramics, plastics, composites. Competition among materials, future trends of material usage. **Structure of materials**: Atomic structure; Bragg's law, electronic configuration, atomic bonding. Crystalline structure; amorphous structure, crystallographic planes and directions, Miller indices. Structure-property relationships. **Crystalline imperfections and diffusion**: Point defects, metallic solid solutions, line defects, slip systems, diffusion in solids. **Solidification and Microstructure:** Nucleation from the liquid state, inoculation, grain growth and grain size, development of microstructure, practical preparation of microsections. **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 ferrous and non-ferrous alloy systems. **Heat Treatment**: Annealing, normalizing, quench hardening, tempering. Solid solution hardening, strain hardening (cold working), annealing and recrystallization, precipitation hardening. **Properties of Materials:** Overview of electrical, optical and thermal properties of materials. **Mechanical properties**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, fatigue test, creep. **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: On completing the course students should be able to:
- Distinguish between different classifications of engineering materials
- Competently describe the electronic and crystalline structure of materials with associated imperfections
- Demonstrate an understanding of solidification and generation of microstructure in metallic materials
- Describe the formation of alloys and associated microstructures using binary equilibrium phase diagrams
- Describe the various procedures for heat treatment of ferrous and non-ferrous metals and alloys
- Distinguish between various properties of materials with special emphasis on mechanical properties and testing
- Describe the processes of corrosion and oxidation and the techniques used to control corrosion and degradation..
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Revision 1:	September 2015
Next Revision:	September 2019

Module Title	**CONTEMPORARY SOCIAL ISSUES**

Code UCSI3580
NQF 5
Contact Hours 1 Contact hours per week for 28 weeks
Credits 8
Assessment Continuous Assessment (100%). 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, with special reference to their sexual behaviour and to inculcate the primacy of moral reasoning in their social relations and their academic lives. In achieving the above aim, the following values and approaches will inform the CSI: Material will be presented on an integrative basis, stressing the interconnections amongst ethics, moral reasoning, citizenship, leadership, and values and approaches that direct to responsible social behaviour. Special emphasis will be placed on the construct of citizenship and its relation to democracy and the common good. Critical transformative theory will under gird the content of CSI. After completion of the CSI students will be empowered in the domains of human sexuality, reproductive health, democracy, the environment, sustainable development, and responsible leadership. Flexible modes of assessment may be harnessed and students are required to sign the class attendance list each time after a class session. Compulsory attendance required.

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

- Practice ethical reasoning
- Demonstrate knowledge to make informed decisions as responsible citizens
- Empower themselves to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship and give back such values to the community, nation, and world
- Sensitise towards the meaning of values and morals and how they affect the attitudes of individuals and groups toward population issues
- Recognise the need of balance between freedom and responsible behaviour
- Discuss stewardship/custodianship of the environment and sustainability of ecosystem services

Explain how human activities affect the environment and the sustainability of ecosystem services.

Issue Date: September 2012
Next Revision: September 2016

Module Title	ENGINEERING MATHEMATICS II
Code	TEGM3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments), 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. **Integration techniques**: integration by parts, integration by trigonometric substitution; Reduction formula, integration by partial fractions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length etc.…. **Differential equations**: Meaning of solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Power series**: radius and interval of convergence. **Power series representation of functions:** Taylor and Maclaurin series. Binomial theorem. Power series solutions of second order ordinary differential equations with variable coefficients. Introduction to Bessel's equation and Bessel functions. **Complex functions**: Cauchy -Riemann equations.

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
- Apply the power series techniques to solve second order odes with variable coefficients
- Apply and solve engineering problems using Bessel's functions
Classify complex functions

Revision 1:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2015
Revision:	January 2019

Module Title	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Code	TEGT 3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100%
Pre-requisite(s)	None

Content: 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, Kirchhoff'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 2:	September 2015
Next Revision:	September 2019

Module Title:	**ENGINEERING MECHANICS I**
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); 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, Analysis of frames and machines.

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.

Revision 2:	September 2015
Next Revision:	September 2019

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

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

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

- 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 2015
Revision:	January 2019

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 6*0% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)* Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE

Content: **Structure of materials**: 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 2015
Next Revision:	September 2019

SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation, Jacobian matrices. **Applications**: optimization on surfaces , constrained optimization . **Integral Transforms**: Laplace Transforms(LT) with applications to differential equations. Introduction to Fourier series. Fourier Transforms. Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.**Analytic functions**: Cauchy's theorem, Cauchy's integral formula, Taylor series, singular points, poles. Laurent series, Residue theorem and evaluation of complex integrals.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

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

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: On completing the course 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 2015
Next Revision:	September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
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 C programing language.

Learning Outcomes: On completing the course 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 simple C programs

Revision 1:	September 2015
Next Revision:	September 2019

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

Content: Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; Creating objects; Drawing with precision; Controlling the drawing display; **Editing methods**; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; **Managing content with AutoCAD design Centre**; Creating a layout to plot; Plotting your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course 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
- Appreciate basic queuing theory

Issue Date 2: September 2015
Revision: September 2019

Module Title:	**STRENGTH OF MATERIALS I**
Code	TCVM3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Basic concepts: Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams. **Stress and strain:** Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke's Law; Modulus of Elasticity; Normal stress and strain; Poisson's ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson's ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants. **Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems:** Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars. **Geometrical characteristics of plane sections:** Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem. **Bending:** Shear force and bending moment diagrams. **Bending and shear stresses in beams:** Theory of beam bending; Section modulus; Composite beams; Shear stress distribution due to bending. **Simple Torsion:** Pure torsion of circular bars; Shear stress and shear strain in shafts, Torsional rigidity; Torsion of hollow shafts. **Stresses in thin cylinders and spheres:** Thin cylindrical and spherical shells subjected to internal pressure; Hoop stress and longitudinal stress.

Learning Outcomes: Upon completion of this module, students should be able to:
- Demonstrate the application of Hooke's Law to normal and shear stresses.
- Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
- Calculate geometrical characteristics of plane sections.
- Draw bending and shear force diagrams in beams.
- Analyse bending and shear stresses in beams.
- Solve problems involving shear stresses and shear flow in beams.
- Analyse stresses and strains in circular shafts subjected to torsion.
- Analyse stresses in thin cylinders and spheres subjected to internal pressure.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**FLUID MECHANICS**
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3592 Engineering Mechanics I

Content: Introduction to fluid mechanics; properties of fluids (density, viscosity, vapour pressure); fluid equilibrium; units. **Fluid Statics**: The governing differential equations; pressure distributions, manometric pressure measurement; fluids in relative equilibrium (constant acceleration); forces on submerged surfaces; buoyancy. **One-dimensional flows with inertia**: 1-D mass conservation; 1-D momentum conservation (Bernoulli equation); total head diagrams; free liquid jets; flow measurement. **Hydraulic systems**: Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram); general loss coefficients; **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.
- Categorize one-dimensional mass and momentum conservation and applications of Bernoulli's equation
- Demonstrate skills for flow measurements
- Solve 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 2:	**August 2015**
Next Revision:	**August 2019**

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

Content: Applications of 2nd order 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. **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. **Multiple Integrals**: 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 and boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. **Difference equations**: modeling with difference equations, methods of solution to first and second order difference equations. Basic computing in numerical methods (using Matlab or any other suitable program)

Learning Outcomes: On completing the course 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, C++ etc

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**ENGINEERING THERMODYNAMICSI**
Code	TMED3642
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	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. **Working fluids:** properties of fluids and vapours; thermodynamic properties of steam; properties diagrams. Avogadro's law, the equation of state of a perfect gas, specific heats and non-flow gas processes. **Application of first law to non-flow processes**; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. **Application of first law to flow processes;** continuity equation, application to boilers, condensers, turbines, compressors, nozzles, diffusers and throttling devices. **Second law of thermodynamics**: concept of the heat engine; cycle efficiency; Reversibility and irreversibility. Engine efficiency. The Carnot cycle. Absolute temperature scale. Entropy; determination and property diagrams.

Learning Outcomes: Upon completion of this module, students should be able to:
- Discuss the first law of thermodynamics and its applications to non-flow and flow processes.
- Discuss and quantify the properties of working fluids.
- Interpret and use thermodynamic property diagrams.
- Apply the equation of state of a perfect gas.
- Discuss the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**MECHANICAL ENGINEERING DESIGN I**
Code	TMEM3642
NQF Level	6
Contact Hours	2L + 1T or 1 PS/Week
NQF Credits	8
Assessment:	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Content: The design spectrum. Design methodology. Design of parts and machine elements. **Particular mechanical and Mechanical engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Mechanical engineering drawings.–**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:
- Discuss the methodology for engineering design
- Discuss key features in the design of machine elements
- Use codes of practice for mechanical engineering and Mechanical engineering drawing
- Use Auto-CAD software in mechanical engineering drawing and design
- Discuss basic mechanisms used in machine design
- Discuss the fundamentals of different methods of mechanism design, analysis and synthesis

Revision 2:	**August 2015**
Next Revision:	**August 2019**

Module Title:	**ENGINEERING MATERIALS**
Code	TMEM3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TEGS3591 Materials Science

Content: Classification and Characteristics of Steels: Review of the Iron-Iron Carbide phase diagram. Plain carbon steels, alloy steels, stainless steels. Special heat treatments for steels: Case hardening, austempering, martempering. Hardenability of steels. Jominy End-Quench test. **Characteristics of Cast Irons**: Grey iron, nodular iron, austempered ductile iron (ADI). **Characteristics of Non-Ferrous Alloys**: Copper, aluminium, titanium, nickel and their alloys. Practical application of strain hardening and precipitation hardening on selected alloys**. Polymers and Plastics:** polymerization processes, degree of polymerization, classification of polymers, glass transition temperature. Common thermoplastics, common thermosetting plastics, common elastomers. **Ceramics**: Traditional ceramics, technical ceramics, structural and functional properties of technical ceramics. **Composite Materials:** Polymeric, metallic and ceramic matrices, fibres for reinforcement, effect of fibre volume fraction on properties. Longitudinal and transverse loading of composites: stress analysis and modulus of elasticity. Shear modulus of composites for parallel model (isostain) and series model (isostress).

Learning Outcomes: Upon completion of this module, students should be able to:
- Distinguish between various classes of steels and cast irons and identify their specific characteristics
- Describe key characteristics and typical applications of common non-ferrous metals and alloys
- Demonstrate knowledge of engineering polymers and plastics and discuss applications of such materials
- Describe the characteristics and uses of traditional and technical ceramics and identify their superior properties.
- Demonstrate knowledge of composition and characteristics of composite materials and describe the procedures for stress analysis in longitudinal and transverse loaded composites.

Revision 2:	**August 2015**
Next Revision:	**August 2019**

Module Title	**COMPUTER PROGRAMMING**
Code	TCMS3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100%
Co-requisite(s)	TCME3621 Computer Science for Engineers

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

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

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**ELECTRICAL MACHINES**
Code	TECP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	TEGT3542 Fundamentals of Electrical Engineering

Content: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines**: Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers**: Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine)**: generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine:** introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, special cage motors, induction regulators, , energy recovery techniques. Drives Applications.

Learning Outcomes: Upon completion of this module, students should be able to:
- Demonstrate an understanding of 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
- Demonstrate an understanding of special-purpose motors and VSDs.

Revision 2:	August 2015
Next Revision:	August 2019

Module Title	MEASUREMENTS AND INSTRUMENTATION
Code	TETA3622
NQF Level	**6**
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGT3542 Fundamentals of Electrical Engineering** 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 (including high frequency signals), Sensors and transducers (Transducer Characteristics), Oscilloscopes, chart recorders, spectrum analysers and signal generation, Network analyser, Introduction to Programmable Logic Controllers (PLCs).

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

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Total Hours	Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite	TEGW3590 Workshop Practice

Module Description: **:** During Industrial Attachment I, students will work under company supervision at the level of **Technician Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
- Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- 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: 2	September 2015
Next Revision:	September 2019

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%% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMEM3622 Engineering Materials

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 forming of plastics and rubber**. Extrusion; Injection moulding; blow moulding, foaming processes. Rapid prototyping. Tool making design (dies and stamps)

Learning Outcomes: Upon completion of this module, students will be able to:
- Apply the knowledge of elastic and plastic behaviour of materials 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
- Discuss the various techniques used in the processing and forming of plastics and rubber

Revision: 2	September 2015
Next Revision:	September 2019

Module Title:	FUNDAMENTALS OF ECONOMICS
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

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

Learning Outcomes: On completing the course students should be able to:
- 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: 2	September 2015
Next Revision:	September 2019

Module Title:	**THERMODYNAMICS AND HEAT TRANSFER II**
Code	TMER3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Co-requisite(s)	TMED3642 Engineering Thermodynamics

Contents: **Vapour power systems.** Steam calculations. Boiler systems. Carnot and Rankine cycles. Introduction to refrigeration and heat pump systems. **Thermodynamics of pure gases and vapour,** non-reactive mixtures and psychometrics. Introduction to air conditioning systems. **Thermodynamics of reactive mixtures:** combustion, first and second laws of thermodynamics applications to reactive systems, heat of combustion, heating values, adiabatic flame temperature, dissociation. **Heat transfer:** principles of conduction, convection and radiation. Thermal conductivity. Steady state one and two-dimensional conduction. Transient heat conduction, convection in laminar and turbulent flow. High velocity flow. Forced and natural convection. Black and grey body thermal radiation. Thermal insulation. **Lagging materials. Exergy analysis. Mass transfer. Heat exchangers theories. 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
- Illustrate the principles of forced and natural convection and perform calculations on the same
- Illustrate the principles of heat radiation, heat insulation and appropriate insulation materials

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**ADVANCED FLUID MECHANICS**
Code	TMER3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	TMEE3611 Fluid Mechanics

Contents: Thermodynamic and dynamic principles applied to fluid behaviour, stream function and velocity potential, ideal, viscous and compressible fluids under internal and external flow conditions. Inviscid flow, boundary layer, vorticity and rotation of fluid particles. Navier-strokes equations, flow through pipes and ducts. High and low Reynolds number flows. Two-dimensional potential flow. Shocks and aerofoil theory.

