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SCHOOL OF ENGINEERING & THE BUILT ENVIRONMENT

Prospectus 2022

FACULTY OF AGRICULTURE, ENGINEERING & NATURAL SCIENCES

A. NOTE

This School Yearbook is valid for 2022 only. Regulations and curricula may be amended without prior notice. General regulations and information appear in the **General Information and Regulations Yearbook**.

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

The information is correct up to 31 October 2022.

The fact that particulars of a specific programmes, subjects or modules have been included in this School Yearbook does not necessarily mean that such programme, subject, or module will be offered in 2022 or any subsequent year.

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

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B. SCHOOL PREAMBLE

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

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

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

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

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

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

Dr. Petrina Johannes

Dean

SCHOOL OF ENGINEERING AND THE BUILT ENVIRONMENT CALENDAR 2022:	
DATE	**FIRST SEMESTER**
10 January	University Open
11 January	Start of Summer Term (Until 22 January)
17 Jan – 04 February	On-Line Registration: Engineering Students Commences (until 04 February 2022)
24 January	Academic staff resumes office duties
25 January	JEDS AAGC Meeting (Agenda closes on 17 Jan) for Admission, Special Cases
31 January	Lectures commence for FIRST SEMESTER – Senior Engineering Students
15 February	SEBE School Board Meeting (Agenda closes on 07 Feb) for Promotion, Special Cases
28 February	Lectures commence for FIRST SEMESTER – First Year Students
11 April	First semester BREAK commences
13 April	JEDS Management Meeting (Agenda closes on 29 Mar)
19 April	Lectures commence after first semester break
13 May	Lectures end for FIRST SEMESTER – Senior Engineering Students
16 May	Regular Examinations commence – Senior Engineering Students
27 May	Regular Examinations end – Senior Engineering Students
01 June	Industrial Attachment commence for 6 weeks (until 15 Jul)
07 June	Lectures end for FIRST SEMESTER – First Year Students
13 June	Regular Examinations commence – First Year Students
15 June	SEBE School Board Meeting (Agenda closes on 01 June) Curriculum, Examiners
24 June	Regular Examinations end – First Year Students
30 June	End of FIRST SEMESTER
04 July	Start of Winter Term (Until 08 July)
04 – 08 July	Mid-year recess

11 – 15 July	Special/Supplementary/Winter Term Examinations commence (Until 15 July)
06 Jul	JEDS Management Meeting (Agenda closes on 24 June)
DATE	**SECOND SEMESTER**
25 July	Lectures commence for SECOND SEMESTER
27 July	SEBE School Board Meeting (Agenda closes on 13 Jul) Promotion
22 August	Second semester BREAK commences
29 August	Lectures resume after second semester break
12 October	JEDS Management Meeting (Agenda closes on 29 Sept)
21 October	Lectures end for SECOND SEMESTER (Main UNAM)
27 October	Regular Examinations commence (Main UNAM)
04 November	Lectures end for SECOND SEMESTER for Senior Engineering Students
07 November	Regular Examinations for Senior Engineering Students commence
18 November	Regular Examinations for all Engineering Students end
28 November	Special/Supplementary Examinations commence (Until 2 December)
28 November	SEBE School Examiner Board Meeting (Agenda closes on 21 Nov)
09 December	End of SECOND SEMESTER
16 December	End of academic year
09 January 2023	Start of Summer School (until 21 January)
12 January 2023	University opens (2023 academic year)
24 January 2023	Academic staff resumes office duties

DUE DATES FOR THE 2022 ACADEMIC YEAR

DATE	GENERAL DATES
21 January	Last day for appeals (Semester 2 & Double modules – Regular and Supplementary/Special examinations of November 2021)
14 January	Last day for application of retention of continuous assessment (CA) mark and Last day for application for exemption(s) (Senior Students)
17 January	Last day for recommendation of retention of continuous assessment mark and Promotion Examinations by Faculties
24 January	Last day for approval of retention of continuous assessment mark and Promotion Examination by Examinations Department
07 February	Promotion Examination
11 February	Last day for application for exemption(s) - senior students
12 February	Last day for Late Registration for all Senior students (*Late fee payable*)
12 February	Last day for approval of module(s) & qualification changes (Senior Students)
04 March	Last day for application for exemption(s) – 1st year students
11 March	Last day for approval of exemption(s) changes – all students
29 April	Last day to submit Theses and Dissertations for examinations (for Spring Graduation 2022)
02 August	Last day for Appeals (Semester 1 Modules - Regular and Supplementary/Special examinations of June 2022)
31 Augustus	Last day to submit outstanding documentation
07 October	Last day to cancel enrolment
28 October	Last day to submit Theses and Dissertations for examinations (For Autumn Graduation 2023)
DATE	**CANCELLATION DUE DATES**
13 May	Last day to cancel Semester 1 modules
07 October	Last day to cancel Semester 2 modules
07 October	Last day to cancel Double modules (module that extends normally over one academic year
DATE	**FINANCE DUE DATES**
18 March	Last day to cancel Semester 1 and Double modules with 100% credit
30 April	Last day to cancel Semester 1 modules with 50% credit
24 June	Last day to cancel Double modules with 50% credit
12 August	Last day to cancel Semester 2 modules with 100% credit
31 August	Last day to cancel Semester 2 modules with 50% credit

UNAM CORE DATES	
DATE	**FIRST SEMESTER**
10 January	University Open
11 January	Start of Summer Term (Until 22 January)
24 January	Academic staff resumes office duties
14 February	Lectures commence for FIRST SEMESTER – Senior Students
28 February	Lectures commence for FIRST SEMESTER – First Year Students
11 April	First semester BREAK commences
19 April	Lectures commence after first semester break
20 May	Lectures end for FIRST SEMESTER – Senior Students
31 May	Regular Examinations commence – Senior Students
07 June	Lectures end for FIRST SEMESTER – First Year Students
13 June	Regular Examinations commence – First Year Students
21 June	Regular Examinations end – Senior Students
24 June	Regular Examinations end – First Year Students
30 June	End of FIRST SEMESTER
04 July	Start of Winter Term (Until 08 July)
04 – 08 July	Mid-year recess
11 – 15 July	Special/Supplementary/Winter Term Examinations commence (Until 15 July)
DATE	**SECOND SEMESTER**
25 July	Lectures commence for SECOND SEMESTER
22 August	Second semester BREAK commences
29 August	Lectures resume after second semester break
21 October	Lectures end for SECOND SEMESTER
27 October	Regular Examinations commence
18 November	Regular Examinations end
28 November	Special/Supplementary Examinations commence (Until 2 December)
09 December	End of SECOND SEMESTER
16 December	End of academic year
09 January 2023	Start of Summer School (until 21 January)
12 January 2023	University opens (2023 academic year)
24 January 2023	Academic staff resumes office duties

A. STRUCTURE AND PERSONNEL OF THE SCHOOL OF ENGINEERING & THE BUILT ENVIRONMENT

A.1. OFFICE OF THE ASSOCIATE DEAN

Associate Dean	Dr. Petrina Johannes BSc (Civil Eng), MSc (Civil Eng), PhD (Civil Eng) (USA)		
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Secretary to the Associate Dean		*Tel:*	(+264 65) 232 4016~~)~~
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Campus Administrator	Mrs. Erastus Tulonga Beata	*Tel:*	(+264 65) 232 4009)
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Examinations Officer	Mrs. Tekla Ndevashiya	*Tel:*	(+264 65) 232 4107)
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General enquiries regarding the School of Engineering & the Built Environment and qualifications offered by the School should be directed to:

The School Officer

School of Engineering & the Built Environment

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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 AND MINING ENGINEERING

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

Bachelor of Science in Mining Engineering (Honours)

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

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

Bachelor of Science in Electrical Engineering (Honours)

DEPARTMENT OF MECHANICAL AND AND METALLURGICAL ENGINEERING

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

Bachelor of Science in Metallurgical Engineering (Honours)

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

B.1. INTRODUCTION

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

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

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

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

B.2. PURPOSE AND SUPPORT FOR THIS CURRICULUM

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

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

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

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.5. 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.5.1. KNOWLEDGE AREA CONTENT

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

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

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

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

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

B.5.2. EXIT LEVEL OUTCOMES

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

1. PROBLEM SOLVING

Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively.

2. APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE

Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering to solve complex Engineering problems.

3. ENGINEERING DESIGN

Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

4. INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Demonstrate competence to formulate and conduct investigations and experiments.

5. ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

6. PROFESSIONAL AND TECHNICAL COMMUNICATION

Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences the community at large.

7. SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY

Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment.

8. INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.

9. INDEPENDENT LEARNING ABILITY

Demonstrate competence to engage in independent learning through well-developed learning skills.

10. ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

11. ENGINEERING MANAGEMENT

Demonstrate knowledge and understanding of Engineering management principles and economic decision making.

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

C. REGULATIONS AND CURRICULUM FORMAT

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

C.1. DEGREE NAMES AND CODES

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

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

C.2. PROGRAMMES ON OFFER IN 2022

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

C.3. ADMISSION REQUIREMENTS

C.3.1. GENERAL REQUIREMENTS

To register in the Bachelor of Science in Engineering degree programme, a candidate must hold a valid National Senior Secondary Certificate (NSSC) at NSSC-O level (IGCSE level) or NSSC-H level (HIGCSE level) with passes in at least five subjects, which add up to at least 25 points, calculated using the specified UNAM scale. Equivalent qualifications are acceptable. The School of Engineering & the Built Environment may administer an entrance test when admission places are scarce.

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

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

(a) At least a “**B**” symbol in Mathematics and “**C**” symbol in Physical Science (or at least a “**C**” symbol in Mathematics and “**B**” symbol in Physical Science); plus a at least a “**C**” symbol in English at NSSC-O level (IGCSE level) or equivalent qualification, **or**

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

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

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

(e) Admission to the School of Engineering & the Built Environment through Mature Age Mode is possible only with those who possess valid Grade 12 Certificates.

C.3.3. MINIMUM ENTRY INTO THE FIRST YEAR OF ENGINEERING (=19BENG)

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

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

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

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

(d) At least **34 points** in five subjects and meeting the above requirements for Mathematics and Physical Science, and a "**D**" symbol in English at NSSC-O level (IGCSE level) or equivalent qualification.

(e) 3 subjects (Mathematics, Physics and Chemistry) on NSSCAS level with an average grade of "*c*" in each subject or higher and 2 subjects on NSSCO level with "C" average or higher, and (c) English must be at minimum "C'' at NSSCO level.

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

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

C.4. PROGRESSION

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

C.5. DURATION OF STUDY

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

C.6. EXEMPTIONS

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

C.7. EXAMINATION REGULATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

C.8. ACADEMIC ADVANCEMENT RULES

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

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

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

C.8.2. FIRST YEAR TO SECOND YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student must have passed at least 110 Credits (**67%** of the total 164 Credits in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

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

A student must have passed at least 110 Credits (**67%** of the total 164 Credits in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

1. Bachelor of Science in Electrical Engineering (Honours)

A student must have passed at least 110 Credits (**67%** of the total 164 Credits in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

1. Bachelor of Science in Mechanical Engineering (Honours)

A student must have passed at least 110 Credits (**67%** of the total 164 Credits in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

1. Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed at least 110 Credits (**67%** of the total 164 Credits in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

1. Bachelor of Science in Mining Engineering (Honours)

A student must have passed at least 110 Credits (**67%** of the total 164 Credits in Year 1). If any of the failed courses is a Pre-requisite for a Second Year course, then the candidate cannot register for the affected Second Year course until the Pre-requisite is passed.

C.8.3. SECOND YEAR TO THIRD YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

A student **must** have passed all **164** credits prescribed in the First Year. In addition, the student must have passed at least **112** credits of Year 2 (78% of the total 144 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

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

A student **must** have passed all 164 credits prescribed in the First Year. In addition, the student must have passed at least 110 credits of Year 2 (78% of the total 140 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

3. Bachelor of Science in Electrical Engineering (Honours)

A student **must** have passed all 164 credits prescribed in the First Year. In addition, the student must have passed at least 116 credits of Year 2 (78% of the total 148 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

4. Bachelor of Science in Mechanical Engineering (Honours)

A student **must** have passed all **164** credits prescribed in the First Year. In addition, the student must have passed at least **106** credits of Year 2 (78% of the total 136 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

5. Bachelor of Science in Metallurgical Engineering (Honours)

A student must have passed all **164 credits** prescribed in the First Year. In addition, the student must have passed at least **110** credits of Year 2 (78% of the total 140 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

6. Bachelor of Science in Mining Engineering (Honours)

A student **must** have passed all **164** credits prescribed in the First Year. In addition, the student must have passed at least **102** credits of Year 2 (78% of the total 132 credits in Year 2) to be able to register for Third Year courses. If any of the failed courses is a Pre-requisite for a Third Year course, then the candidate cannot register for the affected Third Year course until the Pre-requisite is passed.

C.8.4. THIRD YEAR TO FOURTH YEAR OF ENGINEERING

1. Bachelor of Science in Civil Engineering (Honours)

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

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

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

3. Bachelor of Science in Electrical Engineering (Honours)

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

4. Bachelor of Science in Mechanical Engineering (Honours)

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

5. Bachelor of Science in Metallurgical Engineering (Honours)

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

6. Bachelor of Science in Mining Engineering (Honours)

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

C.9. MAXIMUM NUMBER OF CREDITS PER YEAR

1. Bachelor of Science in Civil Engineering (Honours)

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

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

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

3. Bachelor of Science in Electrical Engineering (Honours)

First year: 160 credits

Second year: 202 credits (148 credits of second year plus 54 credits of first year)

Third Year: 164 credits (132 credits of third year plus 32 Credits of second year)

Fourth Year: 169 credits (140 credits of fourth year plus 29 Credits of third year)

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

4. Bachelor of Science in Mechanical Engineering (Honours)

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

5. Bachelor of Science in Metallurgical Engineering (Honours)

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

6. Bachelor of Science in Mining Engineering (Honours)

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

C.10. MINIMUM REQUIREMENTS FOR RE-ADMISSION

1. Bachelor of Science in Civil Engineering (Honours)

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

- At least **54** credits by the end of the first year (at least **33%** of total credits in Year 1).
- At least **132** credits of Year 1 (80% of Year 1) plus **58** credits of Year 2 (40% of Year 2) by the end of the second year.
- All **164** prescribed Year 1 credits plus at least **116** credits of Year 2 (80% of Year 2) plus at least **54** credits of Year 3 (40% of Year 3) by the end of the third year.
- All **164** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus **108** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **144** prescribed Year 2 credits plus all **136** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

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

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

- At least **54** credits by the end of the first year (at least **33%** of total credits in Year 1).
- At least **131** credits of Year 1 (80% of Year 1) plus **56** credits of Year 2 (40% of Year 2) by the end of the second year.
- All **164** prescribed Year 1 credits plus at least **131** credits of Year 2 (80% of Year 2) plus at least **56** credits of Year 3 (40% of Year 3) by the end of the third year.
- All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus **131** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus all **140** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

3. Bachelor of Science in Electrical Engineering (Honours)

- A student will not be re-admitted into the School of Engineering and IT if he/she has not earned:
- At least **54** credits by the end of the first year (at least **33%** of total credits in Year 1).
- At least **131** credits of Year 1 (80% of Year 1) plus **59** credits of Year 2 (40% of Year 2) by the end of the second year.
- All **164** prescribed Year 1 credits plus at least **119** credits of Year 2 (80% of Year 2) plus at least **53** credits of Year 3 (**40%** of Year 3) by the end of the third year.
- All **164** prescribed Year 1 credits plus at least **148** credits of Year 2 plus **106** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **148** prescribed Year 2 credits plus all **132** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

4. Bachelor of Science in Mechanical Engineering (Honours)

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

- At least **54** credits by the end of the first year (at least 33% of total credits in Year 1).
- At least **132** credits of Year 1 (80% of Year 1) plus **54** credits of Year 2 (40% of Year 2) by the end of the second year.
- All **164** prescribed Year 1 credits plus at least **109** credits of Year 2 (80% of Year 2) plus at least **58** credits of Year 3 (40% of Year 3) by the end of the third year.
- All **164** prescribed Year 1 credits plus all **136** prescribed Year 2 credits plus **115** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- All **164** prescribed Year 1 credits plus all **136** prescribed Year 2 credits plus all **144** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

Bachelor of Science in Metallurgical Engineering (Honours)

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

- o At least **54** credits by the end of the first year (at least 33% of total credits in Year 1).
- o At least **131** credits of Year 1 (80% of Year 1) plus **56** credits of Year 2 (40% of Year 2) by the end of the second year.
- o All **164** prescribed Year 1 credits plus at least **112** credits of Year 2 (80% of Year 2) plus at least **58** credits of Year 3 (40% of Year 3) by the end of the third year.
- o All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus **116 credits** of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o All **164** prescribed Year 1 credits plus all **140** prescribed Year 2 credits plus all **144** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

5. Bachelor of Science in Mining Engineering (Honours)

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

- o At least **54** credits by the end of the first year (at least 33% of total credits in Year 1).
- o At least **131** credits of Year 1 (80% of Year 1) plus **53** credits of Year 2 (40% of Year 2) by the end of the second year.
- o All **164** prescribed Year 1 credits plus at least **106** credits of Year 2 (80% of Year 2) plus at least **60** credits of Year 3 (40% of Year 3) by the end of the third year.
- o All **164** prescribed Year 1 credits plus all **132** prescribed Year 2 credits plus **118** credits of Year 3 (80% of Year 3) plus **28** credits of Year 4 (20% of Year 4) by the end of the fourth year.
- o All **164** prescribed Year 1 credits plus all **132** prescribed Year 2 credits plus all **148** prescribed Year 3 credits plus at least **84** credits of Year 4 (**60%** of Year 4) by the end of the fifth year.

C.11. CRITERIA FOR GRADUATION

A student can graduate with the degree of **Bachelor of Science in Engineering (Honours)** in a given discipline only if he/she has earned the **584 NQF Credits** prescribed in the curriculum and has successfully completed **all three Industrial Attachment** sessions. The specified minimum NQF Credits include **30** Credits of Research and 34 Credits of Design Project during Semester 8 of study.

D. CURRICULUM COMPILATION

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

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

UNIVERSITY CORE:

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

SCHOOL CORE:

All modules specified in the approved curriculum

D.2. YEAR 1 OF ENGINEERING 19BENG

Common to all Engineering Disciplines

SCHOOL 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)

SCHOOL CORE:

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

DISCIPLINE SPECIFIC MODULES

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

D.4. YEAR 3 OF ENGINEERING

SCHOOL CORE:

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

DISCIPLINE SPECIFIC MODULES:

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

D.5. YEAR 4 OF ENGINEERING

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

SCHOOL CORE:

TEGT3821 Society and the Engineer
TEGM3891 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 School of Engineering and Information Technology
S	First Letter S represents the School of Science
EGT	School Core Modules
MEE, CEE, CME, ETE, MLE, TCE, MNE …	Engineering Discipline Letter Codes
3	Bachelor Degree Programme
5 - 8	NQF Levels
Full or Half	Module type, even numbers (2, 4, 6) for half, odd numbers for full module, 8 or 9 for ¾ module (12 credits). Also 9 is for modules with 4, 30 or 34 credits.
1 or 2	Semester

Abbreviations:

SEBE	School of Engineering & the Built Environment
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) 176 CREDITS

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 and Complex Numbers	MAT3521	5	8	None
1	Chemistry 1A	SCHM3511	5	16	None
1	Physics for Physical Sciences I	SPHY3511	5	16	None
1 or 2	Computer Literacy	UCLC3509	5	8	None
1 and 2	Contemporary Social Issues	UCSI3580	5	8	
Total Credits				**96**	

SEMESTER	MODULE	CODE		CREDIT	PRE & CO-REQUISITE
2	English for Academic Purposes	ULEA3519	5	16	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
1 or 2	Computer Literacy	UCLC3509	5	8	None
Total Credits				**80**	

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

SEMESTER 1

Module Title: **ENGLISH COMMUNICATION AND STUDY SKILLS**

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

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

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

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

Issue date: September 2015
Next Revision: September 2019

Module Title:	FUNDAMENTALS OF ENGINEERING

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

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

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

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	BASIC MATHEMATICS

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

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

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

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

Issue Date:	January 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 and Excess Reagents; Reaction Yield; Concentration of Solutions. Reactions in Aqueous Solutions: General Properties of Aqueous Solutions; Precipitation Reactions; Acid-Base Reactions; Oxidation and Reduction Reactions (assigning oxidation states, writing redox equations, balancing redox reactions). Quantum Theory and the Electronic Structure of Atoms: The Photoelectric Effect; Bohr's Theory of the Hydrogen Atom; Quantum Numbers; Atomic Orbitals; Electron Configuration; The Building-up Principle. Periodic Relationships Among Elements: Periodic Classification of the Elements; Periodic Variation in Physical Properties (effective nuclear charge, atomic radius, ionic radius); Ionization Energy; Electron Affinity; Variation in Chemical Properties of the Representative Elements (main group elements). Chemical Bonding: Lewis Dot Symbols; Ionic Bonding; Covalent Bonding; Metallic Bonding; Electronegativity; Writing Lewis Structures; Formal Charge; Concept of Resonance; Bond Enthalpy. Basic Molecular Geometry and Hybridization of Atomic Orbitals: Molecular Geometry; Dipole Moments; Valence Bond Theory; Hybridization of Atomic Orbitals; Molecular Orbital Theory; Molecular Orbital Configurations.