Learning Outcomes: Upon completion of this module, students should be able to:
- Analyse boundary layer in fluid particles for internal and external flow conditions.
- Analyse general two-dimensional potential flow.
- Analyse and describe flow over aerofoil profile.

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**MECHANICAL ENGINEERING DESIGN II**
Code	TMER3781
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50%; (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Co-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, pulleys, belts, couplings. **Design of assemblies.** Consideration for tolerances, fits and reliability. Dynamic load systems. Power transmission systems. Professional communication techniques. 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

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGR3761
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%); Lab 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: On completing the course 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 dataApply statistical tools to analyse data.

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**MACHINE TOOLS**
Code	TMEM3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	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, boring machine. Metal cutting. **Design features of cutting tools**. Economics of cutting. Calculations of feeds, cutting speeds and other parameters. Conventional and unconventional machining. **Computer numerical controlled (CNC) machines**. Automation in machine tools.

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

- Describe the principles of the various methods used in metal cutting
- Illustrate the features of various cutting tools and perform calculations on machining parameters
- Differentiate between conventional and non-conventional machining operations
- Apply the principle of computer numerical controlled machines

Revision 2: August 2015
Next Revision: August 2019

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: On completing the course students should be able to:
- Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
- Distinguish the methods used to carry out feasibility studies
- Develop a business plan relating to an engineering endeavor
- Separate the concepts of motivation, competencies, innovation and product marketing
- Relate the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**MECHANICAL VIBRATIONS**
Code	TMER3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	**TEGT3641 Engineering Mechanics II**

Contents: **Fundamentals of vibrations**: Basic Concepts and definitions. Vibration Analysis, Harmonic Motion. **Single degree-of-freedom systems:** Equation of motion, Lagrange's equation, free vibration of undamped and damped systems; logarithmic decrement, other forms of damping. **Forced vibration**: Equation of motion, response to harmonic excitation, resonance, rotating unbalanced, base motion excitation, response to general non-periodic excitation, impulse response function. **Design for vibration control:** Vibration isolation, critical speeds of rotating shafts; practical isolation design. **Multiple degree-of-freedom systems:** Equations of motion; Lagrange's equations, free vibration, natural frequencies and mode shapes, forced vibration, response to harmonic excitations and normal-mode approach. **Continuous systems:** Introduction to continuous systems. **Vibration absorption:**. Balancing of rotating machines.

Learning Outcomes: Upon completion of this module, students should be able to:
- Describe the fundamentals of vibration analysis
- Distinguish between the various forms of vibration
- Appraise the methods used to control vibration in practice including balancing techniques
- Describe techniques used in vibration absorption

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**COMPUTER AIDED ENGINEERING AND MANUFACTURING**
Code	TMER3782
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TEGT3661 Computer Aided Drawing**

Contents: **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. **Computer aided engineering.**

Learning Outcomes: Upon completion of this module, students should be able to:
- Differentiate various techniques of 3-D automated modelling
- Outline the principles of computer aided design
- Explain the main features of computer integrated manufacturing

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**SOLID MECHANICS**
Code	TMEM3772
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50 (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TEGT3592 Engineering Mechanics I**

Contents: **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. **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. **Deflection of beams**: Slope and deflection by integration, Discontinuity functions, statically indeterminate beams, method of superposition. **Energy methods**: Strain energy for various types of loading, Deflection by conservation of energy, Impact loading, Castigliano's theorem. **Mechanics of composite bodies:** Materials; Manufacturing methods; Micromechanics; Macro-mechanics of a lamina; Failure criteria; Laminate analysis; Design of composite structures. **Stress analysis of asymmetric solids:** Thick-walled and compound cylinders; Rotating discs and cylinders; Autofrettage. **Fracture Mechanics:** Theories of linear-elastic and elastic-plastic fracture mechanics and their applications. Crack propagation models. Failure criteria

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
- 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.
- 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.
- Describe general theories of failure and demonstrate an understanding of linear elastic fracture mechanics and failure criteria

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**FUNDAMENTALS OF MECHATRONICS**
Code	TMEM3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50 (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	TETA3622 Measurements and Instrumentation

Contents: **Modelling of mechatronic 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 mechatronic systems
- Illustrate the principles of hydraulic servo systems
- Outline the application of digital control in mechatronic systems
- Design simple mechatronic systems or machines

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**OPERATIONS MANAGEMENT**
Code	TEGT3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50 % (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	**TEGS3691 Statistics for Engineers**

Contents: **Techniques of Operations Management**: Production planning and control systems: material requirements planning; manufacturing resource planning (MRP); measure of performance; techniques for process planning; inventory control. Statistical methods for process control. **Quality assurance and reliability**: Principles and philosophies of quality management. Quality planning and deployment; reliability testing; system reliability and availability; risk analysis and safety. **Total Quality Management** (TQM); International Standards.

Learning Outcomes: Upon completion of this module, students should be able to:
- Describe the various techniques of operation management
- Apply knowledge of quality assurance and reliability measures in engineering projects
- Illustrate the key features of Total Quality Management

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**RIGID BODY DYNAMICS**
Code	TMED3762
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50 (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TEGT3641 Engineering Mechanics II**

Contents: Revision of kinematics and kinetics of a system of particles Kinetic of rotating and reciprocating masses and balancing their out-of-balance   forces.. **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:
- Illustrate the kinematic principles of rigid bodies and perform calculations on the motion of rigid bodies
- Illustrate 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 2:   August 2015
Next Revision: August 2019

Module Title:	**RESEARCH PROPOSAL**
Code	TMER3792
NQF Level	7
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment	Continuous 100% [Seminar Presentation 50%, Proposal 50%)].
Co-requisite(s)	(TEGT3741 Experimental and Research Methods)

Contents: 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 course students should be able to:
- Present their Research Proposals in Seminars
- Produce acceptable typed and bound Research Proposals

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

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

Revision 2:   September 2015
Next Revision: September 2019

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 100%
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: Engineering as a profession: engineering societies and registration procedure for different engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**
Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.

Learning Outcomes: On completing the course students should be able to:
- Identify the role of various engineering disciplines and societies
- Paraphrase the importance of engineering professional ethics and its enforcement by the regulating bodies
- Illustrate the use of engineering codes and standards
- Justify general knowledge of procedural law, law of contracts, commercial law and employment law
- Relate laws of arbitration
- Classify technology policy on the acquisition of technological know-how
- Summarise the strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**PROJECT MANAGEMENT**
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 50% (2 assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Content: **Module Description: Basic principles of project management:** Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.
Learning Outcomes: On completing the course students should be able to:
- Recognise 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
- Demonstrate knowledge of the principles of managing medium to large scale engineering projects
- Hypothesize the principles of managing community-based development projects
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**CONTROL ENGINEERING**
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper).
Pre-requisite(s)	**TEGT3671 Engineering Mathematics III**

Content: **Module Control Systems Basics**: Fundamentals of control Theory, applications of control systems, open and closed loops. **Modelling of Physical Systems:** Laplace transform review**,** transfer functions, poles and zeros, block diagrams reduction, signal flow graphs, state variable models, conversion of transfer function to state space and vice-versa, frequency response representation, modelling of electrical systems. **Control System Analysis:** system response (transient and steady state) using transfer functions, system response (transient and steady state) using state equations. System stability analysis using Routh's stability criterion, stability in state space representation, frequency response parameters and stability analysis (phase margin, gain margin and Nyquist criterion), steady state errors from transfer function, steady state errors for state space represented systems, steady state errors from frequency response, transfer function from frequency response, Root Locus Method, Analysis using Root Locus method. **Control Systems Design and compensation techniques:** Design using root locus (PID controllers), Design using frequency response (lead, lag and lead/lag compensators), design via state space, practical implementation of controllers/compensators.

Learning Outcomes: On completing the course students should be able to:
- 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.
- Use engineering software for modelling, analysis and design of control systems

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**RENEWABLE ENERGY**
Code	TMEE3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper).
Pre-requisite(s)	**TMED3642 Engineering Thermodynamics I**

Content: Current energy demands, environmental effects, renewable energy resources, including photovoltaic, concentrated solar plant (CSP), thermal solar, wind, hydro, geothermal, bioenergy, magneto-hydrodynamics (MHD), tidal, ocean thermal and wave energies. Construction of simple solar arrays for energy production. Comparison between renewable and nuclear energy. Mixture of energy sources. Smart grid technology. Power station economics. Sustainable development. Greenhouse gases. Energy efficiency.

Learning Outcomes: Upon completion of this module, students should be able to:
- Analyse the benefits and limitation of using different renewable energy resources.
- Differentiate 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.
- Analyse economic principles applied to power generation systems.

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**THERMAL MACHINES**
Code	TMEE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TMED3642 Engineering Thermodynamics I**

Content: **Vapour power cycles**. Principle of steam turbines, energy analysis in the steam turbines. Vapour flow in turbine blades and turbine phases. Turbine losses. **Gas power plants**. Internal combustion engines. Principles and applications. Principles of gas turbines. Thermal calculations of the gas turbine scheme, losses and performance. **Refrigeration**: Basic components, refrigeration agents. Refrigeration systems and their applications. Calculations on refrigeration machines. **Air-conditioning**: Basic components, air-conditioning systems and applications. Humidification of gases, Cooling towers. Air-conditioning cooling and heating load calculations. Fault diagnosis and maintenance. Environmental problems, alternative refrigerants.

Learning Outcomes: Upon completion of this module, students should be able to:
- Explain and analyse vapour power cycles
- Explain the principles and characteristics of internal combustion engines; steam turbines and gas turbines
- Solve problems on thermal machines
- Explain the general design principle of power plants
- Solve problems involving refrigeration and air conditioning
- Illustrate knowledge of the various factors that are used to select or determine an appropriate air conditioning system

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**FLUID MACHINERY**
Code	TMEE3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% % (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TMER3721 Advanced Fluid Mechanics**

Content: **Momentum principles applied to fluids**. Jet propulsion. Design of fluid machinery: **Centrifugal and axial flow machines**, (pumps, turbines, compressors, blowers and fans), pipe-machine characteristics, cavitation, water hammer. One directional flow, continuity, momentum and energy equations for steady inviscid, compressible, isentropic flow, wave phenomenon. **Power hydraulics**. Nozzles and diffusers. Turbulent flow. Supersonic flow. Pressure and temperature measurements in compressible flows. Fluid power tools: hydraulic and pneumatic tools.
Tribology: Inclined and tilting hydrodynamic thrust bearings, journal bearings. Hydrostatic thrust bearings. Contact between rigid bodies. The friction and adhesion of metals. The friction of plastics and some other materials. **Wear**; mechanism of wear, effects of wear on surface quality. **Lubrication**; mechanism of lubrication, significance of lubrication film. **Selecting a lubricant**; greases, lubricating oils and special condition lubricants (high temperature, pressure etc.).

Learning Outcomes: Upon completion of this module, students should be able to:
- Explain the principles used in the design of jet engines and general fluid machinery
- Formulate and solve problems in centrifugal and axial flow machines
- Explain the principles and characteristics of power hydraulics
- Distinguish tribological processes that take place due to the interaction of surfaces moving against each other
- Explain the fundamentals of tribology with respect to friction, wear and lubrication
- Apply tribological considerations in the design and maintenance of machines.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	MECHANICAL ENGINEERING DESIGN III
Code	TMEM3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	**TMER3781 Mechanical Engineering Design II**

Content: **Design for manufacture**: Design optimisation. Material selection. Rapid prototyping techniques. Reliability. Standards and specifications. Safety aspects. **Material handling systems**: Belts, conveyors, lifting cranes, ropes and chains, bulk material movement. **Industrial design engineering**. Ergonomics in design. Innovation. Product development. Design exercises. **Model design process:** Design exercises will be done in groups during Tutorial Classes whereby all steps in design methodology, including design realization, material selection, manufacturing and production process, technical and financial constraints, innovation and ergonomics will be demonstrated.

Learning Outcomes: Upon completion of this module, students should be able to:
- Apply knowledge of design features appropriate to a manufacturing undertaking
- Distinguish the various equipment and machines used in handling bulk engineering materials
- Illustrate the roles of ergonomics, innovation and product development in industrial design engineering
- Illustrate an in-depth knowledge of design methodology and the entire design process

Revision 2: September 2015
Next Revision: September 2019

Module Title:	RESEARCH PROJECT
Code	TMER3892
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	30
Assessment	Continuous 100% (20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation).
Co-requisite(s)	TMER3792 Research Proposal, All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
- 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 2: September 2015
Next Revision: September 2019

Module Title:	**MECHANICAL ENGINEERING DESIGN PROJECT**
Code	TMED3890
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	34
Assessment	Continuous 100% (Two Seminar Presentations of design (**20%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**60%**)]
Co-requisite(s)	All third year modules

Content: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. Module may be required before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
- Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
- Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Discuss the role of engineers in the management and organization of engineering enterprises
- Discuss in details the main technical activities undertaken during the attachment.

Revision 2:	August 2015
Next Revision:	August 2019

K.   CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS)

K.1.   DEGREE NAME: Bachelor of Science in Metallurgical Engineering (Honours)   19BMLE

K.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, Physical Metallurgy and Materials Engineering.

K.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, 3and 4 (semesters **III** to **VII**), all students in this degree programme take the same discipline-specific modules and a few common modules. Semester VIII is fully dedicated to Research and Design Projects and thus has no taught modules.

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

YEAR 1 OF BSc IN METALLURGICAL ENGINEERING – 156 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3561	5	8	None
1	*Physics for Physical Sciences* I	SPHY3511	*5*	16	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	*5*	12	*None*
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				**72**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Fundamentals of Electrical Engineering	TEGT3542	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 METALLURGICAL 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** TEGT3561
1	Statistics for Engineers	EGS3691	6	12	**TEGM3591**
1	Metallurgical Thermodynamics I	TMLX3691	6	12	SCHM3512
1	Introduction to Process Metallurgy	TMLX3641	6	8	SCHM3512
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 II	TMLP3622	6	8	TMLX3691
2	Mineral Processing Technology I	TMLP3692	6	12	TMLX3641
2	Crystal Structure and Analytical Techniques	TMLP3642	6	8	TEGS3591
2	Physical Metallurgy I	TMLM3692	6	12	TEGS3591
2	Electrical Machines	TECP3622	6	8	**TEGT3541**
2	Computer Applications in Metallurgy	TMLM3642	6	8	TCME3621
	Industrial Attachment I	TEGT3600	6	-	**TEGW3590**
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING – 148 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Experimental and Research Methods	TEGR3761	7	8	**TEGS3691**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Hydrometallurgy and Electrometallurgy	TMLM3791	7	12	TMLX3641
1	Transport Phenomena and Rate Processes	TMLX3731	7	16	TMLP3622
1	Mechanical Behaviour of Materials	TMLN3791	7	12	TEGS3591
1	Non-metallic Materials	TMLP3751	7	16	TEGS3591
1					
Total Credits Semester V				**68**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Non-ferrous Extractive Metallurgy	TMLF3792	7	12	TMLX3641
2	Corrosion and Wear	TMLM3792	7	12	TMLP3622
2	Metallurgical Process Design	TMLN3752	7	16	TMLP3692
2	Fuels, Furnaces and Refractories	TMLC3792	7	12	TEGS3591
2	Physical Metallurgy II	TMLX3762	7	12	TMLM3692
2	Research Proposal	TMLR3792	7	4	TEGT3741
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

YEAR 4 OF BSc IN METALLURGICAL 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	TEGM3881	8	12	**TEGT3761**
1	Mineral Processing Technology II	TMLX3831	8	16	TMLP3692
1	Metallurgical Production Processes	TMLM3851	8	16	TMLN3791
1	Ferrous Extractive Metallurgy	TMLF3891	8	12	TMLX3641
1	Process Modelling and Control	TMLL3891	8	12	MLN3752
Total Credits Semester VII				**80**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	
2	Research Project	TMLR3892	8	30	All 3rd Year Modules
2	Metallurgical Design Project	TMLD3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

Total credits for the Degree of BSc in Metallurgical Engineering – Physical (Honours)   **584**

K.4   DETAILED COURSE CONTENT FOR BSC IN METALLURGICAL ENGINEERING (HONOURS)

YEAR 1 OF BSc IN METALLURGICAL ENGINEERING

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGM3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Course Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. **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**. Introduction to complex numbers.:**definition, addition, subtraction, multiplication, division of complex numbers. Demoivres' theorem.**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, the chain rule, differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, 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
- Manipulate sequence and series of numbers
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- . Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3561
NQF Level	5
Contact Hours	**2**L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%(minimum of 2 tests and 4 drawing assignments) , Examination 40% (1 x 2 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.

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

Revision 2:	August 2015
Next Revision:	August 2019

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

Contents: Units, significant figures & 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 2015
Revision:	January 2019

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

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 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 2015
Next Revision: September 2019

Module Title:	**WORKSHOP PRACTICE**
Code	TEGW3590
NQF Level	5
Contact Hours	2h Lectures + 4h Practical Sessions per week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

Learning Outcomes: Upon completion of this course, students should be able to:
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.

Describe the general operation of air-conditioning and refrigeration systems.

Revision 2: September 2015
Next Revision: September 2019

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

Content: Classification of engineering materials: metals, ceramics, plastics, composites. Competition among materials, future trends of material usage. **Structure of materials**: Atomic structure; Bragg's law, electronic configuration, atomic bonding. Crystalline structure; amorphous structure, crystallographic planes and directions, Miller indices. Structure-property relationships. **Crystalline imperfections and diffusion**: Point defects, metallic solid solutions, line defects, slip systems, diffusion in solids. **Solidification and Microstructure:** Nucleation from the liquid state, inoculation, grain growth and grain size, development of microstructure, practical preparation of microsections. **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 ferrous and non-ferrous alloy systems. **Heat Treatment**: Annealing, normalizing, quench hardening, tempering. Solid solution hardening, strain hardening (cold working), annealing and recrystallization, precipitation hardening. **Properties of Materials:** Overview of electrical, optical and thermal properties of materials. **Mechanical properties**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, fatigue test, creep. **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: On completing the course students should be able to:
- Distinguish between different classifications of engineering materials
- Competently describe the electronic and crystalline structure of materials with associated imperfections
- Demonstrate an understanding of solidification and generation of microstructure in metallic materials
- Describe the formation of alloys and associated microstructures using binary equilibrium phase diagrams
- Describe the various procedures for heat treatment of ferrous and non-ferrous metals and alloys
- Distinguish between various properties of materials with special emphasis on mechanical properties and testing
- Describe the processes of corrosion and oxidation and the techniques used to control corrosion and degradation..
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Revision 1:	September 2015
Next Revision:	September 2019

Module Title	**CONTEMPORARY SOCIAL ISSUES**

Code UCSI3580
NQF 5
Contact Hours 1 Contact hours per week for 28 weeks
Credits 8
Assessment Continuous Assessment (100%). 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, with special reference to their sexual behaviour and to inculcate the primacy of moral reasoning in their social relations and their academic lives. In achieving the above aim, the following values and approaches will inform the CSI: Material will be presented on an integrative basis, stressing the interconnections amongst ethics, moral reasoning, citizenship, leadership, and values and approaches that direct to responsible social behaviour. Special emphasis will be placed on the construct of citizenship and its relation to democracy and the common good. Critical transformative theory will under gird the content of CSI. After completion of the CSI students will be empowered in the domains of human sexuality, reproductive health, democracy, the environment, sustainable development, and responsible leadership. Flexible modes of assessment may be harnessed and students are required to sign the class attendance list each time after a class session. Compulsory attendance required.

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

- Practice ethical reasoning
- Demonstrate knowledge to make informed decisions as responsible citizens
- Empower themselves to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship and give back such values to the community, nation, and world
- Sensitise towards the meaning of values and morals and how they affect the attitudes of individuals and groups toward population issues
- Recognise the need of balance between freedom and responsible behaviour
- Discuss stewardship/custodianship of the environment and sustainability of ecosystem services

Explain how human activities affect the environment and the sustainability of ecosystem services.

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% (minimum 2 tests and 4 assignments), 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. **Integration techniques**: integration by parts, integration by trigonometric substitution; Reduction formula, integration by partial fractions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length etc.… **Differential equations**: Meaning of solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Power series**: radius and interval of convergence. **Power series representation of functions:** Taylor and Maclaurin series. Binomial theorem. Power series solutions of second order ordinary differential equations with variable coefficients. Introduction to Bessel's equation and Bessel functions. **Complex functions**: Cauchy -Riemann equations.

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
- Apply the power series techniques to solve second order odes with variable coefficients
- Apply and solve engineering problems using Bessel's functions
Classify complex functions

Revision 1:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2015
Revision:	January 2019

Module Title	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**
Code	TEGT 3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100%
Pre-requisite(s)	None

Content: 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, Kirchhoff'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 2:	September 2015
Next Revision:	September 2019

Module Title:	**ENGINEERING MECHANICS I**
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); 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, Analysis of frames and machines.

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.

Revision 2:	September 2015
Next Revision:	September 2019

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

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

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

- 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 2015
Revision:	January 2019

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 6*0% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)* Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE

Content: **Structure of materials**: 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 2015
Next Revision:	September 2019

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	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TEGM3591 Engineering Mathematics I**
Co-requisite(s)	TEGM3592 Engineering Mathematics II

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation, Jacobian matrices. **Applications**: optimization on surfaces , constrained optimization . **Integral Transforms**: Laplace Transforms(LT) with applications to differential equations. Introduction to Fourier series. Fourier Transforms. Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.**Analytic functions**: Cauchy's theorem, Cauchy's integral formula, Taylor series, singular points, poles. Laurent series, Residue theorem and evaluation of complex integrals.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
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 C programing language.

Learning Outcomes: On completing the course 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 simple C programs

Revision 1:	September 2015
Next Revision:	September 2019

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

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: On completing the course 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 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course 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
- Appreciate basic queuing theory

Issue Date 2:	September 2015
Revision:	September 2019

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

Content: Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; Creating objects; Drawing with precision; Controlling the drawing display; **Editing methods**; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; **Managing content with AutoCAD design Centre**; Creating a layout to plot; Plotting your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2: September 2015
Next Revision: September 2019

Module Title:	**METALLURGICAL THERMODYNAMICS I**
Code	TMLX3691
NQF Level	6
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	SCHM3512 Chemistry 1B

Content: Introductory concepts of Thermodynamics: definition of thermodynamic terms, concept of states, simple equilibrium. Equation of states, extensive and intensive properties, homogeneous and heterogeneous systems. Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes. **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. Adiabatic Flame temperature calculations. **Second law of thermodynamics**, entropy, degree of reversibility and irreversibility, criteria of equilibrium, auxiliary functions, combined statements, Maxwell's relations, transformation formula, Gibbs-Helmoltz equation. **Third law of thermodynamics**. **Chemical Equilibria:** equilibrium constants of chemical reactions, free energy and equilibrium constant, temperature dependence of equilibrium constant van't Hoff's isotherm and isochore, Le Chatelier principle, extent of reaction. Ellingham – Richardson diagrams, phase stability diagrams. **Solutions**: partial molar quantities, ideal and non-ideal solutions, Raoult's law, Henry's law, Gibbs – Duhem equation, regular solution. One weight percentage standard state, chemical potential. Dilute solutions, alternate reference and standard states. Interaction parameters. Reactions involving gases and components in solution.

Learning Outcomes: On completing the course students should be able to:
- Describe the concepts of thermodynamic variables, such as enthalpy, entropy, heat capacity
- Calculate enthalpies of formation, and of reactions
- Ability to carry out energy balance of metallurgical processes
- Evaluate the feasibility of potential reactions from thermodynamic data
- Apply Raoult's and Henry's laws to solve thermodynamic problems
- Apply the concepts of partial and excess molar quantities

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**INTRODUCTION TO PROCESS METALLURGY**
Code	TMLX3641
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**SCHM3512 Chemistry 1B**

Content: Dimensions, units and conversion factors; Stoichiometry; Sampling and measurements. Principles of materials and energy balance; Laws of thermodynamics, Thermochemistry and illustration of the concepts with suitable examples, Introduction to Mineral Processing – importance, communition and liberation concentration and agglomeration processes – calcination, sintering, pelletizing briquetting, and nodulizing. Basic concept of Extractive metallurgy (*pyrometallurgy, hydrometallurgy and electrometallurgy*) – roasting, smelting, converting, leaching, precipitation processes, Faraday's law of electrolysis, electrowinning and refining.

Learning Outcomes: On completing the course students should be able to:
- Convert between different systems of units
- Solve heat and mass balance problems
- Illustrate the unit processes involved in extractive metallurgy

Revision 2:	September 2015
Next Revision:	September 2019

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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGM3592 Engineering Mathematics II**
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: **Applications of 2nd order 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. **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. **Multiple Integrals**: 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 and boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. **Difference equations**: modeling with difference equations, methods of solution to first and second order difference equations. Basic computing in numerical methods (using Matlab or any other suitable program)

Learning Outcomes: On completing the course 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
- Aapplications such as Matlab, Mathematica, Maple, C++ etc

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**METALLURGICAL THERMODYNAMICS II**
Code	TMLP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX 3691 Metallurgical Thermodynamics I**

Content: **Phase equilibria:** Phase rule for reacting and non-reacting systems. Equilibrium diagrams and thermodynamic properties (T-P-G variations). Clausius and Clausius-Clapeyron rules for condensed phase equilibria. 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. Chemistry of aqueous solutions. Fused salt electrolysis. Electrode potentials and the electrochemical series. Sloubility, solubility product and the effect of acidity. The Pourbaix diagram and its application.

Learning Outcomes: On completing the course students should be able to:
- Derive and apply the phase rules for reactive and non-reactive systems
- Interpret and apply phase diagrams
- Establish the relationship between chemical and electrical driving forces
- Construct and apply Pourbaix diagrams
- Apply thermodynamics to solve relevant engineering problems.

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**MINERAL PROCESSING TECHNOLOGY I**
Code	TMLP3692
NQF Level	6
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX3641 Introduction to Process Metallurgy**

Content: Introduction to Mineralogy and Mineralogical studies. Classification of minerals and their mineralogical properties. Structures and textures of minerals and their significance in mineral genesis and mineral processing. Application of mineralogy to mineral processing technology. Quantitative mineralogical analysis. Ore sampling techniques – electronic sorting principles. **Introduction to mineral beneficiation**, sampling, liberation studies and its importance. **Communition**: Fundamentals of communition, types of crushers, crushing circuits. **Grinding**: types of grinding mills, open circuit and closed circuit, circulating load. **Size separation** - sieving and screening. **Classification:** movement of solids in fluids, free settling and hindered settling of particles, different types of classifiers. **Concentration:** concentration criteria, gravity separation, jigging, tabling, dense media separation, spirals, froth floatation processes, machineries and practice. Magnetic and electrostatic separation – theory and application of magnetic and electrostatic separation techniques in mineral industries. **Dewatering:** methods of dewatering, sedimentation, filtration and drying dewatering equipment. **Tailing disposal:** methods of disposal of tailings, tailing management. **Materials handling** – bulk solids, solid transport and equipment, feeders, conveyor belts- stockpiles, bins and hoppers. Slurry handling: pipes, pumps, tanks. **Flow sheets:** typical flow sheets for beneficiation of selected minerals. **Metallurgical accounting:** economics of mineral processing technology, sampling and assaying, sampling systems. Material balances in mineral processing.