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

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

Issue Date: January 2013
Next Revision: January 2017

Module Title:	PHYSICS FOR PHYSICAL SCIENCES I

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

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

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

Issue Date:	January 2013
Next Revision:	January 2017

SEMESTER 2

Module Title:	ENGLISH FOR ACADEMIC PURPOSES

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

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

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

Issue Date:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes

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

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

Issue Date: September 2012
Next Revision: September 2016

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

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

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

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

Issue Date: January 2013
Next Revision: January2017

Module Title:	INTRODUCTION TO STATISTICS

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

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

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

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

Issue Date:	September 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:

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

Issue Date:	January 2013
Next Revision:	January 2017

Module Title:	PHYSICS FOR PHYSICAL SCIENCES II

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

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

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

Issue Date: January 2013
Next Revision: January 2017

Module Title:	COMPUTER LITERACY

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

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

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

Issue Date: September 2012
Next Revision: September 2016

G. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING (HONOURS)

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

G.2. AIM

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

G.3. CURRICULUM STRUCTURE

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

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (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 – 164 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
0	Workshop Practice	TEGW3590	5	8	None
1	Materials Science	TEGS3591	*5*	12	*None*
1 and 2	*Contemporary Social Issues*	UCSI3580	5	8	None
1	Fundamentals of Engineering	TEGT3521	5	8	None
Total Credits Semester I				***80***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics II	TEGM3512	5	16	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				***84***	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN CIVIL ENGINEERING – 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3512
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	TEGS3661	6	8	**TEGM3591**
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Strength of Materials I	TCVM3621	6	8	TEGT3592
1	Fluid Mechanics	TMEM3681	6	12	TEGT3592
Total Credits Semester III				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-** REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3512** TEGT3671
2	Building Materials	TCVI3612	6	16	**TEGS3591**
2	Soil Mechanics	TCVD3682	6	12	TEGT3592 and 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	**TEGT3592** TCVM3621
2	*HIV and AIDS Education*	TEGT3602	*6*	-	None
2	Industrial Attachment I	TEGT3600	6	-	None
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN CIVIL ENGINEERING – 136 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
0	Experimental and Research Methods	TEGR3760	7	8	**TEGS3661**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Hydrology for Engineers	TCVD3741	7	8	**TMEM3681**
1	Theory of Structures	TCVS3791	7	12	**TCVM3621**
1	Infrastructure Planning and Design II	TCVD3721	7	8	TCVI3622
1	Geo-technical Engineering	TCVG3711	7	16	TCVM3621 **TCVD3682**
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	**TMEM3681 and** **TEGT3641**
2	Urban Water Systems	TCVD3782	7	12	**TCVI3622** TCVD3741
2	Reinforced and Pre-stressed Concrete Design	TCVD3792	7	12	**TCVM3662** TCVS3791
2	Design of Steel and Timber Structures	TCVS3762	7	8	**TCVM3662** TCVS3791
2	Transport Planning and Traffic Engineering	TCVT3792	7	12	TCVI3622
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Industrial Attachment II	TEGT3700	7	0	TEGT3600
Total Credits Semester VI				**68**	

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	TCVR3892
0	Civil Engineering Design Project	TCVD3890	8	34	All 3rd Year Courses
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: Lines and planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and number series**: the limit of a sequence, tests for convergence, absolutely convergent series. **Functions**: Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to Engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, polar graphs. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers**: definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

1. Use standard equipment for technical drawing
2. Sketch Engineering components free hand or with the aid of drawing equipment
3. Present Engineering components as drawings in orthographic and isometric projections
4. Use sections, interpenetration and development to produce clear Engineering drawings
5. Produce parts drawings and assembly drawings of various Engineering components

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

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

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)

4 Investigations, Experiments and Data Analysis (Course Outcome 9)

Issue Date: September 2015

Next Revision: TBD

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

Content: **Overview of common operating systems** like Windows, Linux and Mac-OS. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra. Information representation in computers. **Computer Network Fundamentals. Web development.**

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

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

CONTRIBUTION to Exit Level Outcome

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

Issue Date:	September 2015
Next Revision:	TBD

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

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

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

1. Describe general safety procedures applicable to Engineering workshops.
2. Describe specific hand tools used in Engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Install air-conditioning and refrigeration systemsDescribe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams
4. Describe the various phase transformations in the $Fe\text{-}Fe_3C$ phase system and associated microstructures
5. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Issue Date: September 2015
Next Revision: TBD

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

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

Learning Outcomes

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

Module Title:	FUNDAMENTALS OF ENGINEERING

Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS /week
Credits	8
Assessment	100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)
Pre-requisites	None

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

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

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

Issue Date:	September 2015
Next Revision:	TBD

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGM3512
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	16
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. **Further integration**: Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations**: Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

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

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

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)

Issue Date: September 2015
Next Revision: TBD

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% (2 Tests 60%, 2 Quizzes (20%) and 2 Practicals (20%))
Pre-requisite(s)	None

Content: Voltage and Current sources, source transformation. Ohm's law, Resistance, Resistor networks, Resistor coding, series and parallel, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, Superposition Theorem, Thevenin's Theorem, Power transfer, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance and mutual inductance, 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: Basics principles of a transformer, AC generator, DC motors, simple and three phase ac systems.

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

1. Distinguish between real and ideal voltage and current source
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving
3. Apply the principles of circuit analysis to series and parallel R,L,C circuits
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information
5. Describe the principles of a transformer and the basic AC generator and DC motors

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

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

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

1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

Content: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces. Distributed forces: centroids and centre of gravity;. **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. **Center of Gravity and Centroid**.

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

1. Express force operations and force systems using vectors
2. Apply the laws of static equilibrium of forces
3. Produce a free body diagram from a specified Engineering problem
4. Analyse trusses using method of joints and method of sections
5. Apply principles of static and kinetic friction in solving Engineering problems
6. Calculate and plot bending moment and shear force distributions in beams

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: TBD

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 60% (minimum 2 tests and 2 assignments) written examination 50% (1x3 hour paper) Examination: (40%) made up of 1 x 3 hour examination paper
Pre-requisite(s)	**ULEG 2419, ULCE 3419 or B in English at IGCSE or 4 in English at HIGCSE**

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

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

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

Issue Date: September 2015
Next Revision: TBD

YEAR 2 OF BSc IN CIVIL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
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)	TEGM3512 Engineering Mathematics II

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

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

1. Apply differential vector calculus to solve mathematical and Engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving Engineering problems
4. Apply the power series method in approximation of solutions of ordinary differential equations
5. Describe the basis for complex analysis in Engineering problem solving
6. Apply the residual theorem to Engineering problems

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

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:

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

CONTRIBUTION to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).
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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (2 Tests (40%), 1 Mini-project (25%), 4 Assignments (35%))
Pre-requisite(s)	**TEGT3561 Engineering Drawing**
Co-requisite(s)	TCME3591 Computing Fundamentals

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (**at least 4** assignments (40%) and 2 Tests (60%)), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGM3591 Engineering Mathematics I**

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

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

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

Contribution to Exit Level Outcome:

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

4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 4, 5, 6)

Issue Date: September 2015
Next Revision: TBD

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

Content: Mineralogy: **Mineralogy**: Properties and composition of rock forming and economic minerals; petrology; composition and identification of common igneous, sedimentary and metamorphic rocks. Practical work involves the identification of common minerals and rocks. **Internal processes**: the nature of the interior of the earth; plate tectonic theory. **Surface processes**: rock weathering and soil formation; erosion and denudation; sediment transport and deposition; the rock cycle in the context of plate tectonic theory; introductory geo-hydrology. Practical work involving geological map interpretation.

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015

Next Revision: TBD

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

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

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

1. Describe properties of fluids and conditions for relative equilibrium in fluids.
2. Categorize one-dimensional mass and momentum conservation and applications of Bernoulli's equation
3. Demonstrate skills for flow measurements
4. Solve general hydraulic systems with respect to energy changes, pipe friction, loss coefficient.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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)	**TEGM3512 Engineering Mathematics II**
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: **Applications of second order ordinary differential equations** with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, 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 **Integral**. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and Engineering applications. **Numerical methods**: Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations.

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

Content: Mineralogy: Properties and composition of rock forming; **Surface processes:** soil formation, erosion, sediment transport. **Soil mechanics concepts, Elasticity:** Effective stresses**,** volume change behaviour of soils, 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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

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

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

Issue Date:	September 2016
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Module Title:	I STRENGTH OF MATERIALS II
Code	TCVM3662
NQF Level	6
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	Continuous 50% (assignments, 2 Tests); Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGT3592 Engineering Mechanics I**
Co-requisite(s)	TCVM3621 Strength of Materials I

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

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

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

Issue Date: September 2015

Next Revision: TBD

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

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

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

1. Describe the organisational structure and the operational processes of the company or organisation
2. Describe in details his/her contribution to the company during the internship

Issue Date: September 2015

Next Revision: TBD

YEAR 3 OF BSc IN CIVIL ENGINEERING

SEMESTER 1

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

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

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

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

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

CONTRIBUTION to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

1. Summarise the hydrological cycle and describe methods for determination of evaporation and transpiration
2. Distinguish modelling floods and measuring stream flow
3. Discuss the processes that lead to soil erosion and sediment production
4. Discuss methods for flow measurement and hydrological modelling

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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 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:

1. Analyse elastic structures using classical methods
2. Compare statically determinate and indeterminate structures using influence line diagrams
3. Demonstrate knowledge of buckling of struts
4. Use matrix methods of analysis in solving statically determinate and indeterminate structures
5. Illustrate forces and stresses in beams, arches and trusses
6. Discuss and compare plates and simple shells
7. Use ULS and SLS design as applied to structural steel works and concrete structures.

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

Module Title:	INFRASTRUCTURE PLANNING AND DESIGN II
Code	TCVD3721
NQF Level	7
Contact Hours	2L + 1T/Week plus field trip
NQF Credits	8
Assessment	Continuous 100% (2 Tests (60%), 4 assignments (40%))
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:

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

Module Title	CONSTRUCTION MANAGEMENT
Code	TCVS3721
NQF Level	7
Contact Hours	**2**L + 1T or 1PS/Week
NQF Credits	8
Assessment:	Continuous 100% (2 Tests (50%); 2 Project reports (25%), 2 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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

SEMESTER 2

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

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.

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

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	TBD

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

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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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:

1. Carry out stress analysis of steel-reinforced concrete elements
2. Apply design codes for steel-reinforced concrete structures
3. Apply limit state philosophy to the design of reinforced concrete structures
4. Formulate characteristic and design features of common structural members
5. Use computational software packages in the analysis and design of reinforced concrete elements
6. Solve general principles of design of pre-stressed concrete structures.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	Continuous 100% [2 Tests (50%); 2 Reports (25%); At least 2 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, management functions, strategic planning and management financial projections, possible sources of finance, resource management, projected levels of growth and operations. Introduction to **change management theory**. Group dynamics. Introduction to **Management accounting. Introduction to Marketing strategies**

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

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

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

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

Issue Date: September 2015
Next Revision: TBD

YEAR 4 OF BSc IN CIVIL ENGINEERING

SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week plus field trip
Credits	8
Assessment	Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).
Co-requisite(s)	TEGT3742 Entrepreneurship

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

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

1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 4 and 5 (Law), 7 (health and safety), 8)

10 Engineering Professionalism (Course Outcomes 1, 2, 3, 6)

ECN Exit Level Outcomes Assessed:

10 ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitute satisfactory performance?

After consideration of the 3 term papers, 3 tests and 3 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "not satisfactory", "satisfactory" or "Excellent". The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Issue Date: September 2015
Next Revision: TBD

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group project plus presentation, 2 Tests, 4 assignments/case studies)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team

Contribution to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

8 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**

Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitute satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitute satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: TBD

Module Title:	STRUCTURAL ENGINEERING
Code	TCVS3811
NQF Level	8
Contact Hours	4L + 1T/Week
NQF Credits	16
Assessment	Continuous 50% (assignments, 2 Tests) making **30%,** presentation (**10%**) and report (**10%)**; Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TCVS3762 Design of Steel and Timber Structures and TCVD3792 Reinforced and Pre-stressed Concrete Design

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

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

1. Discuss main features of design of steel and concrete composite members
2. Use plastic methods to design steel beams and frames
3. Analyse building frames subjected to gravity, lateral or gravity and lateral loads
4. Discuss modern structural systems in buildings and the concept of industrialized building systems
5. Compare structures of buildings
6. Interpret various layouts and topologies for bridges and illustrate them with Engineering drawings
7. Apply computational software packages in the analysis and design of structures.

Contribution to Exit Level Outcome:

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

ECN Exit Level Outcomes Assessed:

2 **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**

Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies

The assessment will constitute the following:

At least 2 Assignments and at least 2 Tests all making 50%**,** Examination (1 x 3 hour paper) making 50%.

To pass this course a student should obtain a sub-minimum mark of 50% in the exam and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, mechanics, basic science and civil Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the design modern structural systems, structural analysis and design of buildings**,** plastic methods to design steel beams and frames as well as various layouts and topologies of bridges; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of civil Engineering science at a fundamental level and in at least one specialist area.

What constitute satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a sub- minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily. The Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of **"Application of Scientific and Engineering Knowlegde"** in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".***

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.
The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

Issue Date:	September 2015
Next Revision:	TBD

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

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

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

1. Describe general layouts and geometry of urban and rural roads and pavements
2. Characterize the key attributes of vehicles, operators, and highway systems that affect geometric design
3. Elaborate on the basic parameters and constraints for design of rural and urban alignment, cross section and intersections and apply them in an actual design project.
4. Correlate the behaviour and selection of construction materials to the construction of roads and highways and available methods of soil stabilization
5. Discuss the various drainage systems for roads and highwaysApply computational software packages in the analysis and design of structures.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

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

Content: Overview of the railway transport system. General technical features of railway layouts; geometry of railways; infrastructure for railways. Soil properties; mechanical stabilization of soils for railway lines. **Design of Railways**: main railway lines**;** underpasses; overpasses, rail traffic control systems, passenger platforms. **Public transport** systems. History and role of Public Transportation in Urban Development. Urban Passenger Transport Modes. Vehicle Characteristics and Motion. Highway Transit Modes: Buses and Trolleybuses. Rail Transit Modes: Street Cars, Light Rail, Rapid Transit and Regional Rail. New Concepts and Proposed Modes. Transit System Performance: Capacity, Productivity, Efficiency and Utilization.

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

1. Discuss the main features of railway transport systems
2. Elaborate on the infrastructure, general layouts and geometry of railway lines
3. Outline properties and stabilization methods for soils suitable for railway lines
4. Develop basic designs of railway lines, passenger platforms and traffic control
5. Demonstrate basic understating the social and economic benefits of public transportation
6. Perform economic feasibility of different transport modes as a function of passenger demand
7. Apply necessary formulation to have an objective estimate of selecting and sizing the public transportation modes

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: TBD

Module title:	WASTE WATER AND SOLID WASTE MANAGEMENT
Code	TCVI3881
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (assignments, 2 Tests) making **30%,** presentation (**10%**) and report (**10%)**; Examination 50% (1 x 3 hours paper)
Pre-requisite(s)	**TCVI3622 Infrastructure Planning and Design I**
Co-requisite(s)	TCVD3782 Urban Water Systems

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

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

1. Discuss methods and technologies used in wastewater treatment.
2. Identify parameters for design of wastewater treatment, sludge treatment and disposal.
3. Discuss legislation and codes of practice for wastewater treatment.
4. Elaborate the characteristics of solid wastes and techniques for solid waste management.
5. Correlate solid waste disposal systems with the design of landfills.
6. Combine life-cycle assessment and material flow analysis in solid waste management.
7. Appraise solid waste treatment including biogas production from waste.

Contribution to Exit Level Outcome:

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

ECN Exit Level Outcomes Assessed:

9 **INDEPENDENT LEARNING ABILITY**

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will constitute the following:

At least 2 Assignments and at least 2 Tests making 30%, Presentation (10%) and Report on selected topics in wastewater (10%), all together making 50%.
Examination (1 x 3 hour paper) making 50%.

To pass this course a student should obtain a sub-minimum mark of 50% in the exam and also meet the requirement of ECN exit level outcome 9 assessed in the presentation and the submitted, independent study report.

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. This will be assessed through tests, individual assignments, presentations and report writing, set in a way that allows evidence of the student's ability to engage in independent learning through well-developed learning skills showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology as well as need to access, comprehend and apply knowledge acquired outside formal instruction to be evaluated.

What constitute satisfactory performance?

The lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a sub-minimum average continuous assessment mark of 50% before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

Quality Assurance Arrangements

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

Issue date: September 2015
Next Revision: TBD

SEMESTER 2

Module title:	RESEARCH PROJECT
Code	TCVR3892
NQF Level	8
Contact Hours	17.5 hours of Research Work per week (17.5 hours x 16 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation
NQF Credits	30
Assessment:	Continuous 100% Two Seminar Presentations (**30%**); Final Oral Presentation of Dissertation (**20%**); Final Written Dissertation (**50%**)]
Co-requisite(s)	TEGR3760 Experimental and Research Methods
Prerequisite	All third year courses

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

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

1. Design an Engineering investigation (methodology)
2. Conduct appropriate experiments for an Engineering investigation (data collection including from simulation) taking into consideration ethical issues like: health, safety and the environment
3. Analyse and interpret the experimental data using appropriate tools including information technology
4. Assess, benefits and impacts of the research: ergonomics, social, legal, health, safety, and environmental
5. Communicate research findings effectively, both orally and in writing, with Engineering audiences and the community at large, clearly drawing reasonable conclusions and suggestions for future work
6. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works

Contribution to Exit Level Outcome:

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

ECN Exit Level Outcomes Assessed:

4 **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Demonstrate competence to formulate and conduct investigations and experiments.

5 **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Demonstrate competence tom use appropriate Engineering methods, skills and tools, including those based on information technology.

6 **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences the community at large.

Assessment Strategies

Continuous Assessment 100% (Progress report presentation 20%; Final Oral Presentation of Research Report 20%; Final Research Report 60%).

To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 4, 5 and 6 assessed in the final research report in the section dealing with the corresponding outcome.

The assessment for each of the outcomes 4, 5 and 6 shall be as follows:

ECN Exit Level Outcome 4 - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN Exit Level Outcome 5</u> - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN exit level outcome 6</u> - **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final research report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of research report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitute satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: TBD

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:

1. Identify, analyse and define a convergent/divergent Engineering problem that can be solved using Engineering knowledge and skills
2. Formulate possible design approaches to the solution of the defined Engineering problem
3. Perform techno-economic analyses to evaluate alternative solutions and select best solution
4. Design (procedural and non-procedural), synthesize and optimized a system prototype based on the selected solution using necessary information and applicable Engineering knowledge, skills and tools, showing elements of creativity/innovation
5. Assess sustainability, benefits and impacts of the design: ergonomics, social, legal, health, safety, and environmental
6. Develop a design project plan and identify resources required to complete project milestones
7. Present technical designs accompanied with detailed analysis, calculations, manual and/or prototype/model of the possible solutions(s) or source codes and any other relevant information in an appropriate form

Contribution to Exit Level Outcome:

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

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**

Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively.

3 **ENGINEERING DESIGN**

Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

7 **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY**

Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment.

Assessment Strategies

Continuous Assessment 100% (Two Seminar Progress report presentations of design 30%; Final Oral Presentation of Design Report 20%; Final Design Report 50%).

To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 1, 3 and 7 assessed as follows:

ECN Exit Level Outcome 1 - **Problem Solving.**

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 - **Engineering Design**

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognise and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimisation.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with Engineering ***Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering ***Design***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering ***Design*** in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If this particular ELO only is missed, the student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: TBD

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

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

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

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

Issue Date: September 2015
Next Revision: TBD

G.4.1. CURRICULUM FOR THE DEGREE BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

G.5. DEGREE NAME: BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS) 19BCEE

G.6. AIM

The curriculum for the degree of **BSc in Electronics and Computer Engineering (Honours)** aims at producing multidiscipline Graduate Engineers with knowledge and skills in electronics and computer Engineering, and who can competently work in the design, production and service of electronics and computer hardware, as well as in the information and communication technology industry, thus providing the potential for further professional training towards the requirements for registration as Professional **Engineers**. The programme is designed with the objective of meeting the national and regional needs for education in Electronics and Computer Engineering. The programme offers students a complementary and multidisciplinary approach to studying the broad area of Electronics and Computer Engineering through modules covering Engineering Sciences, Mathematical Sciences, Basic Sciences, Computing and Information Technologies, Complementary Studies and design and analysis.

G.7. 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 – 164 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 and 2	***Contemporary Social Issues***	UCSI3580	*5*	8	None
1	**Fundamentals of Engineering**	TEGT3521	5	8	None
Total Credits Semester I				***80***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics II	TEGM3512	5	16	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				***84***	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3512
1	**Computer Science for Engineers**	TCME3621	6	8	**TCME3521**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3661	6	8	**TEGM3591**
1	Electric Circuit Analysis I	TECE3691	6	12	TEGT3542
1	Analogue Electronics I	TETE3691	6	12	**TEGT3542**
1	**Software Engineering**	TCEE3661	6	8	**TCME3521**
Total Credits Semester III				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3512** 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	**HIV and AIDS Education**	TEGT3602	6	-	TEGW3590
2	Industrial Attachment I	TEGT3600	6	-	
Total Credits Semester IV				**68**	

YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING - 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1 and 2	**Experimental and Research Methods**	TEGR3760	7	8	**EGS3661**
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	TETA3791 TETD3692
2	Digital Communication	TTCD3792	7	12	**EGS3691** TTCE3741
2	Operating Systems	TCME3792	7	12	TCEE3791
2	Database Systems	TCMS3762	7	8	TCME3521
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**68**	

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**	TCER3892	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**

G.8. DETAILED COURSE CONTENT FOR BACHELOR OF SCIENCE IN ELECTRONICS AND COMPUTER ENGINEERING (HONOURS)

YEAR 1 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

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

Content: Lines and planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and number series**: the limit of a sequence, tests for convergence, absolutely convergent series. **Functions**: Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to Engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, polar graphs. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers**: definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
1. Use standard equipment for technical drawing
2. Sketch Engineering components free hand or with the aid of drawing equipment
3. Present Engineering components as drawings in orthographic and isometric projections
4. Use sections, interpenetration and development to produce clear Engineering drawings
5. Produce parts drawings and assembly drawings of various Engineering components

Contribution to Exit Level Outcome:
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
6 Professional and Technical Comm (Course Outcomes 2, 3, 4, 5)
Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of the module, the student is expected to:
1. Employ units, do unit conversions and use of significant figures.
2. Solve problems regarding one and two dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gases.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Overview of common operating systems like Windows, Linux and Mac-OS. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra. Information representation in computers. **Computer Network Fundamentals. Web development.**

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

CONTRIBUTION to Exit Level Outcome

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of this course, students should be able to:
1. Describe general safety procedures applicable to Engineering workshops.
2. Describe specific hand tools used in Engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Install air-conditioning and refrigeration systemsDescribe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)

5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

Issue Date: September 2015

Next Revision: September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams
4. Describe the various phase transformations in the Fe-Fe_3C phase system and associated microstructures
5. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Issue Date: September 2015

Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGM3512
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous (Quiz (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Further Matrix Algebra: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **Further integration**: Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations**: Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Calculate eigenvalues and eigenvectors and relate them to Engineering solutions
2. Solve calculus problems using integration by parts and the reduction formula technique
3. Apply calculus to trigonometric functions to solve mathematical and Engineering problems
4. Solve Engineering problems using 1st order and 2nd order differential equations
5. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and Engineering problems

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100% (at least 2 tests - 60%, 2 quizzes - 20%) and 2 practical labs – 20%)
Pre-requisite(s)	None

Content: Voltage and Current sources, source transformation. Ohm's law, Resistance, Resistor networks, Resistor coding, series and parallel, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, Superposition Theorem, Thevenin's Theorem, Power transfer, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance and mutual inductance, 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: Basics principles of a transformer, AC generator, DC motors, simple and three phase ac systems.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Distinguish between real and ideal voltage and current source
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving
3. Apply the principles of circuit analysis to series and parallel R, L, C circuits
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information
5. Describe the principles of a transformer and the basic AC generator and DC motors

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces. Distributed forces: centroids and centre of gravity; **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. **Center of Gravity and Centroid**.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Express force operations and force systems using vectors
2. Apply the laws of static equilibrium of forces
3. Produce a free body diagram from a specified Engineering problem
4. Analyse trusses using method of joints and method of sections
5. Apply principles of static and kinetic friction in solving Engineering problems
6. Calculate and plot bending moment and shear force distributions in beams

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 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 and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

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

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

Issue Date: September 2015
Next Revision: September 2019

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

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3512 Engineering Mathematics II
Pre-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:
1. Apply differential vector calculus to solve mathematical and Engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving Engineering problems
4. Apply the power series method in approximation of solutions of ordinary differential equations
5. Describe the basis for complex analysis in Engineering problem solving
6. Apply the residual theorem to Engineering problems.

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).
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:
1. Develop algorithms and apply data structures in computer programs.
2. Apply binary trees to specific programming environment
3. Write programs in MATLAB or equivalent software employing user defined and built in functions.
4. Apply MATLAB (or equivalent software) programming in solving Engineering problems
5. Write simple C programs

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous (4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 2 hour paper) 50%
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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Review of DC Circuits: Thevenin's and Nortons theorems, superposition theorem, concept of input and output resistance of network, single port networks, two-port networks, KCL, KVL, electric power, energy sources, sources transformations, power transfer, maximum power transfer, current and voltage divider theorems, Mesh and Node analysis; D.C. power supplies and their industrial use. **Sinusoidal Steady State Analysis**: AC. behavior in R, L and C elements. Phasor analysis with complex algebra, two terminal networks - impedance, 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:
1. Apply circuit On completing the course students should be able to:
2. Apply circuit theorems to simplify and find solutions to electrical circuits.
3. Interpret, develop and design electrical Engineering circuits
4. Use computer simulation tools for electric circuit analysis and design
5. Perform DC and AC power calculations including power factor correction;
6. Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
7. Analyze, simulate, and experimentally validate DC and AC circuits;

Contribution to Exit Level Outcome:
2 Application of Sciencific and Engineering Knowledge (Course Outcomes 1, 2, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3)

Issue Date:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss the atomic structure of semiconductor materials
2. Discuss the construction and operation of semiconductor diodes.
3. Analyse and design diode based circuits.
4. Discuss the construction of BJT transistors
5. Analyse and design BJT transistor amplifier and switching circuits
6. Discuss the construction of FET transistors
7. Analyse and design FET biasing circuits
8. Discuss the internal circuitry for op-amps
9. Discuss the operation of op-amps
10. Analyse and design basic op-amp circuits
11. Use EDA software to analyse electronic circuits.