Learning Outcomes: On completing the course students should be able to:
- Outline the role of comminution in liberation of minerals
- Describe the principles of concentrating valuable minerals
- Explain the principles involved in solid-liquid separation
- Analyze unit operations in mineral processing.
- Design simple flowsheets for mineral processing

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**CRYSTAL STRUCTURES AND ANALYTICAL TECHNIQUES**
Code	TMLP3642
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

Content: Crystal structures: Crystals and Crystal structures. Two-dimensional patterns, lattices & Symmetry. Bravais lattices & Crystal Systems. Crystal Symmetry - Point groups, Space groups and symmetry related properties. Describing lattice planes & directions in crystals – Miller indices & zone. The reciprocal lattice. Use of stereographic projections to analyze deformation in cubic materials. **Analytical techniques: Metallographic techniques:** Optical metallography, image analysis, quantitative phase estimation Basic descriptions of analytical techniques such as DTA, DSC, TGA, XRD, SEM/EDS and TEM. **Computer applications:** software for analyzing and characterizing microstructure and texture of materials.

Learning Outcomes: On completing the course students should be able to:
- Illustrate different basic crystal structures
- Relate crystal structure to properties
- Apply stereographic projections to derive active slip systems
- Describe the basic analytical techniques
- Apply computer software in the analysis and characterization of microstructures.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**PHYSICAL METALLURGY I**
Code	TMLM3692
NQF Level	6
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	(assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

Content: Introduction to the branches of Physical Metallurgy. **Solidification of pure metal:** Phase rule, Concept of Free Energy, Entropy, Surface Energy (grain boundary) & under cooling, Nucleation& Growth, homogeneous& heterogeneous nucleation, directional solidification. Metallography. **Crystal defects in metals:** Vacancy, interstitial, substitutional, free energy of mixing, dislocation (elementary concepts only), edge / screw dislocation, partial dislocation, stacking fault, dislocation lock, dislocation pile up, Hall Petch relation, grain boundary structure. **Plastic deformation of pure metal:** Mechanisms (slip& twin), critical resolved shear stress, single crystal tensile test (fcc), theoretical strength of ideal crystal. **Diffusion:** Elementary concepts of phenomenological & atomistic approaches. **Solidification of binary alloys:** Limits of solubility, isomorphous system, lever rule, constitutional super cooling, effect of non-equilibrium cooling, eutectic, peritectic, eutectoid & peritectoid system. **Binary phase diagrams of common commercial alloys. Cold working & Annealing:** Recovery, recrystallization & grain growth. **Precipitation from super-saturated solid solution:** Thermodynamics & kinetics of precipitation, precipitation hardening. **Principles of heat treatment;** pearlite transformation, bainite transformation, martensite transformation, tempering. **Heat treatment processes**; annealing, normalizing, hardening, interrupted quenching of plain carbon steel, austempering, martempering. Hardenability of steel, factors influencing hardenability. **Application of physical metallurgy:** Strengthening mechanism, strength vs. toughness (ductility).

Learning Outcomes: On completing the course students should be able to:
- Discuss the solidification processes in metals and alloys.
- Relate the effect of crystal imperfection to the strengthening of materials.
- Discuss the mechanisms involved in the materials' deformation.
- Describe the heat treatment procedures for carbon and alloy steels.

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	**ELECTRICAL MACHINES**
Code	TECP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	**TEGT3542 Fundamentals of Electrical Engineering**

Content: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines**: Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers**: Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine)**: generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine:** introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, special cage motors, induction regulators, , energy recovery techniques. Drives Applications.

Learning Outcomes: Upon completion of this module, students should be able to:
- Demonstrate an understanding of 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
- Demonstrate an understanding of special-purpose motors and VSDs.

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**COMPUTER APPLICATIONS IN METALLURGY**
Code	TMLM3642
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TCME3621 Computer Science for Engineers**

Content: Use of the chosen high level language to perform calculations in areas relevant to process engineering. Emphasis is on doing calculations and not on producing professional programming code for others to use. Advanced Microsoft Excel for metallurgical processes.

Learning Outcomes: On completing the course students should be able to:
- Solve metallurgical problems using relevant software packages
- Apply Advanced Microsoft Excel in Metallurgical processes

Revision 2: September 2015
Next Revision: September 2019

Module Title:	**INDUSTRIAL ATTACHMENT I**
Code	TEGT3600
NQF Level	6
Total Hours	Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite	TEGW3590 Workshop Practice

Module Description: **:** During Industrial Attachment I, students will work under company supervision at the level of **Technician Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:
- Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- 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: 2 September 2015
Next Revision: September 2019

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGR3761
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%); Lab 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: On completing the course 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 dataApply statistical tools to analyse data.

Revision 2: August 2015
Next Revision: August 2019

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

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

Learning Outcomes: On completing the course students should be able to:
- 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 2: August 2015
Next Revision: August 2019

Module Title:	**HYDROMETALLURGY AND ELECTROMETALLURGY**
Code	TMLM3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX3641 Introduction to Process Metallurgy**

Content: Unit processes of hydrometallurgy: Thermodynamics and kinetic aspects. Pourbaix diagrams. **Leaching methods**: acid, alkaline and pressure leaching. **Purification of leach liquors**: ion exchange, solvent extraction and selective precipitation operations. Solid-liquid separation techniques. Principles of electrometallurgy. **Recovery of metal values**: cementation, electrowinning, hydrogen precipitation methods and refining from aqueous solutions. Electrolyte preparation, cell potentials, effect of additives. Application of processes for the recovery of copper, nickel, zinc, aluminum, cobalt, gold and uranium. **Reactor design** and development of models for leaching and extraction. Hydrometallurgy of Rare Earth Elements (REE).

Learning Outcomes: On completing the course students should be able to:
- Explain the unit processes involved in hydrometallurgical extraction of metals.
- Describe unit processes involved in electrometallurgical extraction of metals.
- Apply knowledge of thermodynamics and kinetics to the extraction of metals.
- Apply the fundamental knowledge of unit processes in hydrometallurgical and electrometallurgical processes to the extraction of selected metals.

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**TRANSPORT PHENOMENA AND RATE PROCESSES**
Code	TMLX3731
NQF Level	7
Contact Hours	4L + 2T or 1 PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP3622 Metallurgical Thermodynamics II**

Content: Momentum Transfer: Steady and Unsteady Flows; Overall mass, energy and momentum balance; Navier-Stokes equations; Newton's Law, Non-Newtonian Fluids; Laminar flow in falling film, flow through conduits etc; Inviscid fluid flow, Viscous flow, Laminar and Turbulent Boundary Layer Theory, Friction Factor; Flow past immersed objects, packed and fluidized bed. **Mass Transfer:** Steady state mass transfer and diffusion; molecular diffusion in gasses, liquid, biological gels and solids; Unsteady state mass transfer under different conditions, mass transfer coefficient, diffusion through porous medium and capillaries; Boundary layer flow and turbulence in mass transfer, Simulation heat, mass and momentum transfer. **Heat Transfer**: **Conduction**: Steady State: One Dimensional- Composite wall and cylinder; Multidimensional- Differential heat balance, shape factor, graphical and numerical methods. **Unsteady State**: Analytical solutions of one dimensional lumped heat capacity system, heat flowing semi-infinite solid, convection boundary conditions, Heisler chart solutions. **Convection**: Natural and forced convection, overall heat transfer coefficient, fouling factor, types of heat exchanges. **Radiation**: Physical mechanism, radiation properties, shape factor, heat exchange between non-black bodies, infinite parallel planes, radiation shields, gas radiation. Application of transport phenomena in modelling and simulation: theory of similarity and dimensional analysis, case studies; some case studies of mathematical modeling in metallurgical systems – gas stirred ladle, continuous casting etc. **Principles of Metallurgical kinetics**; reaction rates and mechanisms, homogeneous and heterogeneous systems.

Learning Outcomes: On completing the course students should be able to:
- Establish the principles of metallurgical kinetics
- Calculate concentration gradients and reaction rates of metallurgical reactions
- Evaluate the turbulent flow of fluids
- Describe the concept of viscosity in fluid dynamics
- Discuss the principles of momentum transfer
- Explain the different modes of mass and heat transfer
- Categorize 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 2:	August 2015
Next Revision:	August 2019

Module Title:	**MECHANICAL BEHAVIOUR OF MATERIALS**
Code	TMLN3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (Assignments, Labs, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLM 3692 Physical Metallurgy I**

Content: Introduction to deformation behaviour: Concept of stresses and strains, engineering stresses and strains. **Elasticity Theory:** stress and strain tensor, tensor transformation, principal stress and strain, elastic stress-strain relation. **Yielding and Plastic Deformation:** yield criteria and yield surface, texture and distortion of yield surface., Limitation of engineering strain at large deformation, true stress and true strain, effective stress, effective strain, flow rules, strain hardening, Ramberg-Osgood equation, stress -strain relation in plasticity. **Microscopic view of plastic deformation:** crystals and defects, classification of defects, thermodynamics of defects, geometry of dislocations, slip and glide, dislocation generation – Frank-Read and grain boundary sources, stress and strain field around dislocations, force on dislocation - self-stress, dislocation interactions, partial dislocations, twinning, dislocation movement and strain rate, deformation behavior of single crystal, critical resolved shear stress (CRSS), deformation of polycrystals and other strengthening mechanisms, grain size effect and Hall-Petch equation. **Fracture, Fatigue and High temperature deformation of materials.**

Learning Outcomes: On completing the course students should be able to:
- Explain the deformation processes and their applications.
- Analyse the mechanisms of deformation in materials.
- Discuss the strengthening mechanism in materials; and
- Predict fracture and fracture mechanisms in materials.

Revision 2: August 2015

Next Revision: August 2019

Module Title:	**NON-METALLIC MATERIALS**
Code	TMLP3751
NQF Level	7
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

Content: Classification of engineering materials; metals, polymers, ceramics and composites**. Ceramics;** Traditional ceramics, brick and tile, refractory and insulating materials, china, porcelain, enamels, abrasives, cements, coordination number, interstitial sites, solid solutions, types of transformations, silica and silicate structures, mullite and spinels, glass and glass processing, glass ceramics. Advanced structural ceramics, oxide ceramics, nitride ceramics, fracture toughness, micro crack formation, high temperature application of ceramics, processing of ceramics, shaping and binding, molding, firing, sintering. Testing of ceramics. **Polymeric Materials;** Review of polymer chemistry, introduction to polymers, classification of polymers, polymerization, co-polymerization, structure and properties of thermoplastic and thermosetting polymers, elastomers and rubber, vulcanization, additives and fillers. Processing and fabrication of plastics; extrusion, injection, calendaring and thermoforming. Physical and Mechanical Properties of polymers. Applications of polymeric materials. **Composite Materials;** Introduction to Composite materials, classification and strengthening mechanisms in composites, types of reinforcement – metallic and non metallic fibers, whiskers and particulates. **Fabrication processes of composite** materials – reaction sintering, infiltration, in-situ, filament winding, injection moulding, extrusion, calendaring, and pultrusion and degradation of fibers. Application of composites: Aerospace, marine, automobile, medical products. Design aspects, carbon-carbon and carbon-epoxy based composites, mechanical properties.

Learning Outcomes: On completing the course students should be able to:
- Explain the various classes of engineering materials.
- Evaluate the properties and applications of various engineering materials.
- Apply the knowledge of the fabrication and characterization techniques of various engineering materials.

Revision 2: August 2015
Next Revision: August 2019

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: On completing the course 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 endeavor
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	NON-FERROUS PYROMETALLURGY
Code	TMLF3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX3641 Introduction to Process Metallurgy**

Content: General methods of extraction: Pre-treatment processes – calcinations, roasting and agglomeration. Extraction Processes – smelting and refining: Basic approaches, preparation of pure compounds, purification of crude metal produced in bulk. **Construction and application of Predominance/stability diagrams** (Kellogg-Basu diagrams) for extraction of metals. **Extraction of metals from oxide sources**: (Basic approaches and special features of specific extraction processes, extraction of metals such as magnesium, lead, tin. **Extraction of metals from sulphide ores:** (Pyro-metallurgy of sulphides, production of metals such as copper, lead, zinc, nickel etc.). **Slag chemistry, refractories and fluxes**. Pyrometallurgy of Rare Earth Elements (REE). **Environmental Management:** Management of solid and liquid waste; reprocessing of dumps; processing and recovery of toxic metals. Particulate and gaseous emissions control. Codes of practice and legislation governing the Metallurgical industry in Namibia and the SADC region..

Learning Outcomes: On completing the course students should be able to:
- Summarise the general methods of metal extraction and refining.
- Apply thermodynamics and kinetics principles to solve high temperature processing problems.
- Explain the various pre-treatment and smelting unit processes.
- Analyse pyrometallurgical methods of extracting non-ferrous metals and illustrate them with appropriate flowsheets.
- Relate the impacts of pyrometallurgical processes on society and the environment.

Revision 2:	August 2015
Next Revision:	August 2019

Module Title:	**CORROSION AND WEAR**
Code	TMLM3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMLP3622 Metallurgical Thermodynamics II**

Content: Review of Corrosion processes: Overall classification of types of corrosion. **Basic electrochemistry:** Galvanic and electrolytic cells, Potential measurements, EMF and Galvanic series, Galvanic corrosion and bimetallic contacts. **E–pH diagrams:** Electrode – solution interface, Electrode kinetics and polarization phenomena, Exchange current density. **Polarization techniques to measure corrosion rates**: Mixed potential theory, Activation and diffusion controlled mixed electrodes. **Methods of corrosion prevention and control**: Design, coatings and inhibition, Cathodic protection, Stray current corrosion, Passivity phenomena and development of corrosion resistant alloys, Anodic control. **Biological aspects of corrosion**: Microbially induced corrosion (MIC) - Principles, Types, environments and microbiology. **High temperature oxidation**. **Wear mechanisms**, and categories of wear. **Surface modifications by diffusion**, heat treatment and by coatings, surface processing by laser, electrons and ions. **Materials selection based on corrosion and wear**.

Learning Outcomes: On completing the course students should be able to:
- Identify the common corrosion processes
- Explain the principles of electrochemistry and corrosion
- Recommend processes to reduce or avoid corrosion
- Identify the different wear mechanisms
- Manipulate the interplay between abrasive forces and wear in specific environments
- Recommend processes to reduce wear.
- Predict suitable materials on the basis of corrosion and wear.