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**SOFTWARE ENGINEERING**
Code	TCEE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (at least 2 Assignments – 20%, at least 2 Tests 50 %, mini project - 30%)
Prerequisite(s)	**TCME3521 Computing Fundamentals**

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

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

1. Apply appropriate techniques in software design.
2. Plan and deliver an effective software Engineering process.
3. Capture, document and analyse requirements.
4. Translate requirements into an implementable design, following a structured and organized process.
5. Make effective use of UML, along with design strategies such as defining software architecture.
6. Work on a mini project within a group.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2)
3 Engineering Design (Course Outcomes 1, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 5)
6 Professional and Technical Communication (Course Outcomes 3)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 6)

Issue Date:	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 (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III
Pre-requisite(s)	**TEGM3512 Engineering Mathematics II**

Content: Applications of second order ordinary differential equations with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, 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 **Integral**. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and Engineering applications. **Numerical methods**: Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations.

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

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

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

Content: Review of Vector Algebra: Classification of vector fields. **Electrostatics**: Coulomb Law and Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equations for static EM fields. Electric potential. **Electric Field in Material Space**: 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:
1. Perform calculations involving electric and magnetic fields
2. Describe how energy is stored in electric and magnetic fields
3. Explain the theories and applications of electromagnetic fields and waves in material space
4. Explain the physical meaning and significance of Maxwell's equations;
5. Describe electromagnetic time varying fields and waves, and their implications in modern communication systems
6. Derive and apply equations related to static electromagnetic fields in material space

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss fundamental digital terminology.
2. Perform different number systems and coding conversions.
3. Describe the operation of different logic gates.
4. Analyse and simplify logic equations
5. Analyse and design different combinational logic circuits
6. Analyse and design sequential logic circuits
7. Compare the performance of different logic family devices
8. Discuss and analyse the internal circuitry of different logic family technologies.
9. Design interfaces between circuits of different logic families.

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015

Next Revision: September 2019

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

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

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

New: September 2016
Next Revision: September 2020

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

YEAR 3 OF BSc IN ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER 1

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGR3760
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%)
Pre-requisite(s)	**EGS3661 Statistics for Engineers**

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	ANALOGUE ELECTRONICS II
Code	TETA3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**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:
1. Model and analyse FETs based circuits
2. Determine the frequency response of transistor based circuits
3. Analyse and design op-amp and circuits
4. Analyse and design different op-amp based circuits
5. Analyse and design power amplifiers
6. Analyse and design filter circuits
7. Analyse and design oscillator circuits
8. Analyse and design ADC and DAC circuits
9. Analyse and design switching circuits employing basic power electronics components

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	TELECOMMUNICATION PRINCIPLES
Code	TTCE3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	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:
1. Explain the principles involved in the transmission and reception of information in a communication system.
2. Discuss the architecture of a generic communication system
3. Discuss and Analyze the effect of different types of noise in communication systems
4. Differentiate between different types of analogue modulation
5. Use computer simulation software (e.g. MATLAB or equivalent) to study the principles involved in communication.

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	PROGRAMMABLE ELECTRONICS DESIGN
Code	TETD3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 100% (at least 4 labs 20%, at least 2 assignments 10%, 2 tests 40%, mini 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:
1. Discuss and apply the programmable electronics design cycle.
2. Design, test and implement concurrent statement based logic circuit descriptions.
3. Design, test and implement logic circuits using structural VHDL descriptions.
4. Design, test and implement sequential circuits VHDL descriptions
5. Create VHDL packages, functions and procedures.

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: **Computer Architecture:** The basics of modern processor and system architectures, advanced use of tools such as assemblers, compilers and debuggers in embedded systems, as well as the methods for peripherals interfacing and networking**,** elements and organisation of a computer system**; Memory Devices:** RAM (SRAM, DRAM, DRAM cell arrays), ROM (EPROM, EEPROM), flash memory, memory addressing, address multiplexing, bus contention; **Instruction set architecture. Microprocessors:** types of microprocessors, microprocessors fabrication process, cost of microprocessors. **Microprocessor structures:** registers, arithmetic and logic unit, control unit, internal bus. **External buses:** address bus, data bus, control bus, bus timing. **Memory interfacing:** memory map design, memory address decoder circuit. **Input/output interfacing:** port mapping, port address decoder circuit. Clock generator circuits. **Interrupt mechanism:** interrupt priority, non-maskable interrupt, maskable interrupt, interrupt modes. Execution cycle and execution time of instructions. **Program execution time calculation.** Translation of mnemonics to machine codes.

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

1. Discuss the organization and design principles behind modern microprocessor-based systems
2. Design memory circuit for microprocessors.
3. Design input/output circuit for microprocessors.
4. Design interrupt generating circuit for microprocessor
5. Calculate exact execution time of programs.

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

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

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

Contents: Entrepreneurial perspective: types of entrepreneurs, characteristics of entrepreneurs, examples of successful ventures for national development. Carrying out feasibility studies, writing business plans. Government policies on small business ventures. **Enterprising opportunities**: business motivation, competencies and skills, innovative ideas, product concept and description, market assessment. **Starting new business ventures**: the calculated risk, business planning and organization, management planning, financial projections, possible sources of finance, resource management, projected levels of growth and operations. **Change Management theory**. Group dynamics. **Management accounting**. **Marketing strategies**.

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

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

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11 Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous (at least 2 Assignments – 20%, at least 2 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 2 hour paper)
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:
1. Discuss computer network layers
2. Compare the OSI model and the TCP/IP model
3. Understand the issues related to addressing between networks
4. Identify common security risks for Internet-connected computers.
5. Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
6. Distinguish between the different threats to wireless network security and different types of security threats.
7. Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.
8. Independently study and make a presentation on one emerging network technology.

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	DIGITAL COMMUNICATION
Code	TTCD3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TTCE3642 Telecommunications Principles
Pre-requisite(s)	**EGS3661 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:

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015

Next Revision: September 2019

Module Title	OPERATING SYSTEMS
Code	TCME3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
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:

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

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

Issue Date: September 2015

Next Revision: September 2019

Module Title	DATABASE SYSTEMS
Code	TCMS3762
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 2 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:
1. Differentiate the variety of database systems.
2. Plan and implement database technologies versus conventional file-processing systems.
3. Apply software development life cycle in database systems development.
4. Develop prototyping methodology and enterprise data models.
5. Effectively apply conceptual data modelling.
6. Apply integrity control systems

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

Issue Date: September 2015

Next Revision: September 2019

Module Title:	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned. The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite	TEGT3600 Industrial Attachment I

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

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

1. Describe the organizational structure and the operational processes of the company or organization
2. Describe in details his/her contribution to the company during the internship

Issue Date: September 2015
Next Revision: September 2019

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% (at least 2 Assignments 20%, at least 3 Tests (covering the aspects: Law, Professionalism, Health and Safety) 80%).
Co-requisite(s)	TEGT3742 Entrepreneurship

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace.
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 7 (health and safety), 8)
10 Engineering Professionalism (Course Outcomes 1, 2, 3)

ECN Exit Level Outcomes Assessed:
10 ENGINEERING PROFESSIONALISM
Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies
The assessment will constitute the following:
Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).***Where and how is this exit outcome assessed?***

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitute satisfactory performance?
After consideration of the 3 tests and 2 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3891
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (at least 2 Assignments 20%, at least 2 Tests 30%, group project presentation 20% and group project report 30%). The group must consist of students from a minimum of two different disciplines.
Pre-requisite(s)	**TEGT3761 Fundamentals of Economics**

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

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

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation;
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team.

CONTRIBUTION to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

9 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**
Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**
Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:
Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitute satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitute satisfactory performance?
After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or **"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Tittle	**CONTROL ENGINEERING**
Code	TECP3891
NQF Level	8
Contact Hours	3L + 1PSWeek
NQF Credits	12
Assessment	Continuous 50% (At least 1 Assignment, At least 2 Tests and a mini-project), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGT3671 Engineering Mathematics III**

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss different control theory terminologies.
2. Model basic electrical systems as a control systems or part of parts of control systems.
3. Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control Engineering.
4. Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Use Engineering software for modelling, analysis and design of control systems

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

ECN Exit Level Outcomes Assessed:
2. **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**
Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies
The assessment will constitute the following:
Continuous (at least 2 Assignments – 20%, at least 4 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 3 hour paper)
To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?
Students are expected to demonstrate competence to apply knowledge of mathematics, basic science and Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the use of mathematical, numerical analysis and statistical knowledge and methods to bear on Engineering problems; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of Engineering science at a fundamental level and in at least one specialist area.

What constitute satisfactory performance?
After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
If the performance requirements as stipulated above are not met, the student will be allowed to take the supplementary exam, after which if the minimum competence is still not obtained, then the student is considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title	EMBEDDED SYSTEMS DESIGN II
Code	TETD3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 100% (at least 4 labs 20%, at least 2 tests 40%, Mini Project 40%)
Pre-requisite(s)	**TETD3792 Embedded Systems Design I**

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss merits and demerits of high level and assembly languages as used in embedded systems.
2. Explain the embedded systems design cycle.
3. Discuss advanced embedded systems programming concepts
4. Design and write efficient C programs for embedded systems.
5. Optimise C code for embedded systems.
6. Discuss and use different embedded systems optimisation methods and algorithms
7. Execute micro-controller based individual and/or group projects effectively.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 7)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3)
3 Engineering Design (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5, 6)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 7)

Issue Date:	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	At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics in wireless communication (**10%**), Examination (1 x 3 hour paper) making **50%**
Co-requisites	TTCD3792 Digital Communication
Pre-requisites	**TTCE3741 Telecommunication Principles**

Contents: Radio transmission: Propagation models, ground wave, space wave, ionospheric propagation, interference, noise analysis, Doppler effect. **Multiuser Communication**: Multiuser communication techniques, access techniques, interference mitigation techniques. **Mobile Telephony**: Telephone systems, frequency reuse technique, cellular architecture, handover techniques, mobility management. **Satellite Communication**: Geometry, transmission and access technique, radio sub systems, link design, network, application. **Mobile Communications Systems**: GSM, UMTS and LTE Network. Wireless Local Area Network: IEEE802.11, Bluetooth and IEEE802.15.4 based sensor networks. Individual students project on selected topics in wireless communication.

Learning Outcomes: On completing the course students should be able to:
1. Discuss the Architecture and operation of wireless communications networks
2. Identify and discuss the fundamental operational and design problems of wireless communication systems
3. Apply basic techniques to design point to point wireless links and basic communication systems
4. Discuss network planning in wireless communication
5. Discuss basic technical standards related to 2G/3G/4G wireless systems
6. Make a presentation on independently studied selected topic in wireless communication.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3)
3 Engineering Design (Course Outcomes 2,4, 5)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:
9 **INDEPENDENT LEARNING ABILITY**
Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies
The assessment will constitute the following:
At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics in wireless communication (**10%**), Examination (1 x 3 hour paper) making **50%**
To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 9 which will be assessed as follows:

Where and how is this exit outcome assessed?
Students will be given topics to study independently and make a presentation and submit a report.
This exit level outcome is assessed in the **presentation** and submitted **report** where the students are expected to demonstrate ability to
- Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative
- accurately self-evaluate and take responsibility for learning requirements;
- Consider social and ethical implications of applying knowledge in particular contexts.

What constitute satisfactory performance?
After consideration of the **presentation** and submitted independently studied **report**, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the presentation and report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised independently studied report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will not obtain the sub minimum and hence will not be allowed to proceed to the exam and therefore will have to repeat the course. If a student meets the requirement but failed to obtain a minimum final mark of 50%, then he or she will have to repeat the course.

Issue Date:	September 2015
Next Revision:	September 2019

SEMESTER 2

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

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

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

1. Design an Engineering investigation (methodology);
2. Conduct appropriate experiments for an Engineering investigation (data collection including from simulation) taking into consideration ethical issues like: health, safety and the environment;
3. Analyse and interpret the experimental data using appropriate tools including information technology;
4. Assess, benefits and impacts of the research: ergonomics, social, legal, health, safety, and environmental;
5. Communicate research findings effectively, both orally and in writing, with Engineering audiences and the community at large, clearly drawing reasonable conclusions and suggestions for future work.
6. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.

Contribution to Exit Level Outcome:

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5 Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6 Professional and Technical Communication (Course Outcomes 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**
Demonstrate competence to formulate and conduct investigations and experiments.

5. **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**
Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

6. **PROFESSIONAL AND TECHNICAL COMMUNICATION**
Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.

Assessment Strategies
The assessment will be **100% Continuous** constituting of the following:
Progress report presentation (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcomes 4, 5 and 6 assessed in the final research report in the section dealing with the corresponding outcome.

The assessment for each of the outcomes 4, 5 and 6 shall be as follows:

ECN Exit Level Outcome 4 - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?
Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitute satisfactory performance?
After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN Exit Level Outcome 5</u> - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?
Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitute satisfactory performance?
After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN exit level outcome 6</u> - **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Where and how is this exit outcome assessed?
Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final research report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of research report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitute satisfactory performance?
After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Identify, analyse and define a convergent/divergent Engineering problem that can be solved using Engineering knowledge and skills;
2. Formulate possible design approaches to the solution of the defined Engineering problem;
3. Perform techno-economic analyses to evaluate alternative solutions and select best solution;
4. Design (procedural and non-procedural), synthesize and optimized a system prototype based on the selected solution using necessary information and applicable Engineering knowledge, skills and tools, showing elements of creativity/innovation;
5. Assess sustainability, benefits and impacts of the design: ergonomics, social, legal, health, safety, and environmental;
6. Develop a design project plan and identify resources required to complete project milestones;
7. Present technical designs accompanied with detailed analysis, calculations, manual and/or prototype/model of the possible solutions(s) or source codes and any other relevant information in an appropriate form.

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

ECN Exit Level Outcomes Assessed:
1 **PROBLEM SOLVING**
Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively.

3 **ENGINEERING DESIGN**
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

7 **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY**
Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment.

Assessment Strategies
The assessment will be **100% Continuous** constituting of the following:
Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 1, 3 and 7 assessed as follows:

<u>ECN Exit Level Outcome 1</u> - **Problem Solving.**

Where and how is this exit outcome assessed?
Students are expected to competently Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitute satisfactory performance?
After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the

student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with “Problem Solving” in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 - **Engineering Design**

Where and how is this exit outcome assessed?
Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student’s ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognise and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimisation.

What constitute satisfactory performance?
After consideration of the section of the final design report that deals with Engineering ***Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “ Engineering ***Design***” in a manner that is considered: “*not satisfactory”, “satisfactory” or **“Excellent”.*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with “ Engineering ***Design*** in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 7 - **Sustainability and Impact of Engineering activity.**

Where and how is this exit outcome assessed?
Students are expected to show critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. The final design report should show evidence of the student’s ability to consider the impact and benefits of the design on social, legal, health, safety and environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitute satisfactory performance?
After consideration of the section of the final design report that deals with **Sustainability and Impact of Engineering activity** and with reference to how this knowledge are considered in the Engineering analysis and design considerations, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “**Sustainability and Impact of Engineering activity**” in a manner that is considered: “*not satisfactory”, “satisfactory” or **“Excellent”.*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with “**Sustainability and Impact of Engineering activity**” in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	Continuous assessment 100% (Logbook record 20%, Lecturer/Employer Evaluation 20%, Final report 60%)
Co-requisite(s)	TEGT3700 Industrial Attachment II

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

Learning Outcomes: Upon completion of this course, students should be able to:
1. Describe the organizational structure and the operational processes of the company or organization
2. Describe in details his/her contribution to the company during the internship

Issue Date:	September 2015
Next Revision:	September 2019

G.9. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS)

G.10. DEGREE NAME: BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (HONOURS) 19BECE

G.11. 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.

G.12. 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 - 164 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 and 2	***Contemporary Social Issues***	UCSI3580	5	8	None
1	**Fundamentals of Engineering**	TEGT3521	5	8	None
Total Credits Semester I				***80***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-**REQUISITE
2	Engineering Mathematics II	TEGM3512	5	16	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				***84***	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN ELECTRICAL ENGINEERING -148 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3512
1	**Computer Science for Engineers**	TCME3621	6	8	**TCME3521**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3661	6	8	**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 **TEGT3591**
Total Credits Semester III				**72**	

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3512** 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	**TEGT3541**
2	**Computer Programming**	TCMS3692	6	12	TCME3621
2	**HIV and AIDS Education**	TEGT3602	*6*	-	None
2	Industrial Attachment I	TEGT3600	6	-	**TEGT3590**
Total Credits Semester IV				**76**	

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING - 132 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1 and 2	**Experimental and Research Methods**	TEGR3760	7	8	**TEGS3661**
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	TECT3792	7	12	TECE3731 **TECP3622**
2	**Electrical Engineering Design**	TECE3762	7	8	TECE3731 TECE3711
2	**Renewable Energy Technologies**	TECC3792	7	12	**TEGT3541**
2	Industrial Attachment II	TEGT3700	7	-	TEGT3741
Total Credits Semester VI				**60**	

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**	EGM3881	8	12	**TEGT3761**
1	Control Engineering	TECP3891	8	12	**TEGT3671**
1	**Computation Methods in Power Engineering**	TECE3891	8	12	TECP3831 **TECE3731**
1	Power Systems Protection	TECP3831	8	16	**TECE3791**
1	Microprocessor and Programmable Logic Controllers	TECP3851	8	16	**TETD3692**
Total Credits 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**

A.1. 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 (Quiz (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Lines and planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and number series**: the limit of a sequence, tests for convergence, absolutely convergent series. **Functions**: Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to Engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, polar graphs. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers**: definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
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Module Title:	**ENGINEERING DRAWING**
Code	TEGT3561
NQF Level	5
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (minimum of 2 tests and 4 drawing assignments)
Pre-requisite(s)	None

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

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

1. Use standard equipment for technical drawing
2. Sketch Engineering components free hand or with the aid of drawing equipment
3. Present Engineering components as drawings in orthographic and isometric projections
4. Use sections, interpenetration and development to produce clear Engineering drawings
5. Produce parts drawings and assembly drawings of various Engineering components

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of the module, the student is expected to:
1. Employ units, do unit conversions and use of significant figures.
2. Solve problems regarding one and two dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gases.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.

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

Issue Date:	September 2015
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Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3521
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous assessment (At least 2 Tests, 4 Assignments and 2 Practicals Reports) 50%, written examination (1x2 hour paper) 50%
Pre-requisite(s)	None

Content: Overview of common operating systems like Windows, Linux and Mac-OS. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra. Information representation in computers. **Computer Network Fundamentals. Web development.**

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

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

Issue Date:	September 2015
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Module Title:	**WORKSHOP PRACTICE**
Code	TEGW3590
NQF Level	5
Contact Hours	2L + 1PS/Week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

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

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

1. Describe general safety procedures applicable to Engineering workshops.
2. Describe specific hand tools used in Engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Install air-conditioning and refrigeration systemsDescribe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

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

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

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

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams
4. Describe the various phase transformations in the Fe-Fe_3C phase system and associated microstructures
5. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Issue Date: September 2015

Next Revision: September 2019

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

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

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

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

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

Issue Date:	September 2015
Next Revision	September 2019

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

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

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

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

Issue Date:	September 2015
Next Revision:	September 2019

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS II**
Code	TEGM3512
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous (Quiz (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3591 Engineering Mathematics I

Content: Further Matrix Algebra: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **Further integration**: Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations**: Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Calculate eigenvalues and eigenvectors and relate them to Engineering solutions
2. Solve calculus problems using integration by parts and the reduction formula technique
3. Apply calculus to trigonometric functions to solve mathematical and Engineering problems
4. Solve Engineering problems using 1st order and 2nd order differential equations
5. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and Engineering problems

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Voltage and Current sources, source transformation. Ohm's law, Resistance, Resistor networks, Resistor coding, series and parallel, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, Superposition Theorem, Thevenin's Theorem, Power transfer, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance and mutual inductance, 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: Basics principles of a transformer, AC generator, DC motors, simple and three phase ac systems.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Distinguish between real and ideal voltage and current source
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving
3. Apply the principles of circuit analysis to series and parallel R, L, C circuits
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information
5. Describe the principles of a transformer and the basic AC generator and DC motors

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces. Distributed forces: centroids and centre of gravity; **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. **Center of Gravity and Centroid**.

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

1. Express force operations and force systems using vectors
2. Apply the laws of static equilibrium of forces
3. Produce a free body diagram from a specified Engineering problem
4. Analyse trusses using method of joints and method of sections
5. Apply principles of static and kinetic friction in solving Engineering problems
6. Calculate and plot bending moment and shear force distributions in beams

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 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 and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

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

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

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

YEAR 2 OF BSc IN 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	Continuous (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGM3512 Engineering Mathematics II
Pre-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:
1. Apply differential vector calculus to solve mathematical and Engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Apply functions of several variables in solving Engineering problems
4. Apply the power series method in approximation of solutions of ordinary differential equations
5. Describe the basis for complex analysis in Engineering problem solving
6. Apply the residual theorem to Engineering problems.

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).
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:
1. Develop algorithms and apply data structures in computer programs.
2. Apply binary trees to specific programming environment
3. Write programs in MATLAB or equivalent software employing user defined and built in functions.
4. Apply MATLAB (or equivalent software) programming in solving Engineering problems
5. Write simple C programs

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous (4 assignments 40%, 2 Tests 60%) 50%, Examination (1 x 2 hour paper) 50%
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:
1. Competently express motion of a body in terms of position, velocity and acceleration.
2. Apply principles of kinematics and kinetics to describe motion and causes of motion.
3. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, projectile and relative motion of particles and systems thereof.
5. Apply equations of motion in rectilinear and plane curvilinear motion.
6. Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
7. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Review of DC Circuits: Thevenin's and Nortons theorems, superposition theorem, concept of input and output resistance of network, single port networks, two-port networks, KCL, KVL, electric power, energy sources, sources transformations, power transfer, maximum power transfer, current and voltage divider theorems, Mesh and Node analysis; D.C. power supplies and their industrial use. **Sinusoidal Steady State Analysis**: AC. behavior in R, L and C elements. Phasor analysis with complex algebra, two terminal networks - impedance, 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:
1. Apply circuit On completing the course students should be able to:
2. Apply circuit theorems to simplify and find solutions to electrical circuits.
3. Interpret, develop and design electrical Engineering circuits
4. Use computer simulation tools for electric circuit analysis and design
5. Perform DC and AC power calculations including power factor correction;
6. Represent the total system response as a sum of a transient and steady state response and a natural and forced response;
7. Analyze, simulate, and experimentally validate DC and AC circuits;

Contribution to Exit Level Outcome:

2 Application of Sciencific and Engineering Knowledge (Course Outcomes 1, 2, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3)

Issue Date:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss the atomic structure of semiconductor materials
2. Discuss the construction and operation of semiconductor diodes.
3. Analyse and design diode based circuits.
4. Discuss the construction of BJT transistors
5. Analyse and design BJT transistor amplifier and switching circuits
6. Discuss the construction of FET transistors
7. Analyse and design FET biasing circuits
8. Discuss the internal circuitry for op-amps
9. Discuss the operation of op-amps
10. Analyse and design basic op-amp circuits
11. Use EDA software to analyse electronic circuits.

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

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

Issue Date: 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 (Quizzes (30%), 2 Tests (70%)) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III
Pre-requisite(s)	**TEGM3512 Engineering Mathematics II**

Content: Applications of second order ordinary differential equations with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, 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 **Integral**. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and Engineering applications. **Numerical methods**: Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations.