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**METALLURGICAL PROCESS DESIGN**
Code	TMLN 3752
NQF Level	7
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP 3692 Mineral Processing Technology I**

Content: Fundamental principles of design: Process design criteria. **Design of metallurgical processing systems**. **Method of estimating process cost and profitability**. Translation of process design to plant design. Process flow sheet. Plant flow sheet. The application of fundamental metallurgical principles to the design process which includes thermodynamics, rate phenomena, unit operations and pilot plant design. **Design stages**: laboratory scale, pilot plant and industrial scale. Introduction to modeling and simulation as applied to metallurgical processes. Selection and design of process. General characteristic of metallurgical processing equipment. Integration of process units into a working plant, its construction and operations. **Case studies on design of metallurgical equipment**: furnace, ball mills, sintering plant metal forming mills, floatation cell etc. Feasibility of design including energy requirements for new plant design.

Learning Outcomes: On completing the course students should be able to:
- Apply process engineering and materials engineering principles to the design of metallurgical processes;
- Assess design cost of metallurgical processes; and
- Design a process or plant for a specific metallurgical operation

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	FUELS, FURNACES AND REFRACTORIES
Code	TMLC3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

Content: Fuels: Introduction - Types of solid fuel, origin of coal petrography, mineral matter in coal, classification and grading of coal, chemical and physical properties of coal, plastic/coking properties of coal, thermal decomposition of coal, selection, testing utilization of coking and Non-coking coal. **Coal carbonization**: Fundamentals of coal carbonization, types of carbonization process, by product recovery and coke properties; non-recovery coke ovens. **Liquid Fuels**: Classification of petroleum, characterization of petroleum and their products. Coal liquefaction. **Gaseous Fuels:** Classification of gaseous fuels, production of gaseous fuels such as producer gas, water gas, natural gas and coal bed methane. **Furnaces**: Classification of metallurgical furnaces and reactors: blast furnaces, electric furnaces, rotary kilns, crucible furnaces, tilting furnaces, reverberatory furnaces, open hearth furnaces, converters, fluidized bed reactors. **Refractories:** Classification of refractories, raw materials, manufacture, testing and properties of heavy and special refractories, silica, siliceous aluminosilicate, high alumina, magnesite, chrome, chrome-magnesite, dolomite, forsterite, chemically bonded basic, carbon and insulating refractories and special purpose oxides, carbide nitride refractories. **Binary phase diagrams** of Al_2O_3-SiO_2, CaO-MgO, Cr_2O_3-MgO and MgO-SiO_2 systems. Refractory mortars and cements, Refractory castables, selection of refractories for coke oven, iron blast furnace, copper convertor, soaking reheating furnaces and heat treatment furnaces, electric arc furnace.

Learning Outcomes: On completing the course students should be able to:
- Appraise the various types of fuels, furnaces and refractories used in metallurgical industries.
- Explain the properties of various metallurgical fuels, furnaces and refractories
- Select appropriate fuels, furnaces and refractories for different metallurgical processes.
- Discuss the impact of metallurgical processes on the environment
- Apply relevant techniques to reduce the impact of hazardous substances on the environment
- Analyse the health and safety issues, and relevant legislation governing metallurgical industries locally and regionally
- Value the concept of sustainability

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**PHYSICAL METALLURGY II**
Code	TMLX3762
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMLM3692 Physical Metallurgy I**

Content: Structure – Properties – Performance relationship, Review of Phase diagrams and Alloy theory; Introduction to ternary phase diagrams. **Solid State transformations**: diffusion dependent phase transformation**:** precipitation, eutectoid transformation – pearlitic and bainitic transformations, spinodal decomposition, massive transformation; diffusionless transformation – martensite transformation. **Recrystallization mechanisms:** recovery, primary recrystallization, secondary recrystallization, grain growth, dynamic recovery and recrystallization; **Strengthening mechanisms**: grain size strengthening, solid solution strengthening, precipitation and dispersion hardening, fiber reinforcement, Martensitic strengthening, strain hardening. Heat treating of alloy steels. Application of IT/TTT, CCT diagrams. Thermomechanical treatment: Classification of thermomechanical treatment of steel: HTTMT, LTTMT, hot rolling, ausforming, isoforming, thermomechanical treatment of Non-ferrous alloys: HTTMT and LTTMT. Thermochemical treatment: case hardening of steel: Carburising (pack, liquid and gas); nitriding, carbonitriding cynading, chromizing boronising. Induction and flame hardening. Heat treatment of cast iron; tool steel; stainless steel and Heat resisting steel. Heat treatment of Non-ferrous metals: Al, Cu; precipitation hardening of Non-ferrous metals. **Advances in physical metallurgy** - shape memory alloys, metallic glasses.

Learning Outcomes: On completing the course students should be able to:
- Predict the relationship between structure, properties and performance of metallic materials.
- Discuss the solid state transformations in metals and alloys.
- Explain the strengthening mechanisms in metals and alloys.
- Manipulate the properties of cold worked materials by recovery and recrystallization processes.
- Illustrate the process of precipitation hardening of non-ferrous alloys
- Apply the transformation diagrams to predict structure of ferrous alloys;
- Explain the use of thermochemical and thermomechanical treatment for structural modification of ferrous alloys.
- Discuss the various heat treatment procedures for non-ferrous alloys.

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**RESEARCH PROPOSAL**
Code	TMLR3792
NQF Level	7
Contact Hours	1 L / week
NQF Credits	4
Assessment	Continuous 100% [Seminar Presentation 50%, Proposal 50%)]
Co-requisite(s)	(TEGT3741 Experimental and Research Methods)

Content: 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 course students should be able to:
- Make a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Revision 2: August 2015
Next Revision: August 2019

Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.**
	The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

YEAR 4 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

Module Title:	SOCIETY AND THE ENGINEER
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 100%
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: **Engineering as a profession:** engineering societies and registration procedure for different engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**
Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.
Learning Outcomes: On completing the course students should be able to:
- Identify the role of various engineering disciplines and societies
- Paraphrase the importance of engineering professional ethics and its enforcement by the regulating bodies
- Illustrate the use of engineering codes and standards
- Justify general knowledge of procedural law, law of contracts, commercial law and employment law
- Relate laws of arbitration
- Classify technology policy on the acquisition of technological know-how
- Summarise the strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

Revision 2:	September 2015
Next Revision:	September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 50% (2 assignments, 2 Tests); Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Content: **Module Description: Basic principles of project management:** Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.
Learning Outcomes: On completing the course students should be able to:
- Recognise 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
- Demonstrate knowledge of the principles of managing medium to large scale engineering projects
- Hypothesize the principles of managing community-based development projects
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**MINERAL PROCESSING TECHNOLOGY II**
Code	TMLX3831
NQF Level	8
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP 3692 Mineral Processing Technology I**

Content: **Techno-economic aspects of mineral processing. Characterization 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. **Particle behaviour**: 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. **Solid-Liquid Separations**: Theories of thickening and filtration, Design of thickeners. Mass and water balance of solid-liquid recovery systems. Application of the above in design of process requirements and in design of experimental programmes. **Multiple stream metallurgical accounting**. 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: On completing the course students should be able to:
- Discuss the Techno-economic aspects of mineral processing
- Explain the nature and behaviour of particulate materials
- Apply appropriate methods to size particulate materials
- Analyse 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 2:   September 2015
Next Revision: September 2019

Module Title:	**METALLURGICAL PRODUCTION PROCESSES**
Code	TMLM3851
NQF Level	8
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMLN3791 Mechanical Behaviour of Materials**

Content: **Classification of forming processes**. Fundamentals of metal working – effect of temperature, strain rate, metallurgical structure, friction & lubrication, workability and residual stress. **Rolling** – classification & processes, load, torque, power, variables controlling process, defects. **Extrusion** - classification & processes, force & variables affecting it. **Drawing** of Rods, wires and tubes – processes, drawing stress. **Sheet metal forming** – forming methods, forming limit criterion, special forming techniques and defects in formed products. **Welding** – types of welding processes (gas, arc, resistance, flash, friction and electroslag welding), weldability of metals and alloys. Structure of welds, heat treatment and transformation. Design of welded joints, welding defects and their remedies. Inspection and testing of weldments**. Brazing and soldering**. **Casting techniques**: advantages and applications. Principle of liquid metal processing and solidification. **Risering**: Riser design; risering curves; NRL method of riser design; feeding distance; risering of complex castings. **Gating**: Gating systems and their characteristics; Types of gates and design consideration. **Patterns**: Pattern design; and testing. **Molding and Core Making Processes**, Testing of Sand, Gases in metals, Fluidity of metals, **Casting defects**, Casting quality measurement. **Inspection and Quality Control using Non-destructive Testing (NDT) techniques**. **Introduction to Powder metallurgy**.

Learning Outcomes: On completing the course students should be able to:
- Summarize the various metal working principles and processes.
- Explain joining and welding metallurgy and their applications.
- Expound on the principles involved in powder metallurgy
- Discuss metal casting processes and basic foundry operations for ferrous and Non-ferrous metals
- Manipulate different casting designs and methods
- Analyse the quality control technique in foundry operations

Revision 2:   September 2015
Next Revision: September 2019

Module Title:	**FERROUS EXTRACTIVE METALLURGY**
Code	TMLF3891
NQF Level	8
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX3641 Introduction to Process Metallurgy**

Content: **Iron Ore materials and their characteristics**. **Introduction to Blast furnace route for Iron making**: The blast furnace and its accessories, the burden and its preparation, physical – thermal and chemical processes in a blast furnace, blast furnace slag and its control, Control of hot metal composition, blast furnace plant and accessories. **Alternative Methods:** Need for alternative methods, sponge Iron production by using solid and gaseous reductants, direct and smelting reduction processes. **Modern Steel Making**: different routes of steelmaking, Oxygen steelmaking – Top and bottom blown converter processes, Open hearth, Electric steelmaking – Electric arc furnaces, Induction furnaces. **Secondary Steelmaking:** Deoxidation processes, Clean steel technology. **Casting of liquid steel**: Ingot casting of steel, Continuous casting of steel. Aspects of Stainless steel production. Heat and Mass balance in Iron and steelmaking processes: The Rist diagram and its application.

Learning Outcomes: On completing the course students should be able to:
- Expound on the principles iron ore reduction
- Explain the blast furnace production of iron
- Discuss alternative iron making methods
- Summarize the principles of steel making and various methods of their application
- Manipulate data relating to iron making and conversion to steel
- Explain the production of stainless steel and its limitations
- Assess 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**PROCESS MODELLING AND CONTROL**
Code	TMLL3891
NQF Level	8
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLN 3752 Metallurgical Process Design**

Content: **Mathematical modelling and simulation principles**, type of models – static, dynamic and empirical models. **Multivariate cases**: open and closed systems. Model formulation and solution analysis. **Mathematical modelling and simulation** of metallurgical engineering processes. Development and application of computer algorithm and software for problems in metallurgical processes. **Control objectives** (stability, optimization 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 specialized control systems. Digital simulation of dynamic systems.

Learning Outcomes: On completing the course students should be able to:
- Employ the principles of mathematical modelling and simulation in metallurgical processes.
- Apply suitable computer software to control metallurgical processes.
- Ascertain the objectives of process control in a given system
- Interpret industrial conventions of process control.
- Employ specialized control systems in metallurgical processes

Revision 2:	September 2015
Next Revision:	September 2019

SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TMLR 3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation
NQF Credits	30
Assessment	Continuous 100% Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s)	TCER3891 Research Proposal, All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
- Apply required skills 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 2:	September 2015
Next Revision:	September 2019

Module Title:	METALLURGICAL DESIGN PROJECT
Code	TMLD 3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s)	All third year modules

Content: An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Implement practical skills in the design of engineering components, assemblies and/or systems.
- Apply knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process.
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. Module may be required before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

- Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
- Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Discuss the role of engineers in the management and organization of engineering enterprises
- Discuss in details the main technical activities undertaken during the attachment.

Revision 2:   August 2015
Next Revision: August 2019

L. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

L.1. DEGREE NAME: Bachelor of Science in Mining Engineering (Honours) **19BMNE**

L.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.

L.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 – 152 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics I	TEGM3591	5	12	None
1	Engineering Drawing	TEGT3561	5	8	None
1	*Physics for Physical Sciences* I	SPHY3511	*5*	16	*None*
1	Computing Fundamentals	TCME3521	5	8	None
1	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	*5*	12	*None*
1	*Contemporary Social Issues*	UCSI3580	5	8	None
Total Credits Semester I				*72*	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics II	TEGM3592	5	12	TEGM3591
2	Fundamentals of Electrical Engineering	TEGT3542	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 MINING 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	**TCME3521** TEGT3561
1	Statistics for Engineers	TEGS3691	6	12	**TEGM3591**
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Introduction to Mining Engineering	TMNE3661	6	8	None
1	Strength of Materials I	TCVM3621	6	8	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	Structural Geology	TMNE3622	6	8	TMNE3621
2	Thermofluids	TMNE3632	6	16	SCHM3512
2	Engineering Materials	TMEM3622	6	8	TEGT3562
2	Electrical Machines	TECP3622	6	8	**TEGT3541**
2	Surveying for Engineers	TCVE3642	6	8	**TEGM3591**
2	Industrial Attachment I	TEGT3600	6	-	**TEGW3590**
Total Credits Semester IV				**64**	

YEAR 3 OF BSc IN MINING ENGINEERING – 152 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
1	Experimental and Research Methods	TEGR3761	7	8	**TEGS3691**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Hydrogeology	TMNU3761	7	8	TMNE3622
1	Excavation Engineering	TMNE3711	7	16	TMNE3661
1	Mine Equipment and Machinery	TMNS3791	7	12	TMNE3661
1	Mine Ventilation and Climate Control	TMNC3791	7	12	TMNE3632
1	Soil and Rock Mechanics	TMNU3791	7	12	TEGT3521
Total Credits Semester V				**76**	
SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE& CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Surface Mining	TMNS3792	7	12	TMNE3711
2	Mine Surveying	TMNU3722	7	8	TCVE3642
2	Computer Applications in Mining	TMNU3792	7	12	TCME3621
2	Mineral Processing	TMNS3742	7	8	TMNE3661
2	Technical Valuation	TMNU3742	7	8	TEGS3691
2	Mine Design	TMNS3732	7	8	TMNS 3791
2	Research Proposal	TCER3792	7	4	TEGT3741
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	EGM3881	8	12	**TEGT3761**
1	Mine Safety, Health and Environment	MNU3831	8	16	TEGT3761
1	Underground Mining	TMNU3811	8	16	TMNM3791 TMNS3762
1	Rock Engineering	TMNS3861	8	8	TMNE3711
1	Mine Management Principles and Financial Valuation	TMNS3831	8	16	TMNU3791
Total Credits Semester VII				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	
2	Research Project	TMND3892	8	30	All 3rd Year Modules
0	Mining Design Project	MNR3890	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**

L.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% (minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Course Lines and planes:: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. **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**. Introduction to complex numbers.:**definition, addition, subtraction, multiplication, division of complex numbers. Demoivres' theorem .**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, the chain rule, differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, 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
- Manipulate sequence and series of numbers
- Use various mathematical functions and apply them to engineering
- Apply trigonometry in solving mathematical and engineering problems
- .Apply the principle of differentiation/integration to solve basic mathematical and engineering problems.
- Solve mathematical and engineering problems using partial differentiation

Revision 2:   August 2015
Next Revision: August 2019

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3561
NQF Level	5
Contact Hours	**2**L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 60%(minimum of 2 tests and 4 drawing assignments) , Examination 40% (1 x 2 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.