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Review of Vector Algebra: Classification of vector fields. **Electrostatics**: Coulomb Law and Field Intensity. Electric Field due to Continuous Charge Distribution. Electric flux density, Gauss Law, Maxwell Equations for static EM fields. Electric potential. **Electric Field in Material Space**: 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:
1. Perform calculations involving electric and magnetic fields
2. Describe how energy is stored in electric and magnetic fields
3. Explain the theories and applications of electromagnetic fields and waves in material space
4. Explain the physical meaning and significance of Maxwell's equations;
5. Describe electromagnetic time varying fields and waves, and their implications in modern communication systems
6. Derive and apply equations related to static electromagnetic fields in material space

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss fundamental digital terminology.
2. Perform different number systems and coding conversions.
3. Describe the operation of different logic gates.
4. Analyse and simplify logic equations
5. Analyse and design different combinational logic circuits
6. Analyse and design sequential logic circuits
7. Compare the performance of different logic family devices
8. Discuss and analyse the internal circuitry of different logic family technologies.
9. Design interfaces between circuits of different logic families.

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ELECTRICAL MACHINES
Code	TECP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 100% (2 assignments, 2 Practical Labs, 2 Tests)
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:

1. Demonstrate an understanding of the principle of operation of electrical machinery
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.
3. Describe the principle of operation and applications of transformers and AC windings
4. Describe the principle of operation and applications of three-phase induction machines

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015

Next Revision: September 2019

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

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

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

New: September 2016
Next Revision: September 2020

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

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

Learning Outcomes: Upon completion of this course, students should be able to:
1. Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design, construction, communication, mining, repairs, power generation, maintenance or Engineering services.
2. Discuss the major industrial processes involved in a typical Engineering activity associated with the students' discipline.
3. Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Issue Date: September 2015
Next Revision: September 2019

YEAR 3 OF BSc IN ELECTRICAL ENGINEERING

SEMESTER 1

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGR3760
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%)
Pre-requisite(s)	**EGS3661 Statistics for Engineers**

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

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

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

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

Issue Date:	September 2015
Next Revision:	September 2019

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

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

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

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title	**ELECTRIC CIRCUIT ANALYSIS II**
Code	TECE3791
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous (At least 2 assignments - 30%, At least 2 Tests - 70%) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TEGT3671 Engineering Mathematics III
Pre-requisite(s)	**TECE3691 Electric Circuit Analysis I**

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

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title	FUNDAMENTALS OF POWER SYSTEMS
Code	TECE3731
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%) 50%, Exam 50% (1 x 3 hour paper)
Co-requisite(s)	TECE3791 Electric Circuit Analysis II
Pre-requisite(s	**TECE3691 Electric Circuit Analysis I**

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:

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

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 3, 6, 8)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4, 7)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
9. Independent Learning Ability (Course Outcomes 5, 8)

Issue Date: September 2015
Next Revision: September 2019

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

Content: **Basic Machine Theory:** Emf generation in machines; distribution, coil span and winding factors; emf developed by distributed windings; development of rotating fields; torque developed; simple AC Windings, the per unit (pu) notation in power systems **Single and Three Phase Transformers:** Three Phase Transformer connections and phase shift; equivalent circuit; per unit notation and transformers in parallel. **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:
1. Design and conduct experiments, as well as to analyse and interpret data.
2. Design and implement practical product-oriented systems
3. Apply theoretical Engineering knowledge to practical designs.
4. Demonstrate an understanding of the operation of electrical machines in a power system network
5. Demonstrate understanding of the electromechanical energy conversion process
6. Design a system component of various electrical machines meet desired specifications within realistic constraints
7. Communicate the logic and detailed approach to problem solving.
8. Design a system component of various electrical machines or process to meet desired needs within realistic constraints
9. Demonstrate an ability to effectively communicate design concepts in a written report.
10. Demonstrate an understanding of the operation of electrical machines in a power system network
11. Apply Software Design tools

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	POWER ELECTRONICS	
Code	TECC3791	
NQF Level	7	
Contact Hours	3L + 2T or 1PS/Week	
NQF Credits	12	
Assessment	Continuous 50% (assignments, 2 Tests),	Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	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:
1. Describe the operation of diode and SCR based power electronic circuits
2. Demonstrate an understanding of the basic concepts of switched-mode power supplies and control principles
3. Analyze the steady state operating Characteristics of switching converters
4. Illustrate the operation and apply power electronic devices in Linear dc power supplies
5. Analyze the operation and application of switching converters in Switch mode power supplies
6. Design and implement practical power electronics circuits
7. Design and simulate simple converter circuits for particular applications

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

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

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

Contents: Entrepreneurial perspective: types of entrepreneurs, characteristics of entrepreneurs, examples of successful ventures for national development. Carrying out feasibility studies, writing business plans. Government policies on small business ventures. **Enterprising opportunities**: business motivation, competencies and skills, innovative ideas, product concept and description, market assessment. **Starting new business ventures**: the calculated risk, business planning and organization, management planning, financial projections, possible sources of finance, resource management, projected levels of growth and operations. **Change Management theory**. Group dynamics. **Management accounting**. **Marketing strategies**.

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

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

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11 Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019

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

Contribution to Exit Level Outcome:
2. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 5)
3. Engineering Design (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title	COMPUTER NETWORKS
Code	TCMH3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/week
NQF Credits	8
Assessment	Continuous (at least 2 Assignments – 20%, at least 2 Labs - 30%, at least 2 Tests 50) 50%, Examination 50% (1 x 2 hour paper)
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:
1. Discuss computer network layers
2. Compare the OSI model and the TCP/IP model
3. Understand the issues related to addressing between networks
4. Identify common security risks for Internet-connected computers.
5. Discuss how unauthorized access and virus infections can compromise network data and how denial-of-service (DoS) attacks operate.
6. Distinguish between the different threats to wireless network security and different types of security threats.
7. Identify and apply networking tools to troubleshoot, verify the operations of computer networks and to enforce network security.
8. Independently study and make a presentation on one emerging network technology.

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	POWER TRANSMISSION AND DISTRIBUTION
Code	TECT3792
NQF Level	7
Contact Hours	**3**L + 2T or 1PS/Week
NQF Credits	12
Assessment	50% continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%) Examinations 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; symmetrical components; parameters and equivalent circuits in symmetrical components for overhead and underground lines, transformers, generators and loads; substations; industrial networks; network steady-state analysis; faults; voltage and power static control; power system stability and methods of improving stability. Symmetrical components and fault calculations.

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

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

Content: Fundamentals of various sources of renewable energy and their applications: Solar (thermal and photovoltaic), fuel cells, 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:

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

Contribution to Exit Level Outcome:

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

ECN Exit Level Outcomes Assessed:

7 SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY

Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment.

Assessment Strategies

The assessment will constitute the following:

At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics in renewable energy technologies communication(**10%**), Examination (1 x 3 hour paper) making **50%**

To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 7 assessed in the presentation and the submitted report as follows:

ECN exit level outcome 7 – **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY.**

Where and how is this exit outcome assessed?

Students are expected to show critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. This exit level outcome will be assessed through a 3 hour exam paper concentrating on sustainability and impact of Engineering activity on the social, industrial and physical environment and how these aspects are considered in the Engineering analysis and design.

What constitute satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be allowed to take the supplementary exam, after which if the minimum competence is still not obtained, then the student is considered to have failed the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: 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% (at least 2 Assignments 20%, at least 3 Tests (covering the aspects: Law, Professionalism, Health and Safety) 80%).
Co-requisite(s)	TEGT3742 Entrepreneurship

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace.
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 7 (health and safety), 8)
10 Engineering Professionalism (Course Outcomes 1, 2, 3)

ECN Exit Level Outcomes Assessed:
10 ENGINEERING PROFESSIONALISM
Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies
The assessment will constitute the following:
Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).***Where and how is this exit outcome assessed?***

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitute satisfactory performance?
After consideration of the 3 tests and 2 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3891
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (at least 2 Assignments 20%, at least 2 Tests 30%, group project presentation 20% and group project report 30%). The group must consist of students from a minimum of two different disciplines.
Pre-requisite(s)	**TEGT3761 Fundamentals of Economics**

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation;
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team.

CONTRIBUTION to Exit Level Outcome:
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

8 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**
Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**
Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies
The assessment will constitute the following:
Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

<u>ECN Exit Level Outcome 8</u> - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?
Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitute satisfactory performance?
After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN Exit Level Outcome 11</u> - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?
Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding

of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitute satisfactory performance?
After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Discuss different control theory terminologies.
2. Model basic electrical systems as a control systems or part of parts of control systems.
3. Analyse given electrical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control Engineering.
4. Analyze and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Use Engineering software for modelling, analysis and design of control systems

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title	COMPUTATIONAL METHODS IN POWER ENGINEERING
Code	TECE 3891
NQF Level	8
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	100% continuous (at least 2 tests - 70%, at least 2 labs - 20%, at least 1 assignment - 10%)
Pre-requisite(s)	**TECE3731 Fundamental of Power Systems**,
Co-requisite(s)	(TECP3831 Power Systems Protection)

Content: Electric power system operation; development of models of transmission line components and networks; computer methods for solving linear and nonlinear systems of network equations; operating problems in load flow, scheduling and economic dispatch. Load flow analysis – classification of system variables and generation to B – Bus system. Load flow solution using Gauss-Seidel and Newton-Raphson methods. Computer-aided short circuit analysis of large systems; transient stability analysis; overvoltage calculations and power system protection. Power system stability and methods of improving stability, Application of software tools in modeling and simulation of power system networks (e.g.: CAD Electrical, MEP, DigiSilent, Power Factory, PSS, Power World and Herman–Beta Algorithm etc.).

Learning Outcomes: On completing the course students should be able to:
1. Perform the power system analysis using software package.
2. Use system models for unsymmetrical fault analysis and load flow studies
3. Demonstrate knowledge of major Engineering problems associated with building high power Engineering systems and how they are solved.
4. Use a range of software tools to synthesize electrical power systems

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

ECN Exit Level Outcomes Assessed:

2. **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**

Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies

The assessment will constitute the following: At least 2 Assignments and at least 2 Tests all making **50%,** Examination (1 x 3 hour paper) making **50%.** To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, basic science and Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the use of mathematical, numerical analysis and statistical knowledge and methods to bear on Engineering problems; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of Engineering science at a fundamental level and in at least one specialist area.

What constitute satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be allowed to take the supplementary exam, after which if the minimum competence is still not obtained, then the student is considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title	POWER SYSTEMS PROTECTION
Code	TECP3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 Assignments - 30%, At least 2 Tests - 70%), Exam 50% (1 x 3 hour paper)
Pre-requisite(s)	**TECE3791 Electric Circuit Analysis II**,

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

Learning Outcomes: On completing this course, students should be able to:

1. Illustrate the operation of a modern electricity network, under both steady-state and fault conditions, and the techniques used for network analysis and design
2. Describe the principles of switching and protection of power systems and components
3. Describe the protection equipment used in the switching and protection of electrical power systems,
4. Analyze the response of a power system to demand conditions and corrective measures for its control

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	MICROPROSSESSORS AND PROGRAMMABLE LOGIC CONTROLLERS
Code	TECP3851
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (Quizzes, 2 practical exercises, assignments, 2 Tests), Examination 50% (1 x 3 hour paper)

Pre-requisite(s) **TETD3692 Digital Electronics**

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

1. Plan and implement Memory organization including static and dynamic semiconductor memory, optical and magnetic memory, memory hierarchy and caches.
2. Design memory circuit for microprocessors.
3. Design input/output circuit for microprocessors.
4. Design interrupt generating circuit for microprocessor
5. Calculate exact execution time of programs.
6. Describe the architecture and principles of operation of PLCs
7. Demonstrate an understanding of IEC standard and languages
8. Describe the PLC programing techniques and languages
9. Design PLC Programs for PLC based control applications
10. Program and troubleshoot the PLC based control systems

Contribution to Exit Level Outcome:

1. Problem Solving (Course Outcomes 1, 10)
2. Application of Scientific and Engineering Knowledge (Course Outcomes 6, 7, 8)
3. Engineering Design (Course Outcomes 2, 3, 4, 9)
5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 10)

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

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

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

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

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

Contribution to Exit Level Outcome:

4. Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5. Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6. Professional and Technical Communication (Course Outcomes 5)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8. Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9. Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Demonstrate competence to formulate and conduct investigations and experiments.

5. ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

9. INDEPENDENT LEARNING ABILITY

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: one Seminar presentation (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 4, 5, 9 assessed as follows:

ECN Exit Level Outcome 4 - INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyze, interpret and derive information from data.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modeling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 9 – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. In the course of the research project, students are supposed to show their ability to engage in independent learning through well-developed learning skills and awareness of up-to-date tools, techniques and new developments in Engineering and technology as well as the need to access, comprehend and apply knowledge acquired outside formal instruction and guidance from the supervisor.

What constitute satisfactory performance?

After consideration of student's individual conduct in the course of the research project, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** The supervisor will be expected to give examples of cases where the student demonstrated independent learning skills in the course of the research project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report to beef up independently learned components, within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date:	September 2015
Next Revision:	September 2019

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

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

Learning Outcomes: On completing the course students should be able to:
1. Identify and formally state problems that can be solved using Engineering knowledge and skills.
2. Demonstrate practical skills in the design of Engineering components, assemblies and/or systems.
3. Demonstrate knowledge of creativity, innovation, safety, ergonomics and good Engineering practice in the design process.
4. Develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

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

ECN Exit Level Outcomes Assessed:

1. PROBLEM SOLVING

Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively.

3. ENGINEERING DESIGN

Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

6. PROFESSIONAL AND TECHNICAL COMMUNICATION

Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 1, 3, 6 assessed as follows:

ECN Exit Level Outcome 1 – PROBLEM SOLVING

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyze and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "***Problem Solving***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 – ENGINEERING DESIGN

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognize and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modeling and optimization.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with "***Engineering Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " ***Engineering Design***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "***Engineering Design***" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 6 - PROFESSIONAL AND TECHNICAL COMMUNICATION

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final design report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of design report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitute satisfactory performance?

After consideration of the section of the final design report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 60% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised design report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date:	September 2015
Next Revision:	September 2019

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

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

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

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

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Next Revision: September 2019

G.13. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS)

G.14. DEGREE NAME: BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (HONOURS) 19BMEE

G.15. 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.

G.16. 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 – 164 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 and 2	*Contemporary Social Issues*	UCSI3580	5	8	None
1	Fundamentals of Engineering	TEGT3521	*5*	8	None
Total Credits Semester I				***80***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics II	TEGM3512	5	16	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				***84***	

NB: Students who have done *UCSI3529, ULEA3519, SPHY3511, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN MECHANICAL ENGINEERING –136 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3512
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3661	6	8	**TEGM3591**
1	Strength of Materials I	TCVM3621	6	8	TEGT3592
1	Fluid Mechanics	TMEM3681	6	12	TEGT3592
1	Computer-Aided Drawing	TEGT3661	6	8	TCME3521 **TEGT3561**
Total Credits Semester III				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** & CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3512** 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
2	*HIV and the Organization*	TEGT3602	6	-	None
2	Industrial Attachment I	TEGT3600	6	-	None
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	Modelling and Analysis of Dynamic Systems	TMEM3781	7	12	TETA3622
1	Advanced Fluid Mechanics	TMER3721	7	8	**TMEE3611**
1	Mechanical Engineering Design II	TMER3781	7	12	TMEM3642
1	Experimental and Research Methods	TEGR3760	7	8	**TEGS3661**
1	Machine Tools	TMEM3721	7	8	**TEGT3592**
Total Credits Semester V				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** & CO-REQUISITE
2	Entrepreneurship	TEGT3742	7	8	TEGT3761
2	Thermodynamics and Heat Transfer	TMET3782	7	12	TMED3642
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**
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

YEAR 4 OF BSc IN MECHANICAL ENGINEERING – 140 CREDITS

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Society and the Engineer	TEGT3821	8	8	**TEGT3521** TEGT3742
1	Mechanical Vibrations	TMER3861	7	8	**TEGT3641**
1	Project Management	TEGM3881	8	12	**TEGT3761**
1	Renewable Energy	TMEE3841	8	8	**TMED3642**
1	Thermal Machines	TMEE3831	8	16	TMER3791
1	Fluid Machinery	TMEE3851	8	16	**TMEE3611**
1	Mechanical Engineering Design III	TMEM3821	8	8	**TMER3781**
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** & CO-REQUISITE
2	Research Project	TMER3892	8	30	All 3rd Year Modules TMER3792
2	Mechanical Engineering Design Project	TMED3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

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

G.17. 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: **Lines and planes**: Vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and number series**: the limit of a sequence, tests for convergence, absolutely convergent series. **Functions**: Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to Engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, polar graphs. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers**: definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Use standard equipment for technical drawing
2. Sketch Engineering components free hand or with the aid of drawing equipment
3. Present Engineering components as drawings in orthographic and isometric projections
4. Use sections, interpenetration and development to produce clear Engineering drawings
5. Produce parts drawings and assembly drawings of various Engineering components

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Employ units, do unit conversions and use of significant figures.
2. Solve problems regarding one and two dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton’s laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gases.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTING FUNDAMENTALS
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: Overview of common operating systems like Windows, Linux and Mac-OS. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra. Information representation in computers. **Computer Network Fundamentals. Web development.**

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

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

CONTRIBUTION to Exit Level Outcome

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Describe general safety procedures applicable to Engineering workshops.
2. Describe specific hand tools used in Engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Install air-conditioning and refrigeration systems
11. Describe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams
4. Describe the various phase transformations in the Fe-Fe_3C phase system and associated microstructures
5. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS /week
Credits	8
Assessment	100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)
Pre-requisites	None

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

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

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

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGM3512
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	16
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. **Further integration**: Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations**: Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Calculate eigenvalues and eigenvectors and relate them to Engineering solutions
2. Solve calculus problems using integration by parts and the reduction formula technique
3. Apply calculus to trigonometric functions to solve mathematical and Engineering problems
4. Solve Engineering problems using 1st order and 2nd order differential equations
5. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and Engineering problems

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Voltage and Current sources, source transformation. Ohm's law, Resistance, Resistor networks, Resistor coding, series and parallel, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, Superposition Theorem, Thevenin's Theorem, Power transfer, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance and mutual inductance, 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: Basics principles of a transformer, AC generator, DC motors, simple and three phase ac systems.

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

1. Distinguish between real and ideal voltage and current source
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving
3. Apply the principles of circuit analysis to series and parallel R,L,C circuits
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information
5. Describe the principles of a transformer and the basic AC generator and DC motors

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces. Distributed forces: centroids and centre of gravity;. **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. **Center of Gravity and Centroid**.

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

1. Express force operations and force systems using vectors
2. Apply the laws of static equilibrium of forces
3. Produce a free body diagram from a specified Engineering problem
4. Analyse trusses using method of joints and method of sections
5. Apply principles of static and kinetic friction in solving Engineering problems
6. Calculate and plot bending moment and shear force distributions in beams

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 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 and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

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

Contribution to Exit Level Outcome:

6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
9 Independent Learning Ability (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019

YEAR 2 OF BSC IN MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	50% (minimum 2 tests and 4 assignments) written examination 50% (1x3 hour paper)
Pre-requisite(s)	TEGM3512 Engineering Mathematics II
Co-requisite(s)	TEGM3512 Engineering Mathematics I

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

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

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).
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:

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

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	~~12~~ 8
Assessment	Continuous 50% (**At least 4** assignments and 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;

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

CONTRIBUTION to ECN Exit Level Outcome:
1 Problem Solving (Course Outcomes 2 and 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 5, 7 and 8)

Issue Date: September 2015

Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of this module, students should be able to:
1. Describe properties of fluids and conditions for relative equilibrium in fluids.
2. Categorize one-dimensional mass and momentum conservation and applications of Bernoulli's equation
3. Demonstrate skills for flow measurements
4. Solve general hydraulic systems with respect to energy changes, pipe friction, loss coefficient.

CONTRIBUTION to ECN Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4 and 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (2 tests 40%, 4 assignments 35%, mini – Project 25%)
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3561 Engineering Drawing

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

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

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

CONTRIBUTION to ECN Exit Level Outcome:

3 Engineering Design (Course Outcomes 1, 2, 3 and 4)

Issue Date: 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)	**TEGM3512 Engineering Mathematics II**
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Applications of second order ordinary differential equations with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, 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 Integral**. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrational and solenoidal fields, physical and Engineering applications. **Numerical methods**: Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations.

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

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

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcome 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3 and 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ENGINEERING THERMODYNAMICS
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:
1. Discuss the first law of thermodynamics and its applications to non-flow and flow processes.
2. Discuss and quantify the properties of working fluids.
3. Interpret and use thermodynamic property diagrams.
4. Apply the equation of state of a perfect gas.
5. Discuss the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	HIV AND THE ORGANIZATION
Code	TEGT3602
NQF Level	6
Contact Hours	1L + 1T per week for 14 weeks
NQF Credits	None
Assessment	Continuous assessment 100% (3 Assignments and 1 report)
Pre-requisite(s)	None

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

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

Issue Date: September 2016
Next Revision: September 2020

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:

1. Discuss the methodology for Engineering design
2. Discuss key features in the design of machine elements
3. Use codes of practice for mechanical Engineering and Mechanical Engineering drawing
4. Use Auto-CAD software in mechanical Engineering drawing and design
5. Discuss basic mechanisms used in machine design
6. Discuss the fundamentals of different methods of mechanism design, analysis and synthesis

CONTRIBUTION to ECN Exit Level Outcome:

3 Engineering Design (Course Outcomes 1, 2, 3, 4, 5 and 6)

Issue Date: September 2015
Next Revision: September 2019

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

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:

1. Distinguish between various classes of steels and cast irons and identify their specific characteristics
2. Describe key characteristics and typical applications of common non-ferrous metals and alloys
3. Demonstrate knowledge of Engineering polymers and plastics and discuss applications of such materials
4. Describe the characteristics and uses of traditional and technical ceramics and identify their superior properties.
5. Demonstrate knowledge of composition and characteristics of composite materials and describe the procedures for stress analysis in longitudinal and transverse loaded composites.

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015

Next Revision: September 2019

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

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

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

1. Demonstrate an understanding of the principle of operation of electrical machinery
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.
3. Describe the principle of operation and applications of transformers and AC windings
4. Describe the principle of operation and applications of three-phase induction machines
5. Demonstrate an understanding of special-purpose motors and VSDs.

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	MEASUREMENTS AND INSTRUMENTATION	
Code	TETA3622	
NQF Level	6	
Contact Hours	2L + 1T or 1PS/Week	
NQF Credits	8	
Assessment	Continuous 50% (assignments, 2 Tests),	Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGT3542 Fundamentals of Electrical Engineering** 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:
1. Explain different types and methods of measurements.
2. Describe static and dynamic characteristics of an instrument.
3. Explain the importance of signal generators and signal analyzers in measurements.
4. Classify, calculate errors and reduce them in measurements.
5. Describe the concept of instrument calibration.
6. Explain the use of sensors and transducers.
7. Practically measure different quantities (including high frequency signals), analyse and interpret the measurement results.
8. Describe the architecture and operation of PLCs

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Learning Outcomes: Upon completion of this course, students should be able to:
1. Develop the Organizational Structure of a typical industry involved with manufacturing, production, product/system design,
construction, communication, mining, repairs, power generation, maintenance or Engineering services.
2. Discuss the major industrial processes involved in a typical Engineering activity associated with the students' discipline.
3. Describe the major tools, equipment and machinery used in industry associated with activities in the students' discipline.

Revision: 2 September 2015
Next Revision: September 2019

YEAR 3 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	**MANUFACTURING TECHNOLOGY**
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)	TEGS3591 Materials Science

Content: Elastic and plastic behaviour of materials. Technology of sheet metal forming. Forging, extrusion, stretching, wire drawing, hot and cold forming and printing. Annealing and recrystallization. **Introduction to physico-mechanical basis of metal cutting.** Tool materials. **Metal casting processes**. Special smelting processes. Continuous casting. Ferrous and non-ferrous foundry practice. Defects in castings and how to avoid them. **Welding Processes**: Manual and automated systems. Welding of mild steels, stainless steels and aluminium alloys. Robotics in welding. Weld defects and how to avoid them. Brazing. **Advanced cutting techniques**. Use of water jet, compressed air, ultrasound; Electro erosion; Cutting by penetration with a wire. Electro-chemical dissolution treatment. **Powder metallurgy**, composite materials treatment. Surface Engineering. **Processing and 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:
1. Apply the knowledge of elastic and plastic behaviour of materials to metal forming, forging, extrusion, wire drawing and printing
2. Describe the processes of annealing and recrystallization
3. Describe the principles of metal cutting
4. Describe metal casting processes and basic foundry operations for ferrous and non-ferrous metals
5. Describe the various casting defects and how to control them.
6. Describe the principles of various welding processes used in Engineering and associated welding parameters
7. Describe the principles of non-conventional cutting techniques used in Engineering
8. Apply the knowledge of powder metallurgy to composite materials and to surface Engineering
9. Discuss the various techniques used in the processing and forming of plastics and rubber

CONTRIBUTION to ECN Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1 and 8)

5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 5, 6, 7 and 9)

Revision: 2	September 2015
Next Revision:	September 2019

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	MODELLING AND ANALYSIS OF DYNAMIC SYSTEMS
Code	TMEM3781
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper). To pass this module a student should obtain a minimum final mark of 50%
Pre-requisite(s)	**TEGT3671 Engineering Mathematics III**

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

Learning Outcomes: Upon completion of this module, students should be able to:
1. Discuss different control theory terminologies.
2. Model basic mechanical systems as a control systems or part of parts of control systems.
3. Analyse given mechanical systems or models, using transfer functions, state space methods and frequency response methods, to determine different characteristics required for control Engineering.
4. Analyses and design controllers and compensators, using Root Locus methods, frequency response methods and state space methods to meet set specifications.
5. Use Engineering software for modelling, analysis and design of control systems

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ADVANCED FLUID MECHANICS
Code	TMER3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests and 4 assignments or 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	**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:
1. Analyse boundary layer in fluid particles for internal and external flow conditions.
2. Analyse general two-dimensional potential flow.
3. Analyse and describe flow over aerofoil profile.

CONTRIBUTION to ECN Exit Level Outcome:
- 1 Problem Solving (Course Outcomes 1 and 2)
- 5 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2 and 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**MECHANICAL ENGINEERING DESIGN II**
Code	TMER3781
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous assessment 100% (2 tests, 4 assignments and 1 mini - Design Project)
Co-requisite(s)	TMEM3642 Mechanical Engineering Design I

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:

1. Design a range of machine elements as applicable to mechanical Engineering and present them as drawings and technical reports.
2. Apply the knowledge of tolerances, fits dynamic loading and power transmission in the design of assemblies

CONTRIBUTION to ECN Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcome 2)
3 Engineering Design (Course Outcome 1)
6 Professional and Technical Communication (Course Outcome 1)

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

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

CONTRIBUTION to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**MACHINE TOOLS**
Code	TMEM3721
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous assessment 100% (2 tests, 4 assignments and 1 mini - Design Project)
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:

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

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcome 2)

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 and 4)

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	THERMODYNAMICS AND HEAT TRANSFER
Code	TMET3782
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (3 tests, 3 assignments and 2 practical reports), written examination 50% (1x3 hour paper)
Co-requisite(s)	TMED3642 Engineering Thermodynamics

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:
1. Analyse vapour systems and perform calculations on steam, refrigeration and air conditioning
2. Analyse and perform calculations on heat pump systems
3. Illustrate the principles of forced and natural convection and perform calculations on the same
4. Illustrate the principles of heat radiation, heat insulation and appropriate insulation materials

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTER AIDED ENGINEERING AND MANUFACTURING
Code	TMER3782
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous assessment 100% (2 tests, 4 assignments and 1 mini - Design Project)
Pre-requisite(s)	**TEGT3661 Computer Aided Drawing**

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:
1. Differentiate various techniques of 3-D automated modelling
2. Outline the principles of computer aided design
3. Explain the main features of computer integrated manufacturing

CONTRIBUTION to ECN Exit Level Outcome:

3 Engineering Design (Course Outcome 2)

2 Engineering Methods, Skills, Tools and Technology (Course Outcomes 1 and 3)

Issue Date: September 2015
Next Revision: September 2019

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

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:
1. Analyse equilibrium of rigid bodies subjected to two and three dimensional force systems and demonstrate application to trusses, frames and machines.
2. Apply the method of virtual work for equilibrium and stability analysis.
3. Analyse and solve statically indeterminate problems.
4. Calculate area moments and products of inertia and apply them to mechanics problems.
5. Analyse thermal and assembly stresses
6. Analyse deflection of beams using integration, discontinuity functions and method of superposition.
7. Apply energy methods in stress and strain analysis, deflection and impact loading.
8. Describe and apply Castigliano's theorem to determine deflection of beams.
9. Analyse composite bodies using the principles of Engineering mechanics.
10. Describe design features of composite structures.
11. Analyse stresses in asymmetric solids including cylinders and rotating discs.
12. Describe general theories of failure and demonstrate an understanding of linear elastic fracture mechanics and failure criteria

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcome 3)

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8 and 11)

Issue Date: September 2015
Next Revision: September 2019

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

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:
1. Apply knowledge of mechanisms, electronics and computer technology to model mechatronic systems
2. Illustrate the principles of hydraulic servo systems
3. Outline the application of digital control in mechatronic systems
4. Design simple mechatronic systems or machines

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

CONTRIBUTION to ECN Exit Level Outcome:

1 Engineering Management (Course Outcomes 2 and 3)
1

Issue Date: September 2015
Next Revision: September 2019

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

Content: 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:

1. Illustrate the kinematic principles of rigid bodies and perform calculations on the motion of rigid bodies
2. Illustrate the kinetic principles of rigid bodies and perform calculations on plane kinetics
3. Apply the work-energy principle to describe the dynamics of rigid bodies

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course outcome 3)

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2 and 3)

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1 Distinguish the roles of technologists and technicians in an industrial setting and identify the associated reporting channels.

2 Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.

3 Describe the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: September 2019

YEAR 4 OF 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% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).
Co-requisite(s)	TEGT3742 Entrepreneurship

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

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace.** Impact of Engineering activity social, economic, cultural, environmental and sustainability.

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

1. Identify the role of various Engineering disciplines and societies
2. Paraphrase the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Illustrate the use of Engineering codes and standards
4. Justify general knowledge of procedural law, law of contracts, commercial law and employment law
5. Relate laws of arbitration
6. Classify technology policy on the acquisition of technological know-how
7. Summarise the strategies and methods for HIV/AIDS mitigation in the Engineering sector
8. Apply appropriate tools measuring the financial and social implication of HIV/AIDS on sector companies

CONTRIBUTION to ECN Exit Level Outcome:

8 Individual, Team and Multidisciplinary Working (Course Outcomes 4 and 6)
10 Engineering Professionalism (Course Outcomes 4 and 7)

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**MECHANICAL VIBRATIONS**
Code	TMER3861
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (2 tests, 2 assignments and 2 practical reports) written examination 50% (1x2 hour paper)
Pre-requisite(s)	**TEGT3641 Engineering Mechanics II**

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

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

1. Describe the fundamentals of vibration analysis
2. Distinguish between the various forms of vibration
3. Appraise the methods used to control vibration in practice including balancing techniques
4. Describe techniques used in vibration absorption

CONTRIBUTION to ECN Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group project, 1 Test, 4 assignments/case studies)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

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

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

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation.
2. Apply the processes, tools and techniques of project management in an Engineering context.
3. Discuss the principles of managing medium to large scale Engineering projects.
4. Discuss the principles of managing community-based development projects.
5. Discuss the concepts of close-out phases of the project life cycle.
6. Integrate and balance overall project management functions and apply available software tools for project management.
7. Manage projects in multidisciplinary environment using techniques from economics, business management and project management as an individual or a member of a team.

Contribution to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2 and 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5 and 7)

ECN Exit Level Outcomes Assessed:

10 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**

Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitute satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitute satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**RENEWABLE ENERGY**
Code	TMEE3841
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (2 Tests, 2 Assignments and 1 Mini - Project work)
Pre-requisite(s)	**TMED3642 Engineering Thermodynamics I**

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

Learning Outcomes: Upon completion of t8his module, students should be able to:

1. Analyse the benefits and limitation of using different renewable energy resources.
2. Differentiate the underlying concepts, theory and applications of different renewable energy resources.
3. Build simple photovoltaic arrays or thermal solar arrays to produce electric or thermal energy for different uses.
4. Demonstrate an understanding of energy mix and smart grid technology.
5. Analyse economic principles applied to power generation systems.

CONTRIBUTION to ECN Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 1, 2, 3, 4 and 5)

ECN Exit Outcomes Assessed:

The Exit Level Outcomes are defined as follows:

7. **Sustainability and Impact of Engineering Activity**.

Assessment Strategies

Continuous assessment 100% (2 tests, 2 assignments and 1 mini - Project work)

<u>ECN exit level outcome 7</u> - **Sustainability and Impact of Engineering activity.**

Where and how is this exit outcome assessed?

Students are expected to show critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. The Final Design Report should show evidence of the student's ability to consider the impact and benefits of the design on social, legal, health, safety and environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitute satisfactory performance?

After consideration of the section of the Final Design Report that deals with **Sustainability and Impact of Engineering activity** and with reference to how this knowledge are considered in the Engineering analysis and design considerations, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Sustainability and Impact of Engineering activity**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of final mark of 60% from tests, assignments and Mini-Project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	THERMAL MACHINES
Code	TMEE3831
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (3 tests, 3 assignments and 2 practical reports), written examination 50% (1x3 hour paper)
Pre-requisite(s)	**TMED3642 Engineering Thermodynamics I**

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

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

CONTRIBUTION to ECN Exit Level Outcome:
1 Problem Solving (Course Outcomes 3 and 5)
2 Application of Scientific and Engineering Knowledge (Course Outcome 1)
3 Engineering Design (Course Outcomes 4 and 6)

Issue Date: September 2015
Next Revision: September 2019

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

Content: **Momentum principles applied to fluids**. Jet propulsion. Design of fluid machinery: **Centrifugal and axial flow machines**, (pumps, turbines, compressors, blowers and fans), pipe-machine characteristics, cavitation, water hammer. One directional flow, continuity, momentum and energy equations for steady inviscid, compressible, isentropic flow, wave phenomenon. **Power hydraulics**. Nozzles and diffusers. Turbulent flow. Supersonic flow. Pressure and temperature measurements in compressible flows. Fluid power tools: hydraulic and pneumatic tools.

Tribology: Inclined and tilting hydrodynamic thrust bearings, journal bearings. Hydrostatic thrust bearings. Contact between rigid bodies. The friction and adhesion of metals. The friction of plastics and some other materials. **Wear**; mechanism of wear, effects of wear on surface quality. **Lubrication**; mechanism of lubrication, significance of lubrication film. **Selecting a lubricant**; greases, lubricating oils and special condition lubricants (high temperature, pressure etc.).

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

CONTRIBUTION to ECN Exit Level Outcome:
1 Problem Solving (Course Outcome 2)
2 Application of Scientific and Engineering Knowledge (Course Outcome 2)_
3 Engineering Design (Course Outcomes 1 and 6)
5 Engineering Methods, Skills, Tools and including Technology (Course Outcomes 3, 4 and 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**MECHANICAL ENGINEERING DESIGN III**
Code	TMEM3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (minimum 2 tests and 4 assignments or 2 assignments and 2 practical reports and mini project)
Pre-requisite(s)	**TMER3781 Mechanical Engineering Design II**

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

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

CONTRIBUTION to ECN Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4 and 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3 and 4)
3 Engineering Design (Course Outcomes 2, 4 and 6)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3 and 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4 and 6)
9 Independent Learning Ability (Course Outcomes 2 and 6)
10 Engineering Professionalism (Course Outcomes 4 and 7)

Issue Date:	September 2015
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YEAR 4 OF BSc IN MECHANICAL ENGINEERING

SEMESTER 2

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

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

Learning Outcomes: On completing the course students should be able to:
1. Demonstrate skills necessary to carry out a technological or Engineering investigation.
2. Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
3. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
4. Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Contribution to Exit Level Outcome:

4. Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5. Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6. Professional and Technical Communication (Course Outcomes 5)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8. Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**
Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively.

2 **APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE**
Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

4 **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYISI**
Demonstrate competence to formulate and conduct investigations and experiments.

6 **PROFESSIONAL AND TECHNICAL COMMUNICATION**
Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences the community at large.

Assessment Strategies

Continuous Assessment 100% (Progress report presentation 20%; Final Oral Presentation of Research Report 20%; Final Research Report 60%).

To pass this course a student should obtain a minimum final mark of 60% and also meet the requirement of ECN exit level outcomes 4, 5 and 6 assessed in the final research report in the section dealing with the corresponding outcome.

The assessment for each of the outcomes 1, 2, 4 and 6 shall be as follows:

<u>ECN Exit Level Outcome 1</u> - PROBLEM SOLVING.

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyse and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyse and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “Problem Solving” in a manner that is considered: “*not satisfactory”, “satisfactory” or* ***“****excellent****”.*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “Problem Solving” in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 2 – APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, natural sciences, and Engineering fundamentals and to solve complex Engineering problem from first principles during their research projects where they are expected to solve mechanical Engineering problems.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with **Application of Scientific and Engineering Knowledge**, and with reference to demonstrate competence to apply knowledge of mathematics, natural sciences, Engineering fundamentals and to solve complex Engineering problem from first principles, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “**Application of Scientific and Engineering Knowledge**” in a manner that is considered: “*not satisfactory”, “satisfactory” or* ***“****excellent****”.*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “**Application of Scientific and Engineering Knowledge**” in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course

ECN Exit Level Outcome 4 - INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student’s ability to plan and conduct investigations and experiments using appropriate equipment as well as analyse, interpret and derive information from data.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “**Investigations, Experiments and Data Analysis**” in a manner that is considered: “*not satisfactory”, “satisfactory” or* ***“****excellent****”.*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “**Investigations, Experiments and Data Analysis**” in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 6 - PROFESSIONAL AND TECHNICAL COMMUNICATION

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final research report should show evidence of the student’s ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of research report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitute satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “**Professional and Technical Communication**” in a manner that is considered: “*not satisfactory”, “satisfactory” or “excellent”.* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “**Professional and**

Technical Communication" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: 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:

1. Identify and formally state problems that can be solved using Engineering knowledge and skills.
2. Demonstrate practical skills in the design of Engineering components, assemblies and/or systems.
3. Demonstrate knowledge of creativity, innovation, safety, ergonomics and good Engineering practice in the design process.
4. Develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

Contribution to Exit Level Outcome:

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

ECN Exit Level Outcomes Assessed:

3 **PRACTICAL KNOWLEDGE OF ENGINEERING DESIGN AND SYNTHESIS**
Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

5 **ENGINEERIG METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**
Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

9 **INDEPENDENT LEARNING ABILITY**
Demonstrate competence to engage in independent learning through well-developed learning skills.

10 **ENGINEERING PROFESSIONALISM**
Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies
The assessment will be **100% Continuous** constituting of the following:
Two Seminar Presentations of design (**20%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**60%**)]

To pass this module a student should obtain a minimum final mark of 50% and also meets the ECN exit level outcome 1, 3, 6 assessed as follows:

<u>ECN exit level outcome 3</u> – PRACTICAL KNOWLEDGE OF ENGINEERING DESIGN AND SYNTHESIS.
The student's competency of Engineering problem solving ability shall be accessed:
By the supervisor completing an assessment form indicating whether the student has demonstrated evidence in "practical knowledge of Engineering design and synthesis" in a manner that is considered: ***not satisfactory, satisfactory or excellent,*** based on the mark awarded by the examiners to the student on the section dealing with "practical knowledge of Engineering design and synthesis". The student is expected to obtain a minimum of 50% of the maximum mark allocated to the section dealing with this outcome in the submitted final design report before he or she is declared to have met the requirement of this competency satisfactorily.

<u>ECN Exit Level Outcome 5</u> - ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN Exit Level Outcome 9</u> – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. This will be assessed through tests, individual assignments, presentations and report writing, set in a way that allows evidence of the student's ability to engage in independent learning through well-developed learning skills showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology as well as need to access, comprehend and apply knowledge acquired outside formal instruction to be evaluated.

What constitute satisfactory performance?

The lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a sub-minimum average continuous assessment mark of 50% before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

<u>ECN Exit Level Outcome 10</u> – ENGINEERING PROFESSIONALISM

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitute satisfactory performance?

After consideration of the 3 term papers, 3 tests and 3 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "not satisfactory", "satisfactory" or "Excellent". The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

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

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

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

Issue Date: September 2015
Next Revision: September 2019

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

I. DEGREE NAME: BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING (HONOURS) 19BMLE

J. 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. CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Metallurgical Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study (semester **I** and **II**) is common to all Engineering disciplines. In Year 2, 3 and 4 (semesters **III** to **VII**), all students in this degree programme take the same discipline-specific modules and a few common modules. Semester VIII is fully dedicated to Research and Design Projects and thus has no taught modules.

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

YEAR 1 OF BSc IN METALLURGICAL ENGINEERING – 164 Credits

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 and 2	*Contemporary Social Issues*	UCSI3580	5	8	None
1	Fundamentals of Engineering	TEGT3521	*5*	8	None
Total Credits Semester I				***80***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics II	TEGM3512	5	16	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				***84***	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN METALLURGICAL ENGINEERING – 140 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3512
1	Computer Science for Engineers	TCME3621	6	8	**TCME3521**
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3661	6	8	**TEGM3591**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
1	Metallurgical Thermodynamics I	TMLX3691	6	12	SCHM3512
1	Introduction to Process Metallurgy	TMLX3641	6	8	SCHM3512
Total Credits Semester III				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3512** 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	TMLM3662	6	12	TEGS3591
2	Electrical Machines	TECP3622	6	8	**TEGT3542**
2	Computer Applications in Metallurgy	TMLM3642	6	8	TCME3621
2	HIV and AIDS Education	TEGT3602	6	-	None
	Industrial Attachment I	TEGT3600	6	-	**TEGT3590**
Total Credits Semester IV				**72**	

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING – 144 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Experimental and Research Methods	TEGR3760	7	8	**SSTS3691**
1	Fundamentals of Economics	TEGT3761	7	8	None
1	Hydrometallurgy and Electrometallurgy	TMLM3731	7	16	TMLX3641
1	Transport Phenomena and Rate Processes	TMLX3731	7	16	TMLP3622
1	Mechanical Behaviour of Materials	TMLN3791	7	12	TEGS3591
1	Non-metallic Materials	TMLC3791	7	12	TEGS3591
Total Credits Semester V				**72**	
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	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	TEGT3742
1	Project Management	TEGM3881	8	12	**TEGT3761**
1	Mineral Processing Technology II	TMLX3831	8	16	TMLP3692
1	Metallurgical Production Processes	TMLM3851	8	16	TMLN3791
1	Ferrous Extractive Metallurgy	TMLF3891	8	12	TMLX3641
1	Process Modelling and Control	TMLL3891	8	12	TMLN3732
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	
2	Research Project	TMLR3892	8	30	All 3rd Year Modules
2	Metallurgical Design Project	TMLD3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

Total credits for the Degree of BSc in Metallurgical Engineering (Honours) **588**

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

YEAR 1 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

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

Content: Lines and planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and number series**: the limit of a sequence, tests for convergence, absolutely convergent series. **Functions**: Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to Engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, polar graphs. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers**: definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

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

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

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

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

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

1. Use standard equipment for technical drawing
2. Sketch Engineering components free hand or with the aid of drawing equipment
3. Present Engineering components as drawings in orthographic and isometric projections
4. Use sections, interpenetration and development to produce clear Engineering drawings
5. Produce parts drawings and assembly drawings of various Engineering components

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTING FUNDAMENTALS
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: **Overview of common operating systems** like Windows, Linux and Mac-OS. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra. Information representation in computers. **Computer Network Fundamentals. Web development.**

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

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

CONTRIBUTION to Exit Level Outcome

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Describe general safety procedures applicable to Engineering workshops.
2. Describe specific hand tools used in Engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Install air-conditioning and refrigeration systems
11. Describe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams
4. Describe the various phase transformations in the Fe-Fe_3C phase system and associated microstructures
5. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision September 2019

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS /week
Credits	8
Assessment and	100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, Tests 40%)
Pre-requisites	None

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

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

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

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGM3512
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. **Further integration**: Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations**: Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Calculate eigenvalues and eigenvectors and relate them to Engineering solutions
2. Solve calculus problems using integration by parts and the reduction formula technique
3. Apply calculus to trigonometric functions to solve mathematical and Engineering problems
4. Solve Engineering problems using 1st order and 2nd order differential equations
5. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and Engineering problems

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100% (2 Tests 60%, 2 Quizzes (20%) and 2 Practical Reports (20%)
Pre-requisite(s)	None

Content: Voltage and Current sources, source transformation. Ohm's law, Resistance, Resistor networks, Resistor coding, series and parallel, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, Superposition Theorem, Thevenin's Theorem, Power transfer, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance and mutual inductance, 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: Basics principles of a transformer, AC generator, DC motors, simple and three phase ac systems.

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

1. Distinguish between real and ideal voltage and current source
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving
3. Apply the principles of circuit analysis to series and parallel R,L,C circuits
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information
5. Describe the principles of a transformer and the basic AC generator and DC motors

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

Content: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces, buoyancy. Distributed forces: centroids and centre of gravity; Pappu's second moment. **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. **Centre of Gravity and Centroid**.

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

1. Express force operations and force systems using vectors
2. Apply the laws of static equilibrium of forces
3. Produce a free body diagram from a specified Engineering problem
4. Analyse trusses using method of joints and method of sections
5. Apply principles of static and kinetic friction in solving Engineering problems
6. Calculate and plot bending moment and shear force distributions in beams

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 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 and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

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

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

Issue Date: September 2015
Next Revision: September 2019

YEAR 2 OF BSc IN 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)	TEGM3512 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:
1. Apply vector calculus to solve mathematical and Engineering problems
2. Use Laplace and Fourier transforms in solving differential equations
3. Describe the basis for complex analysis in Engineering problem solving
4. Apply the residual theorem to Engineering problems

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

Issue Date: September 2015
Next Revision: September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (at least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).
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:
1. Generate data structures and algorithms
2. Apply binary trees to specific programming environment
3. Demonstrate knowledge of MATLAB programming
4. Create and use user-defined MATLAB functions
5. Apply MATLAB programming for solving Engineering problems
6. Write simple C programs

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

Issue Date: September 2015
Next Revision: September 2019

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

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (at least 4 assignments (40%) and 2 Tests (60%)), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

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

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

Contribution to Exit Level Outcome:

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

September 2015: September 2015
Next Revision: September 2019

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100%(2 Tests (40%), 1 Mini-project (25%), 4 Assignments (35%))
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	**TEGT3561 Engineering Drawing**

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

Learning Outcomes: Upon completion of this module, students should be able to:
1. Competently use commands and symbols in the computer drawing environment.
2. Create or use standard objects to make Engineering drawings with AUTOCAD
3. Merge text and dimensions with drawings generated from AUTOCAD
4. Make layouts and plot drawings created by AUTOCAD

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

Issue Date: September 2015
Next Revision: September 2019

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

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:

1. Describe the concepts of thermodynamic variables, such as enthalpy, entropy, heat capacity
2. Calculate enthalpies of formation, and of reactions
3. Ability to carry out energy balance of metallurgical processes
4. Evaluate the feasibility of potential reactions from thermodynamic data
5. Apply Raoult's and Henry's laws to solve thermodynamic problems
6. Apply the concepts of partial and excess molar quantities

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**INTRODUCTION TO PROCESS METALLURGY**
Code	TMLX3641
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**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 concepts of extractive metallurgy (*pyrometallurgy, hydrometallurgy and electrometallurgy*) – roasting, smelting, converting, leaching, precipitation processes, Faraday's law of electrolysis, electrowinning and refining.