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

Revision 2:	August 2015
Next Revision:	August 2019

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

Contents: Units, significant figures & 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 2015
Revision:	January 2019

Module Title:	**COMPUTING FUNDAMENTALS**
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50 %(minimum 2 tests and 2 assignments and 2 practical reports); Examination 50% (1 x 2 hour

paper)

Pre-requisite(s)   None

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 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 2015
Next Revision: September 2019

Module Title:	**WORKSHOP PRACTICE**
Code	TEGW3590
NQF Level	5
Contact Hours	2h Lectures + 4h Practical Sessions per week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

Learning Outcomes: Upon completion of this course, students should be able to:
- Discuss general safety procedures applicable to engineering workshops.
- Describe specific hand tools used in engineering workshops.
- Construct basic wall structures using brickwork, cement and mortar.
- Differentiate between a lathe and a milling machine and produce simple components by machining operations.
- Use arc welding and gas welding to fabricate simple components.
- Describe the general operation of internal combustion engines.
- Construct basic electric circuits and use them to perform specified activities.
- Describe procedures for soldering and de-soldering of electronic components.
- Fabricate a prescribed wooden component using the principles of carpentry.
- Perform simple plumbing and pipe fitting exercises.

Describe the general operation of air-conditioning and refrigeration systems.

Revision 2:   September 2015
Next Revision: September 2019

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

Content: Classification of engineering materials: metals, ceramics, plastics, composites. Competition among materials, future trends of material usage. **Structure of materials**: Atomic structure; Bragg's law, electronic configuration, atomic bonding. Crystalline structure; amorphous structure, crystallographic planes and directions, Miller indices. Structure-property relationships. **Crystalline imperfections and diffusion**: Point defects, metallic solid solutions, line defects, slip systems, diffusion in solids. **Solidification and Microstructure:** Nucleation from the liquid state, inoculation, grain growth and grain size, development of microstructure, practical preparation of microsections. **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 ferrous and non-ferrous alloy systems. **Heat Treatment**: Annealing, normalizing, quench hardening, tempering. Solid solution hardening, strain hardening (cold working), annealing and recrystallization, precipitation hardening. **Properties of Materials:** Overview of electrical, optical and thermal properties of materials. **Mechanical properties**: Stress and strain, tensile testing, true stress and true strain, deformation modes; yield and fracture, hardness testing, bend test, impact test, fatigue test, creep. **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: On completing the course students should be able to:
- Distinguish between different classifications of engineering materials
- Competently describe the electronic and crystalline structure of materials with associated imperfections
- Demonstrate an understanding of solidification and generation of microstructure in metallic materials
- Describe the formation of alloys and associated microstructures using binary equilibrium phase diagrams
- Describe the various procedures for heat treatment of ferrous and non-ferrous metals and alloys
- Distinguish between various properties of materials with special emphasis on mechanical properties and testing
- Describe the processes of corrosion and oxidation and the techniques used to control corrosion and degradation..
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Revision 1:	September 2015
Next Revision:	September 2019

Module Title	**CONTEMPORARY SOCIAL ISSUES**

Code   UCSI3580
NQF   5
Contact Hours   1 Contact hours per week for 28 weeks
Credits   8
Assessment   Continuous Assessment (100%). 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, with special reference to their sexual behaviour and to inculcate the primacy of moral reasoning in their social relations and their academic lives. In achieving the above aim, the following values and approaches will inform the CSI: Material will be presented on an integrative basis, stressing the interconnections amongst ethics, moral reasoning, citizenship, leadership, and values and approaches that direct to responsible social behaviour. Special emphasis will be placed on the construct of citizenship and its relation to democracy and the common good. Critical transformative theory will under gird the content of CSI. After completion of the CSI students will be empowered in the domains of human sexuality, reproductive health, democracy, the environment, sustainable development, and responsible leadership. Flexible modes of assessment may be harnessed and students are required to sign the class attendance list each time after a class session. Compulsory attendance required.

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

- Practice ethical reasoning
- Demonstrate knowledge to make informed decisions as responsible citizens
- Empower themselves to responsible behaviour changes and to transform high risk behaviour to the common good and responsible citizenship and give back such values to the community, nation, and world
- Sensitise towards the meaning of values and morals and how they affect the attitudes of individuals and groups toward population issues
- Recognise the need of balance between freedom and responsible behaviour
- Discuss stewardship/custodianship of the environment and sustainability of ecosystem services

Explain how human activities affect the environment and the sustainability of ecosystem services.

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% (minimum 2 tests and 4 assignments), 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. **Integration techniques**: integration by parts, integration by trigonometric substitution; Reduction formula, integration by partial fractions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length etc….
Differential equations: Meaning of solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Power series**: radius and interval of convergence. **Power series representation of functions:** Taylor and Maclaurin series. Binomial theorem. Power series solutions of second order ordinary differential equations with variable coefficients. Introduction to Bessel's equation and Bessel functions. **Complex functions**: Cauchy -Riemann equations.

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
- Apply the power series techniques to solve second order odes with variable coefficients
- Apply and solve engineering problems using Bessel's functions
Classify complex functions

Revision 1:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2015
Revision:	January 2019

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT 3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100%
Pre-requisite(s)	None

Content: 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, Kirchhoff'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 2:	September 2015
Next Revision:	September 2019

Module Title:	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports); 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, Analysis of frames and machines.

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.

Revision 2:	September 2015
Next Revision:	September 2019

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

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

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

- 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 2015
Revision:	January 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 6*0% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper)*
	Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE

Content: **Structure of materials**: 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 2015
Next Revision:	September 2019

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	TEGM3592 Engineering Mathematics II
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation, Jacobian matrices. **Applications**: optimization on surfaces , constrained optimization . **Integral Transforms**: Laplace Transforms(LT) with applications to differential equations. Introduction to Fourier series. Fourier Transforms. Inverse transforms on derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.**Analytic functions**: Cauchy's theorem, Cauchy's integral formula, Taylor series, singular points, poles. Laurent series, Residue theorem and evaluation of complex integrals.

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

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

Revision 2:	September 2015
Next Revision:	September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%
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 C programing language.

Learning Outcomes: On completing the course 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 simple C programs

Revision 1:	September 2015
Next Revision:	September 2019

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

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: On completing the course 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 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course 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
- Appreciate basic queuing theory

Issue Date 2:	September 2015
Revision:	September 2019

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

Content: Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; Creating objects; Drawing with precision; Controlling the drawing display; **Editing methods**; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; **Managing content with AutoCAD design Centre**; Creating a layout to plot; Plotting your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this module, students should be able to:
- 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 2:	September 2015
Next Revision:	September 2019

Module Title:	**INTRODUCTION TO ENGINEEERING GEOLOGY**
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 100%
Pre-requisite(s)	None

Contents: Mineralogy: Properties and composition of rock forming and economic minerals; petrology; composition and identification of common igneous, sedimentary and metamorphic rocks. Practical work involves the identification of common minerals and rocks. **Internal processes**: the nature of the interior of the earth; plate tectonic theory. **Surface processes**: rock weathering and soil formation; erosion and denudation; sediment transport and deposition; the rock cycle in the context of plate tectonic theory; introductory geo-hydrology. Brief on Ore and mineral exploration methods and Prospecting Techniques. Practical work involving geological map interpretation.

Learning Outcomes: On completing the course students should be able to:
- Describe composition and properties of common minerals and rocks
- Analyse the nature of the interior of the earth and the plate tectonic theory
- Describe weathering processes and soil formation processes
- Apply basic knowledge of geology.

Issue Date 2:	September 2015
Revision:	September 2019

Module Title:	**INTRODUCTION TO MINING ENGINEERING**
Code	TMNE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper
Pre-requisite(s)	None

Contents: Introductory concepts: Mining terminologies applied in surface and underground mining and mineral processing. Stages in the life of a mine**,** Role of mining in human civilization. **Minerals and ores**. Mineral deposits. The economic significance of the Namibian Mining Industry. **Structure of the Namibian Mining Industry**. **Processes in Mining: D**rilling, Blasting, Extraction, Loading and Haulage, Drilling equipment and tunnelling. Explosives and its accessories, and magazines. Shallow and deep mining. **Rock transportation systems and their applications**. Diamond and Gold mining technologies and methods. **Introduction to mine safety**, mine ventilation, strata control and Environmental considerations, technical report writing and presentation **mine visits**.

Learning Outcomes: On completing the course students should be able to:
- Explain the basic mining terminologies
- Comprehend the Namibian mining industry and Namibian mineral deposits
- Describe various mining methods and mining equipment
- Explain various mine transportation methods
- Discuss mine safety and mine environmental issues

Issue Date 2:	September 2015
Revision:	September 2019

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

Contents: Basic concepts: Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams. **Stress and strain:** Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke's Law; Modulus of Elasticity; Normal stress and strain; Poisson's ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson's ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants. **Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems:** Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars. **Geometrical characteristics of plane sections:** Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem. **Bending:** Shear force and bending moment diagrams. **Bending and shear stresses in beams:** Theory of beam bending; Section modulus; Composite beams; Shear stress distribution due to bending. **Simple Torsion:** Pure torsion of circular bars; Shear stress and shear strain in shafts, Torsional rigidity; Torsion of hollow shafts. **Stresses in thin cylinders and spheres:** Thin cylindrical and spherical shells subjected to internal pressure; Hoop stress and longitudinal stress.

Learning Outcomes: Upon completion of this module, students should be able to:
- Demonstrate the application of Hooke's Law to normal and shear stresses.
- Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
- Calculate geometrical characteristics of plane sections.
- Draw bending and shear force diagrams in beams.
- Employ bending and shear stresses in beams.
- Solve problems involving shear stresses and shear flow in beams.
- Calculate stresses and strains in circular shafts subjected to torsion.
- Relate stresses in thin cylinders and spheres subjected to internal pressure.

Issue Date 2:	September 2015
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SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Co-requisite(s)	(TEGT3671 Engineering Mathematics III)
Pre-requisite(s)	**TEGM3592 Engineering Mathematics II**

Contents: **Applications of 2nd order 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. **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. **Multiple Integrals**: 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 and boundary value problems, Computational linear algebra with emphasis on numerical solution of linear, and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. **Difference equations**: modeling with difference equations, methods of solution to first and second order difference equations. Basic computing in numerical methods (using Matlab or any other suitable program)

Learning Outcomes: On completing the course 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.

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Module Title:	**STRUCTURAL GEOLOGY**
Code	TMNE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNE3621 Introduction to Geology

Contents: **Structural geology**: brittle and ductile deformation and formation of folds and faults; solution of structural problems involving folded and fractured rocks. **Economic Geology:** ore forming processes and the classification of ore deposits; the geology of the world's major ore deposits. **African geology**: the geological evolution of Africa, with particular reference to its ore deposits. Practical work involves the interpretation of geological maps and the solution of structural problems in a mining context.

Learning Outcomes: On completing the course students should be able to:
- Describe processes leading to the formation of folds and faults
- Comprehend ore forming processes and the classification of ore deposits
- Recognise the world's major ore deposits
- Discuss African geology
- Interpret geological maps.

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Module Title:	**THERMOFLUIDS**
Code	TMNE3632
NQF Level	6
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Co-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; Energy changes in systems; pipe friction (laminar and turbulent friction factors, Moody diagram) flow measurement, state of flow, pumps and fan characteristics

Learning Outcomes: On completing the course students should be able to:
- Discuss the first law of thermodynamics and its applications to non-flow and flow processes
- Explain the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
- Analyse and quantify the properties of working fluids
- Interpret and use thermodynamic property diagrams
- Explain the equation of state of a perfect gas

Issue Date 2:	September 2015
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Module Title:	**ENGINEERING MATERIALS**
Code	TMEM3622
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Co-requisite(s)	TEGS3591 Materials Science

Contents: Classification and Characteristics of Steels: Review of the Iron-Iron Carbide phase diagram. Plain carbon steels, alloy steels, stainless steels. Special heat treatments for steels: Case hardening, austempering, martempering. Hardenability of steels. Jominy End-Quench test. **Characteristics of Cast Irons**: Grey iron, nodular iron, austempered ductile iron (ADI). **Characteristics of Non-Ferrous Alloys**: Copper, aluminium, titanium, nickel and their alloys. Practical application of strain hardening and precipitation hardening on selected alloys**. Polymers and Plastics:** polymerization processes, degree of polymerization, classification of polymers, glass transition temperature. Common thermoplastics, common thermosetting plastics, common elastomers. **Ceramics**: Traditional ceramics, technical ceramics, structural and functional properties of technical ceramics. **Composite Materials:** Polymeric, metallic and ceramic matrices, fibres for reinforcement, effect of fibre volume fraction on properties. Longitudinal and transverse loading of composites: stress analysis and modulus of elasticity. Shear modulus of composites for parallel model (isostain) and series model (isostress).