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

1. Convert between different systems of units
2. Solve heat and mass balance problems
3. Illustrate the unit processes involved in extractive metallurgy

Contribution to Exit Level Outcome:

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

Issue Date: 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)	**TEGM3512 Engineering Mathematics II**
Co-requisite(s)	TEGT3671 Engineering Mathematics III

Content: Applications of second order ordinary differential equations with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, 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 **Integral**. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and Engineering applications. **Numerical methods**: Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations.

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

Contribution to Exit Level Outcome:

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

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	METALLURGICAL THERMODYNAMICS II
Code	TMLP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	**TMLX 3691 Metallurgical Thermodynamics I**
Pre-requisite(s)	**SCHM3512 Chemistry 1B**

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. Solubility, solubility product and the effect of acidity. The Pourbaix diagram and its application.

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

Contribution to Exit Level Outcome:

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

Issue Date: September 2015
Next Revision: September 2019

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

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:
1. Outline the role of comminution in liberation of minerals
2. Describe the principles of concentrating valuable minerals
3. Explain the principles involved in solid-liquid separation
4. Analyze unit operations in mineral processing.
5. Design simple flowsheets for mineral processing

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

Issue Date: 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% (At least 2 assignments, 2 Tests), Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	PHYSICAL METALLURGY I
Code	TMLM3662
NQF Level	6
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

Content: Introduction to the branches of Physical Metallurgy. **Crystal defects in metals:** dislocation lock, dislocation pile up, Hall Petch relation, grain boundary structure. **Plastic deformation of pure metals:** Mechanisms (slip and twin), critical resolved shear stress, single crystal tensile test (fcc), theoretical strength of ideal crystal. **Cold working and Annealing:** Recovery, recrystallization and grain growth. **Precipitation from super-saturated solid solution:** Thermodynamics and 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. **Applications of physical metallurgy:** Strengthening mechanisms, strength vs. toughness (ductility).

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

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

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**COMPUTER APPLICATIONS IN METALLURGY**
Code	TMLM3642
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 100% (4 Lab Exercises, 4 Assignments, 2 Tests, and 1 Mini-project)
Pre-requisite(s)	**TCME3621 Computer Science for Engineers**

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

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

1. Solve metallurgical problems using relevant software packages
2. Apply Advanced Microsoft Excel in Metallurgical processes

Contribution to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2)
9 Independent Learning Ability (Course Outcomes 1, 2)

Issue Date: September 2015
Next Revision: September 2019

Module Title	**HIV AND AIDS EDUCATION**
Code	TEGT3602
NQF Level	6
Contact Hours	1 L+1T per week for 14 weeks
NQF Credits	**None**
Assessment	Continuous assessment 100% (3 Assignments and 1 report)
Pre-requisite(s)	None

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

Learning outcomes: Upon completion of the module students should be able to:

1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis
4.

Issue Date: September 2015
Next Revision: September 2019

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

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

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

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

Revision: 2 September 2015
Next Revision: September 2019

YEAR 3 OF BSc IN METALLURGICAL ENGINEERING

SEMESTER 1

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

Content: Experimentation planning and execution. **Technical report writing**. Report structure and format. **Literature Review**: Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis: Data description**: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. **Data modeling**: Experimental data modelling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination R^2 and adjusted R^2 and the role of adjusted R^2 on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

Research Proposal: During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

Learning Outcomes: On completing the course students should be able to:
1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an Engineering research process
7. Propose an Engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an Engineering audience following specified guidelines

CONTRIBUTION to Exit Level Outcome:

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	FUNDAMENTALS OF ECONOMICS
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T/Week
NQF Credits	8
Assessment	Continuous 50% (4 assignments, 2 Tests); Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Content: Microeconomics: elements of economics; demand and supply; elasticity; applied market analysis; utility; competition and monopoly; labour markets. **Macroeconomics**: inflation and the business cycle; Keynesian aggregate demand; money and interest rates; central banking and monetary policy; world trade and the balance of payments; unemployment. **Financial accounting**: nature of costs, product costing, cost accounting, profit-volume relationships, and financial statements. **Introduction to budgeting. Introduction to marketing**. Long and short-term decision making.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	HYDROMETALLURGY AND ELECTROMETALLURGY
Code	TMLM3731
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	TMLX3641 Introduction to Process Metallurgy

Content: Unit processes of hydrometallurgy: Overview pre-treatment, leaching, purification and recovery processes in hydrometallurgy. **Thermodynamics and kinetic aspects:** Thermodynamics of aqueous systems, Pourbaix diagrams; Kinetics of heterogeneous reactions: leaching reactions; Nernst model, hydrodynamic theory; modelling of leaching kinetics (shrinking particle and shrinking core models). **Leaching practice and processes**: leaching agents, oxidizing and reducing agents; Percolation, agitation, heap and in-situ leaching of various mineral groups; leaching processes for refractory ores, pressure leaching, bioleaching. **Purification of leach liquors**: Ion exchange; theory, resin composition and properties, equilibria, kinetics, practice of IX, Adsorption; Use of activated carbon, properties, loading, desorption and regeneration, practical applications in Ag and Au: CIP/CIL/CIS processes, Solvent extraction; partition between immiscible liquids, extraction mechanisms, extraction equilibria and kinetics, Solvent extraction techniques and practice for uranium and copper. **Precipitation processes for metal recovery:** Chemical precipitation methods for various anions; Reductive precipitation methods, cementation; hydrogen reduction methods; Application of precipitation methods in reclamation of metals from waste effluents. **Electrolytic processes for metal recovery:** Principles of cathodic reduction in electrolytic cells; Tafel equations; Electro-winning; cell and electrode configuration, electrolyte movement, practical applications for selected metals; SX-EW circuits; Electro-refining: Principles, electro-refining of selected metals; Use of fused salt electrolytes.

Reactor design and synthesis of hydrometallurgical plants: Hydrometallurgical reactors and their classification (BR, PFR, CSTR etc); Design of ideal batch reactors and steady state mixed flow reactors; Design of steady state plug flow reactors and their applications in metallurgical processing plants; Case studies on synthesis of full scale hydrometallurgical operations for selected metals. **Hydrometallurgy of Rare Earth Elements (REE)**

Learning Outcomes: On completing the course students should be able to:
1. Explain the unit processes involved in hydrometallurgical extraction of metals.
2. Apply knowledge of thermodynamics to select leaching agents and develop leaching routes for given mineral ores
3. Develop and apply leaching kinetic models
4. Identify and apply suitable purification and metal recovery method for given leach liquors
5. Design reactors needed for specific hydrometallurgical operations from available data
6. Synthesize information from full-scale hydrometallurgical plants for selected metals.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 3)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 5, 6)
6 Professional and Technical Communication (Course Outcomes 3,5, 6)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**TRANSPORT PHENOMENA AND RATE PROCESSES**
Code	TMLX3731
NQF Level	7
Contact Hours	4L + 2T or 1 PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP3622 Metallurgical Thermodynamics II**

Content: Momentum Transfer: Steady and Unsteady Flows; Overall mass, energy and momentum balance; Navier-Stokes equations; Newton's Law, Non-Newtonian Fluids; Laminar flow in falling film, flow through conduits etc; Inviscid fluid flow, Viscous flow, Laminar and Turbulent Boundary Layer Theory, Friction Factor; Flow past immersed objects, packed and fluidized bed. **Mass Transfer:** Steady state mass transfer and diffusion; molecular diffusion in gasses, liquid, biological gels and solids; Unsteady state mass transfer under different conditions, mass transfer coefficient, diffusion through porous medium and capillaries; Boundary layer flow and turbulence in mass transfer, Simulation heat, mass and momentum transfer. **Heat Transfer**: **Conduction**: Steady State: One Dimensional- Composite wall and cylinder; Multidimensional- Differential heat balance, shape factor, graphical and numerical methods. **Unsteady State**: Analytical solutions of one dimensional lumped heat capacity system, heat flowing semi-infinite solid, convection boundary conditions, Heisler chart solutions. **Convection**: Natural and forced convection, overall heat transfer coefficient, fouling factor, types of heat exchanges. **Radiation**: Physical mechanism, radiation properties, shape factor, heat exchange between non-black bodies, infinite parallel planes, radiation shields, gas radiation. Application of transport phenomena in modelling and simulation: theory of similarity and dimensional analysis, case studies; some case studies of mathematical modelling in metallurgical systems – gas stirred ladle, continuous casting etc. **Principles of Metallurgical kinetics**; reaction rates and mechanisms, homogeneous and heterogeneous systems.

Learning Outcomes: On completing the course students should be able to:
1. Establish the principles of metallurgical kinetics
2. Calculate concentration gradients and reaction rates of metallurgical reactions
3. Evaluate the turbulent flow of fluids
4. Describe the concept of viscosity in fluid dynamics
5. Discuss the principles of momentum transfer
6. Explain the different modes of mass and heat transfer
7. Categorize the different types of interface reactions
8. Apply principles of chemical kinetics and transport phenomena to metallurgical processes
9. Solve process and materials related problems using rate phenomena principles

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 9)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 4, 5, 6, 7)
3 Engineering Design (Course Outcomes 8)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 8, 9)

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	MECHANICAL BEHAVIOUR OF MATERIALS
Code	TMLN3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 Assignments, Labs, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLM 3692 Physical Metallurgy I**

Content: Introduction to deformation behaviour: Concept of stresses and strains, Engineering stresses and strains. **Elasticity Theory:** stress and strain tensor, tensor transformation, principal stress and strain, elastic stress-strain relation. **Yielding and Plastic Deformation:** yield criteria and yield surface, texture and distortion of yield surface., Limitation of Engineering strain at large deformation, true stress and true strain, effective stress, effective strain, flow rules, strain hardening, Ramberg-Osgood equation, stress -strain relation in plasticity. **Microscopic view of plastic deformation:** crystals and defects, classification of defects, thermodynamics of defects, geometry of dislocations, slip and glide, dislocation generation – Frank-Read and grain boundary sources, stress and strain field around dislocations, force on dislocation - self-stress, dislocation interactions, partial dislocations, twinning, dislocation movement and strain rate, deformation behaviour of single crystal, critical resolved shear stress (CRSS), deformation of polycrystals and other strengthening mechanisms, grain size effect and Hall-Petch equation. **Fracture, Fatigue and High temperature deformation of materials.**

Learning Outcomes: On completing the course students should be able to:
1. Explain the deformation processes and their applications.
2. Analyse the mechanisms of deformation in materials.
3. Discuss the strengthening mechanism in materials; and
4. Predict fracture and fracture mechanisms in materials.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 3, 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	NON-METALLIC MATERIALS
Code	TMLC3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (2 assignments, 2 practical reports and 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TEGS3591 Materials Science**

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, moulding, 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 fibres, 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:
1. Explain the various classes of Engineering materials.
2. Evaluate the properties and applications of various Engineering materials.
3. Apply the knowledge of the fabrication and characterization techniques of various Engineering materials.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3 Engineering Design (Course Outcomes 3)

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

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:
1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Discuss the methods used to carry out feasibility studies
3. Develop a business plan relating to an Engineering endeavor
4. Discuss the concepts of motivation, competencies, innovation and product marketing
5. Describe the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11 Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	NON-FERROUS PYROMETALLURGY
Code	TMLF3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX3641 Introduction to Process Metallurgy**
Pre-requisite(s)	**TMLX 3691 Metallurgical Thermodynamics I**

Content: General methods of extraction: Pre-treatment processes – calcinations, roasting and agglomeration. Extraction Processes – smelting and refining: Basic approaches, preparation of pure compounds, purification of crude metal produced in bulk. **Construction and application of Predominance/stability diagrams** (Kellogg-Basu diagrams) for extraction of metals. **Extraction of metals from oxide sources**: (Basic approaches and special features of specific extraction processes, extraction of metals such as magnesium, lead, tin. **Extraction of metals from sulphide ores:** (Pyrometallurgy of sulphides, production of metals such as copper, lead, zinc, nickel etc.). **Slag chemistry, refractories and fluxes**. Pyrometallurgy of Rare Earth Elements (REE). **Environmental Management:** Management of solid and liquid waste; reprocessing of dumps; processing and recovery of toxic metals. Particulate and gaseous emissions control. Codes of practice and legislation governing the Metallurgical industry in Namibia and the SADC region.

Learning Outcomes: On completing the course students should be able to:
1. Summarise the general methods of metal extraction and refining.
2. Apply thermodynamics and kinetics principles to solve high temperature processing problems.
3. Explain the various pre-treatment and smelting unit processes.
4. Analyse pyrometallurgical methods of extracting non-ferrous metals and illustrate them with appropriate flowsheets.
5. Discuss the impact of metallurgical processes on the environment
6. Apply relevant techniques to reduce the impact of hazardous substances on the environment
7. Analyse the health and safety issues, and relevant legislation governing metallurgical industries locally and regionally
8. Value the concept of sustainability

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 2, 3, 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 6, 7)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 6, 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6, 7, 8)
Issue Date: September 2015
Next Revision: September 2019

Module Title:	CORROSION AND WEAR
Code	TMLM3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP3622 Metallurgical Thermodynamics II**

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:

1. Identify the common corrosion processes
2. Explain the principles of electrochemistry and corrosion
3. Recommend processes to reduce or avoid corrosion
4. Identify the different wear mechanisms
5. Manipulate the interplay between abrasive forces and wear in specific environments
6. Recommend processes to reduce wear.
7. Predict suitable materials on the basis of corrosion and wear.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2, 3, 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 6, 7)
3 Engineering Design (Course Outcomes 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4, 6, 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 1, 5, 6, 7)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	METALLURGICAL PROCESS DESIGN
Code	TMLN 3752
NQF Level	7
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP 3692 Mineral Processing Technology I**

Content: Fundamental principles of design: Process design criteria. **Design of metallurgical processing systems**. **Method of estimating process cost and profitability**. Translation of process design to plant design. Process flow sheet. Plant flow sheet. The application of fundamental metallurgical principles to the design process which includes thermodynamics, rate phenomena, unit operations and pilot plant design. **Design stages**: laboratory scale, pilot plant and industrial scale. Introduction to modeling and simulation as applied to metallurgical processes. Selection and design of process. General characteristic of metallurgical processing equipment. Integration of process units into a working plant, its construction and operations. **Case studies on design of metallurgical equipment**: furnaces, ball mills, sintering plant, metal forming mills, flotation cell etc. Feasibility of design including energy requirements for new plant design.

Learning Outcomes: On completing the course students should be able to:

1. Apply process Engineering and materials Engineering principles to the design of metallurgical processes;
2. Assess design cost of metallurgical processes; and
3. Design a process or plant for a specific metallurgical operation

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2)
3 Engineering Design (Course Outcomes 3)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3)
6 Professional and Technical Communication (Course Outcomes 3)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
8 Individual, Team and multi-discipline Working (Course Outcomes 2, 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	FUELS, FURNACES AND REFRACTORIES
Code	TMLC3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 Assignments, 2 Tests, Presentation and Technical Report) 50%, Examination 50% (1 x 3 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:
1. Appraise the various types of fuels, furnaces and refractories used in metallurgical industries.
2. Explain the properties of various metallurgical fuels, furnaces and refractories
3. Distinguish coal proximate analysis from the ultimate analysis and report coal analysis on moist basis, dry basis, dry mineral-matter-free basis, and moist mineral-matter-free basis.
4. Select appropriate fuels, furnaces and refractories for different metallurgical processes.
5. Relate the environmental impacts of burning fossil fuels and remediation strategies for the impacts
6. Analyse combustion processes and calculate air requirements
7. Evaluate processes for production of secondary fuels from coal
8. Predict properties and composition of refractories from the phase diagrams

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 4, 6, 7, 8)
3 Engineering Design (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 6, 7, 8)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5)

ECN Exit Outcomes Assessed:

7. SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY

Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment.

Assessment Strategies

Continuous (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

To pass this module a student should obtain a minimum final mark of 50%

At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics on the selection of appropriate fuels, furnaces and refractories for different metallurgical processes and the environmental impact of such selected fuels (**10%**), Examination (1 x 3 hour paper) making **50%**

To pass this course a student should obtain a minimum CA of 50% to qualify for the examination and a sub-minimum of 40% from the examination in order to meet the requirement of ECN exit level outcome 7.

ECN exit level outcome 7 – **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY.**

Where and how is this exit outcome assessed?

Students are expected to show critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. The presentation and report should show evidence of the student's ability to consider the impact and benefits of the selected fuel, furnace and refractories for the particular metallurgical process on social, legal, health, safety and environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitute satisfactory performance?

After consideration of the tests, assignments, presentation and submitted report, and with reference to evidence showing awareness of **Sustainability and Impact of Engineering activity** and how this knowledge is considered in the Engineering analysis and design considerations, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Sustainability and Impact of Engineering activity**" in a manner that is considered: "*not satisfactory", "satisfactory" or "**Excellent".*** In addition, the student is expected to obtain a minimum CA of 50% before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

Quality Assurance Arrangements

The evaluation and improvement of the quality and standards of teaching and learning will be by internal and/or external moderation of examination scripts and marked examination scripts, student evaluation, etc.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**PHYSICAL METALLURGY II**
Code	TMLX3762
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMLM3692 Physical Metallurgy I**

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: Carburizing (pack, liquid and gas); nitriding, carbonitriding, cyaniding, chromizing and boronizing. 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:
1. Predict the relationship between structure, properties and performance of metallic materials.
2. Discuss the solid state transformations in metals and alloys.
3. Explain the strengthening mechanisms in metals and alloys.
4. Manipulate the properties of cold worked materials by recovery and recrystallization processes.
5. Illustrate the process of precipitation hardening of non-ferrous alloys
6. Apply the transformation diagrams to predict structure of ferrous alloys;
7. Explain the use of thermochemical and thermomechanical treatment for structural modification of ferrous alloys.
8. Discuss the various heat treatment procedures for non-ferrous alloys.

Contribution to Exit Level Outcome:

2	Application of Scientific and Engineering Knowledge (Course Outcomes 1- 8)
4	Investigations, Experiments and Data Analysis (Course Outcomes 8)
5	Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5, 6)

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**INDUSTRIAL ATTACHMENT II**
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1 Distinguish the roles of technologists and technicians in an industrial setting and identify the associated reporting channels.

2 Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.

3 Describe the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: September 2019

YEAR 4 OF 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% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety)
Co-requisite(s)	TEGT3742 Entrepreneurship

Content: **Engineering as a profession:** Engineering societies and registration procedure for different Engineering disciplines. **General principles of Engineering ethics:** statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation.** **Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration.**

Technology policy: utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace.** Impact of Engineering activity social, economic, cultural, environmental and sustainability.

Learning Outcomes: On completing the course students should be able to:
1. Identify the role of various Engineering disciplines and societies
2. Paraphrase the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Illustrate the use of Engineering codes and standards
4. Justify general knowledge of procedural law, law of contracts, commercial law and employment law
5. Relate laws of arbitration
6. Classify technology policy on the acquisition of technological know-how

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 7 (health and safety), 8)

10 Engineering Professionalism (Course Outcomes 1, 2, 3)

ECN Exit Level Outcomes Assessed:

10 ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitute satisfactory performance?

After consideration of the 3 tests and 2 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group Project Presentation, 2 Test, 4 assignments/case studies)
Pre-requisite(s)	TEGT3761 Fundamentals of Economics

Content: **Basic principles of project management:** Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale Engineering projects**: inception to completion, appropriate contacts; general conditions of contract for Engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on Engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation;
2. Apply the processes, tools and techniques of project management in an Engineering context
3. Discuss the principles of managing medium to large scale Engineering projects
4. Discuss the principles of managing community-based development projects
5. Discuss the concepts of close-out phases of the project life cycle
6. Integrate and balance overall project management functions and apply available software tools for project management
7. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team.

Contribution to Exit Level Outcome:

5. Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8. Individual, Team and multi-discipline Working (Course Outcomes 7)
11. Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

11 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**

Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments 20%, at least 2 Tests 40%, group project presentation 20% and group project report 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

<u>ECN Exit Level Outcome 8</u> - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student’s ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitute satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of “**Individual, Team and Multidisciplinary Working**” in a manner that is considered: “*not satisfactory”, “satisfactory” or **“excellent”.*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitute satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be given a supplementary test and assignment within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	MINERAL PROCESSING TECHNOLOGY II
Code	TMLX3831
NQF Level	8
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLP 3692 Mineral Processing Technology I**

Content: **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:
1. Discuss the Techno-economic aspects of mineral processing
2. Explain the nature and behaviour of particulate materials
3. Apply appropriate methods to size particulate materials
4. Analyse the influence of different forces on the movement and fracture of particles
5. Design experimental programmes to evaluate important parameters in minerals processing
6. Report on the techniques, results and limitations of the different available processes
7. Design specific operations for the processing of a given ore body

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3 Engineering Design (Course Outcomes 5, 7)
4 Investigations, Experiments and Data Analysis (Course Outcomes 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 5, 6)
6 Professional and Technical Communication (Course Outcomes 1,6)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 1)

2. APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE

Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies

Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

To pass this module a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, basic science and Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the use of mathematical, numerical analysis and statistical knowledge and methods to bear on Engineering problems; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of Engineering science at a fundamental level and in at least one specialist area.

What constitute satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will not be allowed to sit for the examination if he/she has not achieved the sub-minimum requirement of 50% CA and will have to repeat the course.

The student will be allowed to sit for the supplementary exam ONLY if she/he has reached at least 45% in the regular exam.

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Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	METALLURGICAL PRODUCTION PROCESSES
Code	TMLM3851
NQF Level	8
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 2 Tests), Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLN3791 Mechanical Behaviour of Materials**

Content: **Classification of forming processes**. Fundamentals of metal working – effect of temperature, strain rate, metallurgical structure, friction and lubrication, workability and residual stress. **Rolling** – classification and processes, load, torque, power, variables controlling process, defects. **Extrusion** - classification and processes, force and 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. **Moulding 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:
1. Summarize the various metal working principles and processes.
2. Explain joining and welding metallurgy and their applications.
3. Expound on the principles involved in powder metallurgy
4. Discuss metal casting processes and basic foundry operations for ferrous and Non-ferrous metals
5. Manipulate different casting designs and methods
6. Analyse the quality control technique in foundry operations

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 3, 4, 5, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 4, 5, 6)
6 Professional and Technical Communication (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	FERROUS EXTRACTIVE METALLURGY
Code	TMLF3891
NQF Level	8
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMLX3641 Introduction to Process Metallurgy**

Content: **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:
1. Expound on the principles iron ore reduction
2. Explain the blast furnace production of iron
3. Discuss alternative iron making methods
4. Summarize the principles of steel making and various methods of their application
5. Manipulate data relating to iron making and conversion to steel
6. Explain the production of stainless steel and its limitations
7. Assess the techno-economic and environmental aspects of iron and steel making
8. Apply relevant computer software to solve heat and mass balance problems in iron and steel making

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 8)
6 Professional and Technical Communication (Course Outcomes 5, 6)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 7)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	PROCESS MODELLING AND CONTROL
Code	TMLL3891
NQF Level	8
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 Assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**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:
1. Employ the principles of mathematical modelling and simulation in metallurgical processes.
2. Apply suitable computer software to control metallurgical processes.
3. Ascertain the objectives of process control in a given system
4. Interpret industrial conventions of process control.
5. Employ specialized control systems in metallurgical processes

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 3, 4, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3 Engineering Design (Course Outcomes 2, 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2)
6 Professional and Technical Communication (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019

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 (**30%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**50%**)]
Pre-requisite	All third year modules

Content: A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
1. Design an Engineering investigation (methodology)
2. Conduct appropriate experiments for an Engineering investigation (data collection including from simulation) taking into consideration ethical issues like: health, safety and the environment
3. Analyse and interpret the experimental data using appropriate tools including information technology
4. Assess, benefits and impacts of the research: ergonomics, social, legal, health, safety, and environmental
5. Communicate research findings effectively, both orally and in writing, with Engineering audiences and the community at large, clearly drawing reasonable conclusions and suggestions for future work
6. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.

Contribution to Exit Level Outcome:

4. Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5. Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6. Professional and Technical Communication (Course Outcomes 5)
7. Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Demonstrate competence to formulate and conduct investigations and experiments.

5. **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

9. **INDEPENDENT LEARNING ABILITY**

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: one Seminar presentation (**30%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**50%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 4, 5, 9 assessed as follows:

<u>ECN Exit Level Outcome 4</u> - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyze, interpret and derive information from data.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or*

"Excellent". In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 9 – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. In the course of the research project, students are supposed to show their ability to engage in independent learning through well-developed learning skills and awareness of up-to-date tools, techniques and new developments in Engineering and technology as well as the need to access, comprehend and apply knowledge acquired outside formal instruction and guidance from the supervisor.

What constitute satisfactory performance?

After consideration of student's individual conduct in the course of the research project, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** The supervisor will be expected to give examples of cases where the student demonstrated independent learning skills in the course of the research project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report to beef up independently learned components, within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	METALLURGICAL DESIGN PROJECT
Code	TMLD 3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s)	All third year modules

Content: An essential element of Engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated Engineering drawings or computer source codes consistent with professional Engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
1. Identify and formally state problems that can be solved using Engineering knowledge and skills.
2. Implement practical skills in the design of Engineering components, assemblies and/or systems.
3. Apply knowledge of creativity, innovation, safety, ergonomics and good Engineering practice in the design process.
4. Design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4, 6)
9 Independent Learning Ability (Course Outcomes 2, 6)
10 Engineering Professionalism (Course Outcomes 4, 7)
11 Engineering Management (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**

Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively.

3 **ENGINEERING DESIGN**

Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

6\. **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 1, 3, 6 assessed as follows:

ECN Exit Level Outcome 1 – **PROBLEM SOLVING**

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyze and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgement through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “Problem Solving” in a manner that is considered: “*not satisfactory”, “satisfactory” or* ***“Excellent”.*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “Problem Solving” in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 3 – **ENGINEERING DESIGN**

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student’s ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognize and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimization.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with Engineering ***Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “ Engineering ***Design***” in a manner that is considered: “*not satisfactory”, “satisfactory” or* ***“Excellent”.*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “ Engineering ***Design*** in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN exit level outcome 6 - **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final design report should show evidence of the student’s ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of design report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitute satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in “**Professional and Technical Communication**” in a manner that is considered: “*not satisfactory”, “satisfactory” or “Excellent”.* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with “**Professional and Technical Communication**” in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course

Issue Date: September 2015
Next Revision: September 2019

Module Title:	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate Engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
2. Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3. Discuss the role of engineers in the management and organization of Engineering enterprises
4. Discuss in details the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: September 2019

M. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS)

M.1. DEGREE NAME: BACHELOR OF SCIENCE IN MINING ENGINEERING (HONOURS) 19BMNE

M.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.

M.3. CURRICULUM STRUCTURE

The programme for the degree of Bachelor of Science in Mining Engineering (Honours) runs over **four (4) academic years**, which are made up of a total of **eight (8) semesters**. A semester consists of **14 weeks** of lectures plus **2 weeks** of university examinations. Year 1 of study (semester **I** and **II**) is common to all Engineering disciplines. In Years 2 to 4 (semesters **III** to **VIII**), students take discipline-specific modules and a few common modules. There are no taught modules in Semester VIII since this semester is fully dedicated to Research and Design Projects.

A **16 Credit** module requires a total of 56 hours of Lecture (L) plus 28 hours of Tutorials (T) or Labs (Practical Session (PS)). A **12 Credit** module requires a total of 42 hours of Lecture plus 28 hours of Tutorials or Practical Session. An **8 Credit** module requires a total of 28 hours of Lecture plus 14 hours of Tutorials or Practical Session. As part of **Continuous Assessment** (CA), students must do at least two (2) Written Tests in addition to some assignments and Lab reports, where applicable.

YEAR 1 OF BSc IN MINING ENGINEERING – 164 Credits

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 and 2	*Contemporary Social Issues*	UCSI3580	5	8	None
1	Fundamentals of Engineering	TEGT3521	5	8	None
Total Credits Semester I				***80***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE & CO-REQUISITE**
2	Engineering Mathematics II	TEGM3512	5	16	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				***84***	

NB: Students who have done *UCSI3529, ULEA3519, TEGT3521, SPHY3511, SPHY3512* and *SCHM3512* will be exempted from taking them in this year.

YEAR 2 OF BSc IN MINING ENGINEERING – 132 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	**TEGM3591** TEGM3512
1	Computer Science for Engineers	TCME3621	6	8	TCME3521
1	Engineering Mechanics II	TEGT3641	6	8	TEGT3592
1	Statistics for Engineers	TEGS3661	6	8	**TEGM3591**
1	Computer Aided Drawing	TEGT3661	6	8	**TEGT3591** TCME3521
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Introduction to Mining Engineering	TMNE3661	6	8	None
1	Strength of Materials I	TCVM 3621	6	8	TEGT3592
Total Credits Semester III				**72**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**PRE** & CO-REQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	**TEGM3512** TEGT3671
2	Structural Geology	TMNE3622	6	8	TMNE3621
2	Thermofluids	TMNE3682	6	12	SCHM3512
2	Engineering Materials	TMEM3622	6	8	TEGT3562
2	Electrical Machines	TECP3622	6	8	TEGT3541
2	Surveying for Engineers	TCVE3642	6	8	TEGM3591
2	*HIV and AIDS Education*	TEGT3602	*6*	-	None
2	Industrial Attachment I	TEGT3600	6	-	TEGT3590
Total Credits Semester IV				**60**	

YEAR 3 OF BSc IN MINING ENGINEERING – 148 Credits

SEMESTER	MODULE	CODE	NQF LEVEL	NQF CREDITS	PRE & CO-REQUISITE
1	Experimental and Research Methods	TEGR3760	7	8	**TEGS3661**
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	SSTS3691
2	Mine Design	TMNS3732	7	16	TMNS3791
2	Industrial Attachment II	TEGT3700	7	-	TEGT3600
Total Credits Semester VI				**72**	

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	TEGT3742
1	Project Management	TEGM3881	8	12	TEGT3761
1	Mine Safety, Health and Environment	TMNU3831	8	16	**TMNU3741** TMNS3762
1	Underground Mining	TMNU3811	8	16	TMNE3711
1	Rock Engineering	TMNS3861	8	8	TMNU3791
1	Mine Management Principles and Financial Valuation	TMNS3831	8	16	TMNU3742
Total Credits Semester VII				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**NQF CREDITS**	
2	Research Project	TMNR3892	8	30	All 3rd Year Modules
0	Mining Design Project	TMND3890	8	34	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	-	TEGT3700
Total Credits Semester VIII				**64**	

TOTAL CREDITS FOR BSc IN MINING ENGINEERING (HONOURS) **584**

M.4. DETAILED COURSE CONTENT FOR BSc IN MINING ENGINEERING (HONOURS)

YEAR 1 OF BSc IN MINING 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: Lines and planes: Vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: Matrix algebra, row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Sequences and number series**: the limit of a sequence, tests for convergence, absolutely convergent series. **Functions**: Limits and continuity of functions: limit at a point, improper limit, and continuity. Exponential functions, logarithmic functions, hyperbolic functions, area functions, partial fractions, applications to Engineering. Radian measure and applied problems, trigonometric identities, inverse of a function, inverse trigonometric functions, polar graphs. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. Implicit differentiation, Partial differentiation, Chain rule. Differentiation of algebraic functions. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Introduction to complex numbers**: definition, addition, subtraction, multiplication, division of complex numbers. Demoivre's theorem.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Solve basic mathematics and Engineering problems using vectors and matrices
2. Manipulate sequence and series of numbers
3. Use various mathematical functions and apply them to Engineering
4. Apply trigonometry in solving mathematical and Engineering problems
5. Apply the principle of differentiation/integration to solve basic mathematical and Engineering problems.
6. Solve mathematical and Engineering problems using partial differentiation

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2 and 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 4, 5)

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Module Title:	ENGINEERING DRAWING
Code	TEGT3561
NQF Level	5
Contact Hours	2L + 2T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (minimum of 2 tests and 4 drawing assignments)
Pre-requisite(s)	None

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Use standard equipment for technical drawing
2. Sketch Engineering components free hand or with the aid of drawing equipment
3. Present Engineering components as drawings in orthographic and isometric projections
4. Use sections, interpenetration and development to produce clear Engineering drawings
5. Produce parts drawings and assembly drawings of various Engineering components

Contribution to Exit Level Outcome:
1 Eng Design (Course Outcomes 4, 5)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)
6 Professional and Technical Comm (Course Outcomes 2, 3, 4, 5)

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Module Title:	PHYSICS FOR PHYSICAL SCIENCES I
Code	SPHY3511
NQF level	5
Contact hours	4L + 2T or 1 PS/Week
NQF Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Contents: Units, significant figures and scientific notation; vectors: properties, components, unit vectors, products; average and instantaneous speed, velocity and acceleration; one dimensional motion with constant acceleration; falling bodies; two dimensional motion with constant acceleration; projectile motion; uniform circular motion; circular motion; relative velocity and acceleration; Newton's laws; inertial frames; weight; friction; applications; work and kinetic energy; power; conservative and non-conservative forces; gravitational potential energy; conservation theorem; work-energy theorem; linear momentum and impulse; conservation of linear momentum - 2 particle system; collisions; equilibrium; centre of gravity; applications; Newtonian gravitation; gravitational constant; weight and gravitational force; Kepler's laws; pressure; Archimedes' principle; laminar flow; Bernoulli's equation; temperature and temperature scales; thermal expansion; ideal gas; heat; heat capacity; latent heat; heat transfer.

Learning Outcomes: Upon completion of the module, the student is expected to:

1. Employ units, do unit conversions and use of significant figures.
2. Solve problems regarding one and two dimensional kinematics.
3. Solve problems regarding the dynamics of linear motion via Newton's laws.
4. Solve problems regarding the dynamics of linear motion using energy methods.
5. Solve simple problems in rotational kinematics and dynamics.
6. Solve basic problems in statics and Newtonian gravitation.
7. Solve problems using the principles of fluids.
8. Solve basic problems regarding heat and gases.
9. Demonstrate entry-level general laboratory skills including elementary data analysis.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2 – 8)
4 Investigations, Experiments and Data Analysis (Course Outcome 9)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTING FUNDAMENTALS
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: Overview of common operating systems like Windows, Linux and Mac-OS. **Principles of information processing**: Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. **Computer Architecture:** The design and structure of a computer. **The logical basis of computing**. The binary system, Boolean logic and number representation. Boolean algebra. Information representation in computers. **Computer Network Fundamentals. Web development.**

Learning Outcomes: Upon completion of this module, students should be able to:

1. Use a computer under the Windows Operating environment
2. Differentiate between word processors, spreadsheets, presentations and databases
3. Describe basic features of common Operating Systems
4. Describe computer architecture
5. Describe how a computer processes information using the binary numbering system.
6. Apply Boolean logic to predict the outcome of an event
7. Describe the characteristics of logic gates and their circuits
8. Describe basic features of computer networks including the use of the internet
9. Demonstrate basic knowledge of web design tools

CONTRIBUTION to Exit Level Outcome

5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	WORKSHOP PRACTICE
Code	TEGW3590
NQF Level	5
Contact Hours	2L + 1PS/Week
NQF Credits	8
Assessment	Continuous: 100% made up of 60% Reports (minimum 5 practical reports) and 40% Fabricated Components.
Pre-requisite(s)	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal, Machining (Drilling, Cutting, Turning, Fitting, Milling, Shaping), Auto Mechanics, Electrical Installation, Electrical Wiring, Soldering and de-soldering of electronic components. Refrigeration and Air-conditioning and their installation.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Describe general safety procedures applicable to Engineering workshops.
2. Describe specific hand tools used in Engineering workshops.
3. Fabricate a prescribed component using the various workshops.
4. Make basic wall structures using brick work, cement and mortar.
5. Differentiate between the functions of a lathe and a milling machine and produce simple components by machining operations.
6. Use arc welding and gas welding to fabricate simple components.
7. Describe the general operation of internal combustion engines.
8. Construct basic electric circuits and use them to perform specified activities.
9. Describe procedures for soldering and de-soldering of electronic components.
10. Install air-conditioning and refrigeration systems
11. Describe the general operation of air-conditioning and refrigeration systems.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 10)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 6, 9)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MATERIALS SCIENCE
Code	TEGS3591
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (2 Assignments, 2 Practical Reports and 2 Tests); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	None

Content: Materials for Engineering: Introduction to Engineering Materials, Types of Materials, Processing-Structure-Property relationship of Materials, Competition among materials, Future trends of material usage. **Structure of materials**: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions: Miller indices; Bragg's law; Defects in crystals; **Solidification, Crystalline Imperfections and Diffusion in solids**; Solidification of Metals, Single Crystals, Metallic Solid Solutions, Crystalline Imperfections and Atomic diffusion in Solids; **Equilibrium phase diagrams:** unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **Properties of Materials:** review of Mechanical, Electrical, Optical and Thermal properties of materials. **Mechanical properties of materials**: Stress and Strain, Tensile testing, True stress and True strain, Deformation modes; Yield and Fracture, Hardness testing, bend test, impact test, simple fracture mechanics and strengthening mechanisms. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials. **Behaviour of Materials in Service**: Fatigue, Creep and Corrosion.

Learning Outcomes: On completing the course students should be able to:

1. Describe the structure of materials from the electronic level to the alloy state
2. Explain the diffusion mechanisms in solids
3. Describe the formation of metals and alloys using binary equilibrium phase diagrams
4. Describe the various phase transformations in the Fe-Fe_3C phase system and associated microstructures
5. Describe the processes that take place during corrosion and the techniques used to control corrosion and degradation
6. Demonstrate general laboratory skills in metallography and testing of mechanical properties of materials

Contribution to Exit Level Outcome:

1 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title	CONTEMPORARY SOCIAL ISSUES
Code	UCSI3580
NQF	5
Contact Hours	1 Contact hours per week for 28 weeks
Credits	8
Assessment	Continuous Assessment (100%). variety of assessments which evaluate and test the students' individual learning and mastering of the course content (subject knowledge) through quizzes, tests, Moodle assignments, journal entries, reflections as well as service and experiential learning projects.
Prerequisite	None

Module Descriptor: The module, **Contemporary Social Issues (CSI3580)**, is designed to encourage behavioural change among UNAM students and inculcate the primacy of moral reasoning in their social relations and their academic lives. In providing students with critical and analytical thinking the module enables students to grow and develop into well rounded citizens, capable of solving contemporary social challenges experienced in their communities and societies. The teaching of the module takes three dimensions: the intellectual, the professional and the personal dimensions. The intellectual dimension is fostered through engaging students with subject knowledge, independent learning and module assessment. The professional dimension, on the other hand, is fostered through exposing students to real life situations of case studies and practical exercises that draws attention to social issues that attract ongoing political, public and media attention and/or debate. Finally, the professional dimension is fostered through group work, online discussions and class participation.

Learning Outcomes

By the end of this module students should be able to:

- Contribute to family, community and society;
- Develop social consciousness, thinking skills, self-concepts as well as moral and ethical sensitivity;
- Illustrate key contemporary social issues and challenges experienced within the Namibian society and globally;
- Discuss the role of human conduct, structures, institutions and relations of power in shaping social life in the country;
- Promote ethical and moral reasoning, anticorruption behaviours, human rights, healthy lifestyles, gender equality, productive citizenship, responsible leadership, social media ethics and environmental sustainability; and
- Open their minds to possible meaningful and worthwhile career opportunities.

Contribution to Exit Level Outcome:

10 Engineering Professionalism (Course Outcomes 4, 11, 12, 13)

Issue Date: September 2015
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Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3521
NQF Level	5
Contact Hours	2L + 1T or 1PS /week
Credits	8
Assessment	100% Continuous Assessment (Quizzes 10%, Assignments 20%, Project and Presentation 30%, and Tests 40%)
Pre-requisites	None

Content: Introduction to Engineering: What is Engineering? Historical perspective of Engineering**,** Common traits of good engineers; The Technology team (Scientist, Engineers, Technologist, Technician and Artisans) Difference between Scientific and Engineering Methods, Engineering Job Functions. **Branches of Engineering:** Civil, Electronics and Computer, Electrical, Mechanical, Metallurgical, Mining and others**. Engineering as a Profession:** Engineering Council of Namibia (ECN), Professional engineers – how to become one and significance of having the title. Professional Societies. **Introduction to Engineering Design and Problem Solving:** Types of Problems, Problem Solving Approach and Skills, The Design process, Brainstorming, Criteria and Evaluation, Sustainability. **Engineering Ethics**: Interaction Rules, Ethical decision making, Plagiarism, Settling Conflicts, Moral theories and The Ethical Engineer**. Engineering tools**: Presentation software, Internet as a research tool, Computational tools – Microsoft Excel. **Engineering Communication and Teamwork Skills**: The Importance of Communication Skills in Engineering, Basic Presentation skills, Basic Technical Writing Skills. Principles of Teamwork, Characteristics of an Effective Team Member

Learning Outcomes: Upon completion of this module, students will be able to:

- Distinguish the roles of Scientists, Engineers, Technologists, Technicians and Artisans
- Describe the various branches of Engineering, possible careers, and job prospects
- Describe how to solve basic Engineering problems
- Identify general steps involved in Engineering design and communication
- Use modern Engineering and communication tools and procedures.

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SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGM3512
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	16
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. **Further integration**: Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), and integration by trigonometric substitution. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length. **Differential equations**: Meaning and solutions. First order ordinary differential equations; separable, homogeneous, exact and linear types; Graphical solutions. Second order linear equations with initial or boundary value conditions. **Sequences and series of numbers:** the limit of a sequence, absolutely convergent series, tests of convergence. Power series: radius and interval of convergence. Power series representation of functions: Taylor and Maclaurin series. Binomial theorem.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Calculate eigenvalues and eigenvectors and relate them to Engineering solutions
2. Solve calculus problems using integration by parts and the reduction formula technique
3. Apply calculus to trigonometric functions to solve mathematical and Engineering problems
4. Solve Engineering problems using 1st order and 2nd order differential equations
5. Manipulate sequence and series of numbers
6. Apply the binomial theorem in solving mathematical and Engineering problems

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 4, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 2, 3, 4, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous Assessment 100% (at least 2 Tests 60%, 2 Quizzes (20%) and 2 Practical Report (20%))
Pre-requisite(s)	None

Content: Voltage and Current sources, source transformation. Ohm's law, Resistance, Resistor networks, Resistor coding, series and parallel, voltage divider and current divider rules, Kirchhoff's laws, mesh and nodal analysis, Superposition Theorem, Thevenin's Theorem, Power transfer, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance and mutual inductance, 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: Basics principles of a transformer, AC generator, DC motors, simple and three phase ac systems.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Distinguish between real and ideal voltage and current source
2. State and apply the laws and rules of electrical circuit analysis including Ohms law, Kirchhoff's current and voltage laws, current and voltage division laws, superposition theorem, Norton's and Thevenin's theorems for problem solving
3. Apply the principles of circuit analysis to series and parallel R,L,C circuits
4. Perform a range of measurements in an electrical laboratory environment and be able to manipulate the measured data to derive supplementary information
5. Describe the principles of a transformer and the basic AC generator and DC motors

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	PHYSICS FOR PHYSICAL SCIENCES II
Code	SPHY3512
NQF Level	5
Contact Hours	4L + 2T or 1 PS/Week
NQF Credits	16
Assessment	Continuous 50% (minimum 2 tests and 2 assignments and 2 practical reports) , Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for Physical Sciences I

Contents: Electric charge; insulators and conductors; Electric force and coulomb's law, Electric field and Gauss's law; Electric potential; Capacitance and capacitors; Direct current; Ohm's law and simple circuits; Magnetic field; Alternating current; Transformers; Phenomenological approach to RL and RC circuits; Basic geometrical optics; Radioactivity and its detection; Sound.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Solve problems on electric and magnetic fields
2. Sketch electric circuits and solve problems on capacitors and resistors
3. Discuss and solve problems in geometrical optics, radioactivity and sound.
4. Prepare and perform experiments related to the contents of the module.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcome 4)
8 Individual, Team and multi-discipline Working (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ENGINEERING MECHANICS I
Code	TEGT3592
NQF Level	5
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 tests and 4 assignments); Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SPHY3511 Physics for physical Sciences I

Content: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. **Analysis of forces in a truss:** Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces. Distributed forces: centroids and centre of gravity;. **Friction:** Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. **Center of Gravity and Centroid**.

Learning Outcomes: Upon completion of this module, students should be able to:

1. Express force operations and force systems using vectors
2. Apply the laws of static equilibrium of forces
3. Produce a free body diagram from a specified Engineering problem
4. Analyse trusses using method of joints and method of sections
5. Apply principles of static and kinetic friction in solving Engineering problems
6. Calculate and plot bending moment and shear force distributions in beams

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1-6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 3-6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	CHEMISTRY 1B
Code	SCHM3512
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least *2 tests and 4 assignments or 2 assignments and 2 practical reports)*, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	None

Content: Gases: Pressure of a Gas; The Gas Laws; The Ideal Gas Equation; Gas Stoichiometry; The Kinetic-Molecular Theory of Gases; Deviation from Ideal Behaviour. Basic Thermochemistry: The Nature of Energy and Types of Energy; Energy Changes in Chemical Reactions; Introduction to Thermodynamics; Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; Heat of Solution and Dilution. Introductory Chemical Kinetics: Rate of Reaction; Rate Law; Relation between Reactant Concentration and Time; Activation Energy and Temperature Dependence of Rate Constants; Reaction Mechanisms; Catalysis. Introduction to Chemical Equilibrium: The Equilibrium Constant; Writing Equilibrium Constant Expressions; Relationship between Chemical Kinetics and Chemical Equilibrium; What Does the Equilibrium Constant tell Us? Factors that Affect Chemical Equilibrium. Acid-Base Equilibria and Solubility Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

Learning Outcomes: Upon completion of this course, students should be able to:
1. Explain and use the gas laws
2. Discuss energy changes in chemical reactions
3. Analyse the rates of chemical reactions.
4. Explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system.
5. Distinguish between the three laws of thermodynamics
6. Explain acid-base equilibria and solubility equilibria.
7. Demonstrate an understanding of how galvanic cells work.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title	**ENGLISH FOR ACADEMIC PURPOSES**
Code	ULEA 3519
NQF Level	5
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous: 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 and Vocabulary, Functional Situations in Academic Writing, Selecting and Synthesizing, Applied Writing, APA Reference, Avoiding Plagiarism, Introduction to other types of referencing, Extensive and intensive reading, Semantic relations, Academic Paragraph Writing, Academic Speaking.

Learning outcomes: Upon completion of the module students should be able to:
1. Demonstrate understanding of language print
2. Practice effective writing skills
3. Demonstrate official and basic academic speaking
4. Demonstrate academic study skills

Contribution to Exit Level Outcome:
6 Professional and Technical Communication (Course Outcomes 1, 2, 3)
9 Independent Learning Ability (Course Outcome 4)

Issue Date: September 2015
Next Revision: September 2019

YEAR 2 of BSc in Mining Engineering

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
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)	TEGM3512 Engineering Mathematics II

Content: **Vector Calculus**: Vector valued functions, limits, continuity, differentiation, partial differentiation. Scalar and vector fields, space curves, tangent to curves, normal, binormal, torsion, curvature, the gradient of a scalar field, the del operator and its properties, the directional derivative, the divergence, the curl, physical and Engineering applications. Functions of Several Variables: limits, continuity derivatives, differentials, the Jacobian matrix and determinants, composite functions, higher order derivatives, extrema with constraints, surfaces, applications in Science and Engineering **Integral Transforms:** Laplace Transforms (LT) with applications to differential equations, Introduction to Fourier series. Fourier transforms. Inverse transforms derivatives and integrals, unit step functions, LT of derivatives and integrals, application to solve 1st, 2nd and 3rd order ordinary differential equations. An application of Fourier transforms to boundary value problems.. Power series solutions of second order ordinary differential equations and introduction to Bessel functions. **Analytic functions**: Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formulae, Taylor series, singular points, poles. Laurent series, Residues, Residue Theorem, evaluation.