Learning Outcomes: Upon completion of this module, students should be able to:
- Distinguish between various classes of steels and cast irons and identify their specific characteristics
- Describe key characteristics and typical applications of common non-ferrous metals and alloys
- Demonstrate knowledge of engineering polymers and plastics and discuss applications of such materials
- Describe the characteristics and uses of traditional and technical ceramics and identify their superior properties.
- Demonstrate knowledge of composition and characteristics of composite materials and describe the procedures for stress analysis in longitudinal and transverse loaded composites.

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

Contents: Introduction to electrical machinery*: Review of magnetic circuits, three phase power systems, principles of rotating machines, rotating magnetic field, production of rotating fields, synchronous speed, reversal of rotation. **D.C. machines***: Introduction and general arrangement, principle of operation, emf equation, windings, armature reaction, commutation, characteristic of d.c. motors, characteristics of d.c. generators and parallel operation, rotating amplifiers, semi-conductor d.c. drives. **Transformers***: Introduction and general arrangement, principle of operation, emf equation, transformer on no-load (ideal and real), equivalent circuit, voltage regulation, open circuit and short circuit tests and characteristics, losses and efficiency, autotransformer, parallel operation, current transformer, magnetizing current waveforms. **A.C. windings (single phase AC machine)***: generation of emf., stator and rotor windings, distribution, pitch and winding factors. **Three phase induction machine:** introduction and general arrangement, principle of operation, emf equation, equivalent circuit, torque-slip characteristic, range of slip and working modes, locus of the stator current (circle diagram), starting, braking and speed control, special cage motors, induction regulators, , energy recovery techniques. Drives Applications

Learning Outcomes: On completing the course students should be able to:
- Demonstrate an understanding of 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

Issue Date 2:	September 2015
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Module Title:	**SURVEYING FOR ENGINEERS**
Code	TCVE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour 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: On completing the course 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
- Explain the GPS survey systems
- Demonstrate knowledge of surveying calculations
- Use contour and surface modelling software in surveying exercises

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Module Title:	**INDUSTRIAL ATTACHMENT I**
Code	TEGT3600
NQF Level	6
Contact Hours	Six (6) weeks preferably during the June/July break in Year 2 of Study
NQF Credits	-
Assessment	Continuous 100% (Logbook Record 20%, Lecturer/Employer Evaluation 20%, Final Report 60%)
Pre-requisite(s)	TEGT3590 Workshop Practice

Contents: During Industrial Attachment I, students will work under company supervision at the level of **Technician Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

- Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or engineering services.
- 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.

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YEAR 3 OF BSc IN MINING ENGINEERING

SEMESTER 1

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGT3741
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** I

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

Learning Outcomes: On completing the course 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

Issue Date 2:   September 2015
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Module Title:	**FUNDAMENTALS OF ECONOMICS**
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 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, and financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

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

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Module Title:	HYDROGEOLOGY
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMNE3622 Structural Geology

Contents: Basic hydrogeology: Groundwater flow equations and flow net analysis: piezometer, piezometer nests and potentiometric surface map; regional groundwater flow systems; ground recharge mechanisms and estimation techniques. **Aquifer Hydraulics:** Theis equation; computing drawdown; aquifer parameters from time-drawdown data; slug tests; intersecting pumping cones and well interference; effect of hydro geologic boundaries; aquifer test design; well loss; well efficiency; well specific capacity & 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.

Learning Outcomes: On completing the course students should be able to:
- Explain the mechanics of groundwater recharge and its analysis.
- Discuss the theory of aquifer hydraulics, model underground aquifers and evaluate them.
- Appraise the reactions governing underground solutions
- Explain the effect of groundwater and its pumping on underground openings.
- Design pumping systems and sequences for underground mining purposes.
- Develop methods of controlling and predicting contamination levels of underground water by minerals and other solutions.

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Module Title:	EXCAVATION ENGINEERING
Code	TMNE3711
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMNE3661 Introduction to Mining Engineering

Contents: Powering Systems: Fundamentals of powering systems for machines: electrical, pneumatic, hydropower, Fluid and hydraulic (mineral oil and emulsion systems) **Mechanical Excavation:** Mechanics of cutting with picks, discs, toothed roller cutters, button cutters. Application in terms of machine design and operation to: Coal cutters, Continuous miners, Longwall and short-wall, drum shearers, Tunnel and Shaft borers, drilling Rigs. **Mechanics Of Impact Breaking:** Application in terms of machine design, operation and impact breaking machines for hard rock tabular mining. **Rock Drilling And Explosives: Factors affecting rock penetration,** Principles of rock drilling, percussive drilling, rotary drilling, drilling machines and consumables, cost. History, classification and composition of explosives, transportation and storage of explosive, chemical and physical characteristics, disposal of expired and deteriorated explosives, Fundamental chemical calculations, mechanics of detonation, Hydrodynamic theory of detonation, Ideal and non-ideal detonation, Theory of initiation. **Rock Breaking And Blasting Applications:** Mechanism of rock breaking: propagation of shock waves in solid medium, interaction of compressive waves from free face, mechanics of breaking rock, crack propagation, interaction of cracks, current research. **Underground Blasting:** Stopping practice, drilling pattern in underground mining, sequential firing, ring blasting, development and shaft sinking**, Surface mining blasting:** Practical applications: Bench blasting, Drilling patterns, charge calculation, Blasting methods (non-electrical blasting, safety fuse and detonating cord electrical), Electrical circuits (series, parallel, series-parallel), test circuit, Initiation patterns, misfire, ground vibrations, air blast and fly rocks. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:
- Explain various powering systems used in the mining industry
- Discuss the various techniques of mechanical excavation of rock and earth matter
- Analyse the mechanics of impact breaking of solid materials
- Assess rock drilling and use of explosives in mining
- Discuss various rock breaking and blasting techniques
- Appraise blasting techniques for underground and surface mining.

Issue Date 2:	September 2015
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Module Title:	**MINE EQUIPMENT AND MACHINERY**
Code	TMNS3791
NQF Level	7
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TMNE3661 Introduction to Mining Engineering

Contents: Description of the following systems and their production capabilities, Consideration of the mechanics of operation and the basis for performing calculations to determine cycle times, sizes, numbers, power and strengths. **Bulk solids handling**: Conveyor systems: conventional, cable belt, pipe conveyor, high angle conveyors, calculation of power requirements and carrying capacity of belts. Chairlifts. Underground scraper winch systems and loaders. Railway tramping systems for rock, men and material. Loading machines: rope shovels, hydraulic mining shovels, bucket excavators and draglines, dredges, front end loaders, trackless load haul dump units. **Selected topics**: Off-highway haul trucks and traceless haul trucks. Mine water distribution service, collection, treatment, storage and pumping. Pneumatic conveying of solids in pipelines. Underground powered supports and coal cutters. **Rail transport system and selection of wagons/rail cars Coal mining equipment**, panel design and production potential. **Mine visits.**
Learning Outcomes: On completing the course students should be able to:
- Explain modern mining machinery and mine transportation systems
- Design and select appropriate mine equipment, machinery and systems for loading and hauling
- Analyse and control haulage operations
- Evaluate fluid power systems in mining.
- Discuss electrical systems used in mining operations
- Explain the principles of materials handling and power system consideration and performance.

Issue Date 2: September 2015
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Module Title:	**MINE VENTILATION AND CLIMATE CONTROL**
Code	TMNC3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMNE3632 Thermofluid**

Contents: Ventilation: Fundamentals of mine ventilation, general air circulation, mine gases, presence of other gases, Control of mine gases, dust and engineering control of mine dust, classification of gases emitted from diesel engines, types of air-conditioning Air availability in mines, determination of quantities of air required in the mines, respiratory requirements. Oxygen depletion, gas laws and gas constant, general ideal gas equations, Graham's law of diffusion, layering and layering number, Effect of elevation and altitude Mechanics of fluids, Bernoulli equation, airflow in airways, Critical velocity, mine static head, mine velocity head and total mine head. Atkinsion equation for friction loss, selection of Friction factor, combine friction and shock loss, airpower. Basic ventilation circuits, ventilation networks, kirchoff's and its direct application, regulators, booster fans, fan characteristics, fans in series and parallel summary of fan law, fan performance. Different ventilation systems. Application of ventilation software, **Deep level mining climate control:** Psychrometry, basic relationship in psychrometry, Dalton's law of partial pressure, determination of moisture content , latent heat of evaporation, relative humidity, percentage humidity. Human thermoregulation system, heat, heat stress and disorder, heat stroke, acclimatization and tolerance, spray chambers, ice plant. **Typical ventilation systems:** in a coal mine, gold mine and uranium mine. Visits to underground mines.
Learning Outcomes: On completing the course students should be able to:
- Appraise air quantity required in mines
- Apply the principles of fluid flow to ventilation systems.
- Evaluate and apply fan behaviour to ventilation systems.
- Design a ventilation system for a mine.
- Explain the environmental hazards found in mines and outline the control measures that detect, monitor, minimise and/or manage these hazards.
- Discuss typical ventilation systems in selected mines such as coal, gold and uranium mines.

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Module Title:	**SOIL AND ROCK MECHANICS**
Code	TMNU3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMNE3621 Introduction to Engineering Geology**

Contents: Simple soil properties, classification of soils and rocks, Soil profiles, site exploration, drilling and sampling. Compaction of soils, shear strength, settlement, bearing capacity, slope stability, earth pressure. Problems of equilibrium and deformation, Effective and total stresses, Consolidation and settlements of soils Theory of shear strength in soils. **Mechanics of solids**: Two-dimensional analysis of stress and strain; linear elasticity; stresses and displacements around mining excavations; three-dimensional elasticity. Strength and deformation characteristics of rock: Intact rock properties; shear strength of discontinuities; mechanical properties of rock masses; **Mohr-Coulomb and Hoek-Brown failure criteria**. Mine Tour: a series of visits to mines and mining-related institutions as arranged by the Department at appropriate times.

Learning Outcomes: On completing the course students should be able to:
- Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
- Assess knowledge of the strength and deformation characteristics of rock masses
- Discuss useful mechanical properties of rock masses
- Analyse failure criteria for rocks and rock masses.

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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: On completing the course students should be able to:
- Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
- Distinguish the methods used to carry out feasibility studies
- Develop a business plan relating to an engineering endeavor
- Separate the concepts of motivation, competencies, innovation and product marketing
- Relate the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Issue Date 2:	September 2015
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Module Title:	**SURFACE MINING**
Code	TMNS3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMNE3711 Excavation Engineering**

Contents: Introduction to open-pit mining; factor affecting the selection of open pit mining; ore reserve estimation methods **Open pit design**; slope stability in relation to design; haul road design; drilling and blasting patterns; economics and stripping ratios; economic cut-offs; pit optimization. **Quarry operations**; working platforms; bench width; optimum depth **Strip mining of mineral deposits**; strip mine design and planning; optimum pit limit, economics of strip mining; environmental considerations; dragline operations; range diagrams. **Marine mining**; dredging; mechanized earth- moving; hydraulic mining; equipment selection; power systems; matching and fleet optimization; economic considerations of equipment selection & purchase; type life; cycle times. Practical exercises, Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:
- Explain surface mining technologies and operations
- Design granite quarries for production of aggregates and dimension stones
- Design layouts for strip mining of coal and include important economic and environmental considerations
- Explain the technology for marine mining and include important economic and environmental considerations

Issue Date 2:	September 2015
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Module Title:	**MINE SURVEYING**
Code	TMNU3722
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)	TCVE3642 Surveying for Engineers

Contents: Mine surveying: introduction to the importance of mine surveying in the efficient and safe running of a mine; principles of surveying and mine surveying. **Surveying tools: Plans, maps, photographs**, sections and profiles. Comparison of the engineering and cartographic approach to producing the graphic document, **Scales**. Simple map projections, developable surfaces and distortions, Geometrical construction of a grid, scale bars and diagonal scales. **Rectangular and polar coordinates**: Contours and their interpolation, Cartographic conventions, layout, marginal information. Superimposition of design contours and cut/fill lines, longitudinal profiles and cross-sections, reserve estimation of mineral deposits The plane-meter and areas **Interpretation of maps and plan:**. Understanding map projections, developable surfaces and distortions; transfer of surface surveys to the underground environment; underground mine surveying methods, application to mine planning, design and safety; surveying legal requirements and their application to the mining industry; mathematical and surveying principles for solving three dimensional mine design problems; interpretation of mine surveying results for improved decision making. **Practical**: distance measurement, measuring errors; levelling traversing (with tapes & total stations); vertical surveys; care of surveying equipment; using a gyro-theodolite to determine azimuth; GPS instruments; observations and producing mine surveying records in terms of the mining laws.
Learning Outcomes: On completing the course students should be able to:
- Explain the principles of surveying as applied to mines
- Apply the knowledge of producing and analysing plans, maps and photographs of mines
- Interpret map projections, geometrical constructions and diagonal scales
- Evaluate rectangular and polar coordinates for contours and cartographic sections
- Apply the detailed knowledge of underground mine surveying methods
- Analyse and interpret mine surveying data for decision making
- Relate practical knowledge of surveying in the field
- Analyse map projections and interpret mine surveying data

Issue Date 2:	September 2015
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Module Title:	**COMPUTER APPLICATIONS IN MINING**
Code	TMNU3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TCME3621 Computer Science for Engineers**

Contents: This course builds on the basic computing skills learnt in Computer Aided Drawing and extends to the use of these skills in applications relevant to Mining Engineering. Topics covered include applications of software like MinSched, Surpac etc. geo-statistical evaluation packages. GIS software. Contouring packages, CAD packages, MATLAB, RocLab. SPSS. applications in mining and mine design packages. Ore body modelling and its role in mineral deposit evaluation and exploitation. Practical exercises on ore body modelling. A mini project on an approved topic will be included.

Learning Outcomes: On completing the course students should be able to:
- Apply Computer Aided Drawing skills
- Use GIS, Contouring packages and MATLAB in resource modelling
- Apply software packages for mine design.

Issue Date 2:	September 2015
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Module Title:	**MINERAL PROCESSING**
Code	TMNU3792 TMNS3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMNE3661 Introduction to Mining Engineering**

Contents: 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 flow-sheet design for selected minerals coal preparation, heavy sands processing etc. **Basic Extractive Metallurgy:** pyrometallurgy, hydrometallurgy, electrometallurgy.

Learning Outcomes: On completing the course students should be able to:
- Discuss the role of comminution in liberation of minerals
- Discuss the processes involved in size reduction of minerals
- Apply the principles of concentrating valuable minerals
- Explain the principles involved in solid-liquid separation
- Sketch simple flowsheets for mineral processing
- Explain the basic methods of extracting metals from concentrated ores.

Issue Date 2:	September 2015
Revision:	September 2019

Module Title:	**TECHNICAL VALUATION**
Code	TMNU3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGS3691 Statistics for Engineers**

Contents: Statistical valuation methods: Overview of descriptive statistics; inference from normal distributions, estimation of mean and standard deviation, confidence levels on parameters, hypothesis testing. Student's T and F-ratio's tests, correlation and regression methods, tests of significance, multivariate regression and trend surface analysis, inference from lognormal distributions, estimation of mean and confidence levels. Grade/tonnage curves. **Geo-statistical valuation methods**: inverse distance techniques, calculation and modelling of semi-variograms, estimation of unknown values, ordinary and universal rigging, volume/variance relationships. **Geo-statistical applications**: valuation and mine economics; mine process flow; mining factors; economic effects of dilution and recovery; SAMREC code; reporting of resources and reserves; paylimits; economic and planning cut-off grades; grade control.

Learning Outcomes: On completing the course students should be able to:
- Review statistical valuation methods
- Analyse various geo-statistical models
- Apply geo-statistical methods in ore valuations.

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Module Title:	**MINE DESIGN**
Code	**TMNS3791**
NQF Level	7
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (Assignments 2 and Tests 2 making **30%,** presentation (**10%**) and report (**10%**) on selected topics in Mining Engineering,, Examination (1 x 3 hour paper)
Co-requisite(s)	TMNS3791 Mine Equipment and Machinery

Contents: Factors affecting the selection of surface mining methods: .Different technological diagrams of surface mining methods Determination of parameters such as optimum depth of a quarry or open pit. **Design of Bench element:** Design of slopes. Determination of overall slope angle, Design of width or working platform of a bench, **Design of surface mines:** Feasibility study of granite or dimension stones quarries. **Selection of mine equipment and machinery:** Typical drilling and blasting pattern designs. Design and construction of explosive magazines Economic indices of surface mine design. Application of software packages to surface mine design. Design of transportation systems and haul roads.**Opening of mineral deposits and the design of mine**: Factors to be considered during the location of shafts, Shaft selection and location, Shaft design, construction. Development of mine fields (levels, panels, and combined methods). **Design of different underground mining methods for different types of deposits:** Design of ventilation circuits, Design of ventilation networks in an underground mine. Design of support systems: wood, bolt and nut, concrete and steel arch supports. Geological modelling of a coal deposit from borehole longs. Selection of transportation systems Application of software packages to mine design- Ventism software.

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

- Analyse surface mining systems
- Evaluate the working platform and optimum depth
- Design a surface mine e.g. a granite quarry
- Design and construct explosive magazines magazine
- Select 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

Issue Date 2:	September 2015
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Module Title:	**RESEARCH PROPOSAL**
Code	TMNR3792
NQF Level	7
Contact Hours	1 hour per week for 14 weeks
NQF Credits	4
Assessment	Continuous 100% [Seminar Presentation 50%, Proposal 50%]
Co-requisite(s)	(TEGT3741 Experimental and Research Methods)

Contents: 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 course students should be able to:
- Make a Presentation of their Research Proposal in a Seminar
- Produced an acceptable typed and bound Research Proposal

Issue Date 2:	September 2015
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Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Contact Hours	Six (6) weeks preferably during the June/July break in Year 3 of Study
NQF Credits	-
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s)	(TEGT3600 Industrial Attachment I)

Contents: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

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

Issue Date 2:	September 2015
Revision:	September 2019

YEAR 4 OF BSc IN MINING ENGINEERING

SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 100%

Co-requisite(s)   (TEGT3742 Entrepreneurship)

Contents: Engineering as a profession: engineering societies and registration procedure for different engineering disciplines. **General principles of engineering ethics:** statement of ethical principles, engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration. Technology policy:** utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace. HIV/AIDS education**. Impact of HIV/AIDS on the workforce, HIV/AIDS workplace programmes, HIV/AIDS cost benefit analysis.

Learning Outcomes: On completing the course students should be able to:
- Discuss the role of various engineering disciplines and societies
- Discuss the importance of engineering professional ethics and its enforcement by the regulating bodies
- Discuss the use of engineering codes and standards
- Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
- Demonstrate knowledge of the laws of arbitration
- Discuss the role of technology policy on the acquisition of technological know-how
- Discuss the strategies and methods for HIV/AIDS mitigation in the engineering sector
- Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

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Module Title:	**PROJECT MANAGEMENT**
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment	Continuous 50% (Assignments 2, Tests 2, group project presentation) and group project report) and Examination (1 x 3 hour paper)

Pre-requisite(s)   **TEGT3761 Fundamentals of Economics**
Contents: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale engineering projects**: inception to completion, appropriate contacts; general conditions of contract for engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:
- 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
- Demonstrate knowledge of the principles of managing medium to large scale engineering projects
- Demonstrate knowledge of the principles of managing community-based development projects
- 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

Issue Date 2:   September 2015
Revision: September 2019

Module Title:	**MINE HEALTH, SAFETY AND ENVIRONMENT**
Code	TMNU3831
NQF Level	8
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% **%** (Assignments 2, Tests 2, group project presentation) and group project report) and Examination (1 x 3 hour paper)
Co-requisite(s)	(TMNM3791 Mine Ventilation & Climate Control), (TMNS3762 Surface Mining)

Contents: Safety organization in mines; personal protective equipment, causes of mine accidents; accident statistics and records keeping; industrial hygiene; basic first aid; analysis of health and safety problems in the Namibian mining industry. **Surface and underground Mine safety precautions:** during stripping, drilling and blasting, extraction-loading and haulage, opening of stope driving of tunnels Safety precaution during mining with dredges. Safety precaution in the use and transportation of explosives and their accessories, Explosive magazines, **Mine environment**: Mine dust, mine gases, mine fires, mine water, noise, illumination, mine air, radioactive and toxic substances. Health, safety and environmental issues in the mining of radioactive substances like uranium. **Health Issues:** Different occupational diseases associated with mining, silicosis from fine silica dust, cancer associated with coal mining. Slope stability, Analysis of water and soil quality using ASTM standard and USEPA. **Mine Communication. Mine Law and Regulations**: Mining and the environment; mining legislation. Minerals (Prospecting and Mining) Act; mineral rights. **Environmental issues**: Environmental Impact Assessment (EIA); **Environmental pollution:** definitions, causes and interrelationships. Gaseous and particulate pollutants and their sources, **Mine atmosphere:** detection of mine gases, physiological effects, inflammation and detonation, gas layering and diffusion. Dust hazards. Pollution monitoring and control, methods of controlling gaseous and particulate pollutants, **Mine effluents**: effects on air, surface and ground water, and land. Spontaneous combustion, acidic mine drainage etc. Methods of effluent treatment, Impact of mining on mine environs effects on agriculture, surrounding habitats, etc. Mine drainage: water recovery and re-cycling mine reclamation and rehabilitation, mine closure and different types mine reclamation methods. **Case Studies**: Typical case studies on health and safety problems in mines. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:
- Analyse safety and health issues at the mine and how to control them
- Relate the knowledge of environmental issues of mining projects and how to control them
- Relate occupational disease associated with mining and symptoms
- Explain various techniques used in mine communication
- Discuss basic knowledge of legal aspects of mining safety and the environment as stipulated in the Minerals (Prospecting and Mining) Act
- Discuss mineral rights and the general mine law
- Discuss procedures for carrying out environmental impact assessment (EIA) of mine projects and treatment of mine effluents

Issue Date 2: September 2015
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Module Title:	UNDERGROUND MINING
Code	TMNU3811
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMNE3711 Excavation Engineering**

Contents: Historical and present-day methods of exploitation: of hard rock mineral deposits; selection of mining techniques; location of shafts. Shaft sinking; shaft station layouts. Major development layout; level, horizon and panels methods of development, Conventional and specialized development. **Mining systems**: Methods of extraction of deposits, short-walls and long-walls mining systems mine design parameters Mining processes in underground operations **Mechanization of operations and special technologies**: Design: practical design exercises for exploiting tabular ore deposits. **Exploitation of massive ore bodies**: open stopping, room and pillar mining, cut and fill stopping, shrinkage mining, post pillar cut and fill mining, block caving, continuous block caving, forced caving, sublevel caving, sundry mining methods. **Coal mining methods**: the safe and efficient exploitation of underground coal deposits by means of board and pillar, pillar extraction, rib-pillar, short wall, long wall and specialized thick- and thin-seam techniques. **Coal mining equipment**, panel design and production potential., market identification, plant design, mine design, layout scheduling **Trackless mining**: selection and operation of underground trackless equipment for massive mining. Practical design exercise.

Learning Outcomes: On completing the course students should be able to:
- Explain shaft locations techniques
- Explain mine development methods
- Design and select mining methods and specify parameters for safe underground extraction
- Design and analyse different design techniques and mechanical technologies used in massive mining
- Discuss the mining systems and factors to be considered for safe working environment.

Issue Date 2:	September 2015
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Module Title:	ROCK ENGINEERING
Code	TMNS3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNU3791 Soil and Rock Mechanics

Contents: Introduction to Rock Engineering: Definition of terms and importance of rock mechanics; applications of rock engineering to Mining, Civil and Petroleum Engineering. **Physical and Mechanical properties:** Porosity Density; Permeability; Strength: Slaking and Durability: Sonic velocity as an index to degree of fissuring; **Classification and Index properties of rocks** – Geological classification of rocks (crystalline rocks, organic rocks); Classification of rock masses for engineering purposes. Rock strength and Failure Criteria Modes of failure of rocks Common Laboratory strength tests (Uniaxial, Tri-axial, Brazilian, Flexural tests); Stress-Strain behaviour in compression; Effect of confining pressure; **Discontinuities in rocks**: crack, fissure, fracture, bedding plane. **Application of rock engineering in surface mines** Slope stability analysis. Application of the complete Stress-Strain curve The Mohr Coulomb failure criterion; the effect of water; The influence of the principal Stress ration on failure; Empirical criteria of failure; Coulomb-Navier criterion of failure of rocks; Griffith brittle failure Criterion. Elastic properties, **Applications of rock engineering in underground openings:** Support systems design and selection – caving and subsidence. Roof and ground control.. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:
- Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
- Discuss strength and deformation characteristics of rock masses
- Explain mechanical properties of rock masses
- Discuss failure criteria for rocks and rock masses

Issue Date 2:	September 2015
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Module Title:	**MINE MANAGEMENT PRINCIPLES AND FINANCIAL VALUATION**
Code	TMNS3831
NQF Level	8
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMNU3742 Technical Valuation

Contents: Management Principles: History of management theory; managerial conceptual thinking; management work within the business. Organizing and determinants of organization, Planning and organization of mines, Controlling, leading, determination of shift, daily, monthly and yearly production, Managerial activities and tools; time management; attributes of a manager, industrial relations and legislation. **Risk management**: risk management terminology; functions and principles of risk management; introduction to risk assessment; due diligence; requirements of the Mine Health and Safety Act. **Introduction to financial analysis**: Introduction; financial statements; behaviour of costs; time value of money; capital value decisions; inflation; discounted cash flow models. **Funding**: sources of funding, cost of capital, gearing; **Revenue**: metals and minerals market, price influences, hedging and option pricing, margins and marginality; Reporting: annual reports, financial statements, competent persons report, valuations and acquisitions, takeovers. **Applied financial analysis**: financing of projects; depreciation and depreciation methods, replacement, taxation, applied valuation; evaluation of alternatives: organizational objectives, investor expectations, mining company growth, economic valuation of Investment alternatives, quantitative methods applied. **Decision making**; structure of decision making, feasibility studies, decision making criteria, economic value add, sensitivity analyses, comparative valuations, benchmarking and ranking. Investment analysis: techno-economic analysis of mining projects, financial analysis, intangible analysis, risk assessment and risk management. Financial valuation of a coal mine, **Coal as a commodity**: coal quality, coal utilization and marketing.
Learning Outcomes: On completing the course students should be able to:
* Explain knowledge of general management principles
* Discuss the planning an organisation of mines
* Illustrate a simple organisation chart of a mine
* Discuss techniques of time management
* Explain the industrial relations and legislation pertaining to the mining industry.
* Explain principles and functions of risk management
* Analyse financial management and principles
* Discuss various funding sources and funding mechanisms for mines
* Apply financial analysis in the decision making process

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SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMNR3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	Continuous 100% Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s	TCER3891 Research Proposal, All third year modules

Contents A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

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

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Module Title:	**MINING DESIGN PROJECT**
Code	TMND3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s	All third year modules

Contents An essential element of engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated engineering drawings or computer source codes consistent with professional engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
- Identify and formally state problems that can be solved using engineering knowledge and skills.
- Apply practical skills in the design of engineering components, assemblies and/or systems.
- Apply 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.

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Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Contact Hours	Six (6) weeks preferably during the June/July break in Year 4 of Study
NQF Credits	-
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite(s	TEGT3700 Industrial Attachment II)

Contents During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

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

- Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
- Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or engineering operation.
- Discuss the role of engineers in the management and organization of engineering enterprises
- Discuss in details the main technical activities undertaken during the attachment.

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