Learning Outcomes: Upon completion of this module, students should be able to:

7. Apply differential vector calculus to solve mathematical and Engineering problems
8. Use Laplace and Fourier transforms in solving differential equations
9. Apply functions of several variables in solving Engineering problems
10. Apply the power series method in approximation of solutions of ordinary differential equations
11. Describe the basis for complex analysis in Engineering problem solving
12. Apply the residual theorem to Engineering problems

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2, 3, 4, 5, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 3, 4, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title	**COMPUTER SCIENCE FOR ENGINEERS**
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (At least 2 Assignments – 20%, at least 3 Labs - 30%, at least 2 Tests 50%).
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:

1. Generate data structures and algorithms
2. Apply binary trees to specific programming environment
3. Demonstrate knowledge of MATLAB programming
4. Create and use user-defined MATLAB functions
5. Apply MATLAB programming for solving Engineering problems
6. Write simple C programs

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 4, 5)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 4)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3641
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (At least 4 assignments and 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:

1. Competently express motion of a body in terms of position, velocity and acceleration.
2. Apply principles of kinematics and kinetics to describe motion and causes of motion.
3. Use rectangular and curvilinear coordinates to solve dynamics problems.
4. Analyse linear, angular, projectile and relative motion of particles and systems thereof.
5. Apply equations of motion in rectilinear and plane curvilinear motion.
6. Apply the work-energy principle and impulse-momentum principle to solve particle dynamics problems.
7. Demonstrate an understanding of the kinetics of a system of particles and analyse them using the work-energy principle and the impulse-momentum principle.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 3, 4, 5, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 5, 6)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 3, 4, 6, 7)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	STATISTICS FOR ENGINEERS
Code	TEGS3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (**at least 4** assignments (40%) and 2 Tests (60%)), Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGM3591 Engineering Mathematics I

Contents: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; Probability Distributions and Densities: Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; Sampling Distributions: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; Linear Regression and Correlation: Simple and Multiple Linear Regression, Correlation; Analysis of Variance: Completely Randomized and Randomized Block Designs, Multiple Comparisons;

Learning Outcomes: On completing the course students should be able to:

1. Describe the theory of probability
1. Analyse data using probability distribution and densities
2. Use the principles of sampling distribution to analyse data
3. Apply linear regression and correlation to a set of data
4. Apply analysis of variance to solve Engineering problems

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 3, 4, 5, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 4, 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3661
NQF Level	6
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 100% (At least 2 Tests (40%), 1 Mini-project (25%), 4 Assignments (35%))
Co-requisite(s)	TCME3521 Computing Fundamentals
Pre-requisite(s)	TEGT3561 Engineering Drawing

Content: Getting started; **Setting up the drawing Environment**; Using commands and system variables; Using coordinate systems; Creating objects; Drawing with precision; Controlling the drawing display; **Editing methods**; Using layers and object properties; Adding text to drawings; Creating dimensions; Using blocks and external references; **Managing content with AutoCAD design Centre**; Creating a layout to plot; Plotting your drawing; Working in three-dimensional space; Creating three-dimensional objects.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Competently use commands and symbols in the computer drawing environment.
2. Create or use standard objects to make Engineering drawings with AUTOCAD
3. Merge text and dimensions with drawings generated from AUTOCAD
4. Make layouts and plot drawings created by AUTOCAD

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
5 Eng Methods, Skills, and Tools including IT (Course Outcomes 1, 2, 4)
6 Professional and Technical Communication (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	INTRODUCTION TO ENGINEEERING GEOLOGY
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	None

Contents: Mineralogy: Properties and composition of rock forming and economic minerals; petrology; composition and identification of common igneous, sedimentary and metamorphic rocks. Practical work involves the identification of common minerals and rocks. **Internal processes**: the nature of the interior of the earth; plate tectonic theory. **Surface processes**: rock weathering and soil formation; erosion and denudation; sediment transport and deposition; the rock cycle in the context of plate tectonic theory; introductory geo-hydrology. Brief on Ore and mineral exploration methods and Prospecting Techniques. Practical work involving geological map interpretation.

Learning Outcomes: On completing the course students should be able to:
1. Describe composition and properties of common minerals and rocks
2. Analyse the nature of the interior of the earth and the plate tectonic theory
3. Describe weathering processes and soil formation processes
4. Apply basic knowledge of geology.

Contribution to Exit Level Outcome:
1 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
8. Individual, Team and multi-discipline Working (Course Outcomes 2, 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	INTRODUCTION TO MINING ENGINEERING
Code	TMNE3661
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	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:

1. Explain the basic mining terminologies
2. Comprehend the Namibian mining industry and Namibian mineral deposits
3. Describe various mining methods and mining equipment
4. Explain various mine transportation methods
5. Discuss mine safety and mine environmental issues

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 4, 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5)

ECN Exit Outcomes Assessed:

7. **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY**

Demonstrate critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment.

Assessment Strategies

The assessment will constitute the following:

At least 2 Assignments and at least 2 Tests making **30%,** Presentation (**10%**) and Report on selected topics on the Mine Safety, Health and Environment (**10%**), Examination (1 x 3 hour paper) making **50%**

To pass this course a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 7 assessed in the presentation and the submitted report as follows:

ECN exit level outcome 7 – **SUSTAINABILITY AND IMPACT OF ENGINEERING ACTIVITY.**

Where and how is this exit outcome assessed?

Students are expected to show critical awareness of the sustainability and impact of Engineering activity on the social, industrial and physical environment and how this awareness is considered in the Engineering analysis and design. The presentation and report should show evidence of the student's ability to consider the impact of Mining activities on the social, legal, health, safety, environmental dimensions and perform techno-economic analysis including impacts on the physical environment.

What constitute satisfactory performance?

After consideration of the test, assignments and presentation and submitted report, and with reference to evidence showing awareness of **Sustainability and Impact of Engineering activity** and how this knowledge is considered in the Engineering analysis and design considerations, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Sustainability and Impact of Engineering activity**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum CA of 50% before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
If the performance requirements as stipulated above are not met, the student will be considered to have failed the course

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**STRENGTH OF MATERIALS I**
Code	TCVM3621
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	TEGT3592 Engineering Mechanics I

Contents: Basic concepts: Major principles and assumptions; Force equilibrium; Supports and support reactions; Free body diagrams. **Stress and strain:** Internal effects of forces - Concept of stress and strain; Tensile test; Ductility constants; Hooke's Law; Modulus of Elasticity; Normal stress and strain; Poisson's ratio; Shear stress and strain; Modulus of rigidity; Effect of Poisson's ratio on two-dimensional stress; Volumetric strain; Bulk modulus; Relationship between elastic constants. **Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems:** Axially loaded bars of varying cross sections and bars loaded at intervals; Simple indeterminate problems on direct tension and compression; Compound bars. **Geometrical characteristics of plane sections:** Centroids of simple and complex areas; Second moment of area; Polar moment of area; Parallel axes theorem; Perpendicular axes theorem. **Bending:** Shear force and bending moment diagrams. **Bending and shear stresses in beams:** Theory of beam bending; Section modulus; Composite beams; Shear stress distribution due to bending. **Simple Torsion:** Pure torsion of circular bars; Shear stress and shear strain in shafts, Torsional rigidity; Torsion of hollow shafts. **Stresses in thin cylinders and spheres:** Thin cylindrical and spherical shells subjected to internal pressure; Hoop stress and longitudinal stress.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Demonstrate the application of Hooke's Law to normal and shear stresses.
2. Solve problems involving axially loaded bars, temperature stresses and simple indeterminate elements and structures.
3. Calculate geometrical characteristics of plane sections.
4. Draw bending and shear force diagrams in beams.
5. Employ bending and shear stresses in beams.
6. Solve problems involving shear stresses and shear flow in beams.
7. Calculate stresses and strains in circular shafts subjected to torsion.
8. Relate stresses in thin cylinders and spheres subjected to internal pressure.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1,2, 3, 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6,7)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5, 6,7)

Issue Date:	September 2015
Next Revision:	September 2019

SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS IV
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% (At least minimum 2 tests and 4 assignments), Examination 50% (1 x 3 hour paper)
Co-requisite(s)	(TEGT3671 Engineering Mathematics III)
Pre-requisite(s)	**TEGM3512 Engineering Mathematics II**

Contents: Applications of second order ordinary differential equations with constant coefficients: The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations, rotation of a rigid body; matrix methods: systems of oscillating particles. **Partial differential equations**: Classification of PDEs as Elliptic, Parabolic and hyperbolic, Neumann, 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 **Integral**. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and Engineering applications. **Numerical methods**: Zeros of functions, Polynomial interpolation and Least Squares approximation, different numerical differentiation and integration. Numerical solution of ordinary differential equations. Boundary value problems. Computational linear algebra with emphasis on numerical solution of linear and nonlinear equations, numerical computation of Eigenvalues and Eigenvectors. Basic computing in numerical methods. **Difference equations**: Modelling with difference equations, methods of solution to first and second order difference equations.

Learning Outcomes: On completing the course students should be able to:
1. Describe the applications of Cayley-Hamilton theorem to solving differential equations
2. Apply linear differential equations to solve Engineering problems involving simple harmonic motion, damped oscillations and forced oscillations
3. Apply integral calculus to functions of several variables and describe Green's theorem
4. Describe the principle of numerical methods and computational linear algebra
5. Perform polynomial interpolation and apply the Least squares approximation
6. Apply numerical differentiation and integration to solve ordinary differential equations including using computer applications.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4, 5, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	STRUCTURAL GEOLOGY
Code	TMNE3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNE3621 Introduction to Geology

Contents: Structural geology: brittle and ductile deformation and formation of folds and faults; solution of structural problems involving folded and fractured rocks. **Economic Geology:** ore forming processes and the classification of ore deposits; the geology of the world's major ore deposits. **African geology**: the geological evolution of Africa, with particular reference to its ore deposits. Practical work involves the interpretation of geological maps and the solution of structural problems in a mining context.

Learning Outcomes: On completing the course students should be able to:
1. Describe processes leading to the formation of folds and faults
2. Comprehend ore forming processes and the classification of ore deposits
3. Recognise the world's major ore deposits
4. Discuss African geology
5. Interpret geological maps.

Contribution to Exit Level Outcome:
1. Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
9 Independent Learning Ability (Course Outcomes 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	THERMOFLUIDS
Code	TMNE3682
NQF Level	6
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	SCHM3512 Chemistry 1B

Content: Thermodynamics; Basics concepts in thermodynamics, system, process, state, property of a system, cycle, pressure, volume, temperature, work, heat. **First law of thermodynamics**: internal energy; non-flow energy equation; energy equation and reversibility. Application of first law to non-flow processes; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. **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:
1. Discuss the first law of thermodynamics and its applications to non-flow and flow processes
2. Explain the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
3. Analyse and quantify the properties of working fluids
4. Interpret and use thermodynamic property diagrams
5. Explain the equation of state of a perfect gas

Contribution to Exit Level Outcome:

1 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2,3, 4)
6 Professional and Technical Communication (Course Outcomes 4)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4)

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	ENGINEERING MATERIALS
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

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:
1. Distinguish between various classes of steels and cast irons and identify their specific characteristics
2. Describe key characteristics and typical applications of common non-ferrous metals and alloys
3. Demonstrate knowledge of Engineering polymers and plastics and discuss applications of such materials
4. Describe the characteristics and uses of traditional and technical ceramics and identify their superior properties.
5. Demonstrate knowledge of composition and characteristics of composite materials and describe the procedures for stress analysis in longitudinal and transverse loaded composites.

CONTRIBUTION to ECN Exit Programme Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3 and 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ELECTRICAL MACHINES
Code	TECP3622
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 100% (At least 2 assignments, 2 Tests, 2 Practical Labs,)
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:
1. Demonstrate an understanding of the principle of operation of electrical machinery
2. Describe the principle of operation of DC machines such as DC motors, generators, drives.
3. Describe the principle of operation and applications of transformers and AC windings
4. Describe the principle of operation and applications of three-phase induction machines

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 3, 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	SURVEYING FOR ENGINEERS
Code	TCVE3642
NQF Level	6
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	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:
1. Demonstrate knowledge of the overview of surveying and its applications to Engineering
2. Describe the various techniques and tools used in practical surveying
3. Explain the GPS survey systems
4. Demonstrate knowledge of surveying calculations
5. Use contour and surface modelling software in surveying exercises

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 4)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4, 5)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 5)
9 Independent Learning Ability (Course Outcomes 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title	HIV AND AIDS EDUCATION
Code	**TEGT3602**
NQF Level	5
Contact Hours	1L + 1T per week for 14 weeks
NQF Credits	None
Assessment	Continuous assessment 100% (3 Assignments and 1 report)
Pre-requisite(s)	None

Content: The Engineer and HIV: Basic facts of HIV and AIDS; Prevention, Counselling and Testing, and Treatment of HIV and AIDS; Drivers of the HIV and AIDS Epidemic in Namibia, The Engineering Sector and HIV and AIDS. **Impact of HIV and AIDS**: Socio-Economic Impacts on the workforce; Impact Assessment; HIV and AIDS cost benefit analysis. **HIV and AIDS Mitigation:** The Policy Environment; Design and Implementation of HIV and AIDS workplace programmes

Learning outcomes: Upon completion of the module students should be able to:
1. Describe the Impact of HIV/AIDS on the workforce in an organization
2. Describe HIV/AIDS workplace programmes
3. Perform HIV/AIDS cost benefit analysis

Issue Date: September 2016
Next Revision: September 2020

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Total Hours	Six (6) weeks preferably during the June/July break in Year 2 or Year 3 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Pre-requisite	TEGW3590 Workshop Practice

Content: During Industrial Attachment I, students will work under company supervision at the level of an Artisan and will undertake at least six weeks of attachment to an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Describe the organisational structure and the operational processes of the company or organisation
2. Describe in details his/her contribution to the company during the internship

Issue Date:	September 2015
Next Revision:	September 2019

YEAR 3 OF BSc IN MINING ENGINEERING

SEMESTER 1

Module Title:	**EXPERIMENTAL AND RESEARCH METHODS**
Code	TEGR3760
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	**Continuous 100%** (Technical Report (10%); Assignments (20%); Test (20%) Research Proposal Seminar (20%); Research Proposal Reports (30%)
Pre-requisite(s)	**TEGS3661 Statistics for Engineers**

Content: Experimentation planning and execution. **Technical report writing**. Report structure and format. **Literature Review**: Reasons for reviewing relevant literature, citation and referencing (with emphasis on plagiarism). **Research methodology**. Formulation and presentation of research proposals. **Statistical data analysis: Data description**: box and whisker plots, bar charts and histograms, scatter plots on given experimental data. **Data modeling**: Experimental data modeling with simple linear, and multiple linear regression models. Interpretation of the coefficient of determination R^2 and adjusted R^2 and the role of adjusted R^2 on model building. One way ANOVA on experimental data and hypothetical conclusions. Software (SPSS, EXCEL, SAS or any other software)

Research Proposal: During the second semester, students will be required to develop a research proposal under the guidance of a member of the academic staff who will become the supervisor for that research project. The students will then be required to present their Research Proposals in a seminar to be arranged by their respective Departments (20%). Towards the end of the semester, each student will submit a typed and bound research proposal report (30%).

Learning Outcomes: On completing the course students should be able to:

1. Describe the principles of experimentation planning and execution
2. Write and present a concise technical report
3. Describe the principles used in research methodology
4. Use statistical software to describe data using graphs
5. Use statistical software to model experimental data using regression models and ANOVA technique and interpret the result
6. Identify a possible problem that can be investigated through an Engineering research process
7. Propose an Engineering investigation method for the identified problem
8. Propose data collection and analysis methods for the investigation
9. Present the research proposal both orally and in writing, to an Engineering audience following specified guidelines

CONTRIBUTION to Exit Level Outcome:

4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 5, 6 - 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4, 5)
6 Professional and Technical Communication (Course Outcomes 2, 9)

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	FUNDAMENTALS OF ECONOMICS
Code	TEGT3761
NQF Level	7
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 50% (At least 4 assignments, 2 Tests); 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:
1. Discuss the fundamentals of microeconomics
2. Discuss the fundamentals of macroeconomics
3. Apply the fundamentals of financial accounting in an Engineering project
4. Apply the principles of budgeting in an Engineering project
5. Apply the principles of marketing an Engineering product

Contribution to Exit Level Outcome:
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	HYDROGEOLOGY
Code	TMNU3761
NQF Level	7
Contact Hours	2L + 1T or 1PS /Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests and practical's) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	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 and optimum pumping rates; solute transport in aquifers: diffusion; advection; dispersion; retardation; sorption reactions; redox reactions; cation exchange; carbonate dissolution and precipitation reactions. **The advection-dispersion equation**; mass transport with reaction; first order kinetic reactions; equilibrium sorption reactions.

Learning Outcomes: On completing the course students should be able to:
1. Explain the mechanics of groundwater recharge and its analysis.
2. Discuss the theory of aquifer hydraulics, model underground aquifers and evaluate them.
3. Appraise the reactions governing underground solutions
4. Explain the effect of groundwater and its pumping on underground openings.
5. Design pumping systems and sequences for underground mining purposes.
6. Develop methods of controlling and predicting contamination levels of underground water by minerals and other solutions.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4, 5, 6)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	EXCAVATION ENGINEERING
Code	TMNE3711
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 3 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:
1. Explain various powering systems used in the mining industry
2. Discuss the various techniques of mechanical excavation of rock and earth matter
3. Analyse the mechanics of impact breaking of solid materials
4. Assess rock drilling and use of explosives in mining
5. Discuss various rock breaking and blasting techniques
6. Appraise blasting techniques for underground and surface mining.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 4, 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINE EQUIPMENT AND MACHINERY
Code	TMNS3791
NQF Level	7
Contact Hours	3L + 2T /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 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:

1. Explain modern mining machinery and mine transportation systems
2. Design and select appropriate mine equipment, machinery and systems for loading and hauling
3. Analyse and control haulage operations
4. Evaluate fluid power systems in mining.
5. Discuss electrical systems used in mining operations
6. Explain the principles of materials handling and power system consideration and performance.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 2)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINE VENTILATION AND CLIMATE CONTROL
Code	TMNC3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests and practical) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMNE3682 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:
1. Appraise air quantity required in mines
2. Apply the principles of fluid flow to ventilation systems.
3. Evaluate and apply fan behaviour to ventilation systems.
4. Design a ventilation system for a mine.
5. Explain the environmental hazards found in mines and outline the control measures that detect, monitor, minimise and/or manage these hazards.
6. Discuss typical ventilation systems in selected mines such as coal, gold and uranium mines.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 3, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	SOIL AND ROCK MECHANICS
Code	TMNU3791
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMNE3621 Introduction to Engineering Geology**

Contents: Simple soil properties, classification of soils and rocks, Soil profiles, site exploration, drilling and sampling. Compaction of soils, shear strength, settlement, bearing capacity, slope stability, earth pressure. Problems of equilibrium and deformation, Effective and total stresses, Consolidation and settlements of soils Theory of shear strength in soils. **Mechanics of solids**: Two-dimensional analysis of stress and strain; linear elasticity; stresses and displacements around mining excavations; three-dimensional elasticity. Strength and deformation characteristics of rock: Intact rock properties; shear strength of discontinuities; mechanical properties of rock masses; **Mohr-Coulomb and Hoek-Brown failure criteria**. Mine Tour: a series of visits to mines and mining-related institutions as arranged by the Department at appropriate times.

Learning Outcomes: On completing the course students should be able to:

1. Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
2. Assess knowledge of the strength and deformation characteristics of rock masses
3. Discuss useful mechanical properties of rock masses
4. Analyse failure criteria for rocks and rock masses.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019

SEMESTER 2

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T /Week
NQF Credits	8
Assessment	Continuous 100% [2 Tests (50%); 2 Reports (25%); At least 2 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:
1. Discuss the concept of entrepreneurship and important parameters that characterise a good entrepreneur
2. Distinguish the methods used to carry out feasibility studies
3. Develop a business plan relating to an Engineering endeavor
4. Separate the concepts of motivation, competencies, innovation and product marketing
5. Relate the procedure used when starting a new business venture including conceptualization, planning, financing, operations, accounting and marketing strategies

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2)
11 Engineering Management (Course Outcomes 4, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	SURFACE MINING
Code	TMNS3792
NQF Level	7
Contact Hours	3L + 2T or 1PS/Week
NQF Credits	12
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMNE3711 Excavation Engineering**

Contents: Introduction to open-pit mining; factor affecting the selection of open pit mining; ore reserve estimation methods **Open pit design**; slope stability in relation to design; haul road design; drilling and blasting patterns; economics and stripping ratios; economic cut-offs; pit optimization. **Quarry operations**; working platforms; bench width; optimum depth **Strip mining of mineral deposits**; strip mine design and planning; optimum pit limit, economics of strip mining; environmental considerations; dragline operations; range diagrams. **Marine mining**; dredging; mechanized earth- moving; hydraulic mining; equipment selection; power systems; matching and fleet optimization; economic considerations of equipment selection and purchase; type life; cycle times. Practical exercises, Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:

1. Explain surface mining technologies and operations
2. Design granite quarries for production of aggregates and dimension stones
3. Design layouts for strip mining of coal and include important economic and environmental considerations
4. Explain the technology for marine mining and include important economic and environmental considerations

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2, 3)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 2, 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINE SURVEYING
Code	TMNU3722
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests and practical's) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TCVE3642 Surveying for Engineers

Contents: Mine surveying: introduction to the importance of mine surveying in the efficient and safe running of a mine; principles of surveying and mine surveying. **Surveying tools: Plans, maps, photographs**, sections and profiles. Comparison of the Engineering and cartographic approach to producing the graphic document, **Scales**. Simple map projections, developable surfaces and distortions, Geometrical construction of a grid, scale bars and diagonal scales. **Rectangular and polar coordinates**: Contours and their interpolation, Cartographic conventions, layout, marginal information. Superimposition of design contours and cut/fill lines, longitudinal profiles and cross-sections, reserve estimation of mineral deposits The plane-meter and areas **Interpretation of maps and plan:**. Understanding map projections, developable surfaces and distortions; transfer of surface surveys to the underground environment; underground mine surveying methods, application to mine planning, design and safety; surveying legal requirements and their application to the mining industry; mathematical and surveying principles for solving three dimensional mine design problems; interpretation of mine surveying results for improved decision making. **Practical**: distance measurement, measuring errors; levelling traversing (with tapes and total stations); vertical surveys; care of surveying equipment; using a gyro-theodolite to determine azimuth; GPS instruments; observations and producing mine surveying records in terms of the mining laws.

Learning Outcomes: On completing the course students should be able to:

1. Explain the principles of surveying as applied to mines
2. Apply the knowledge of producing and analysing plans, maps and photographs of mines
3. Interpret map projections, geometrical constructions and diagonal scales
4. Evaluate rectangular and polar coordinates for contours and cartographic sections
5. Apply the detailed knowledge of underground mine surveying methods
6. Analyse and interpret mine surveying data for decision making
7. Relate practical knowledge of surveying in the field
8. Analyse map projections and interpret mine surveying data

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 7, 8)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2,3, 5, 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 2, 8)
8. Individual, Team and Multidisciplinary Working (Course Outcomes 3, 6, 8)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	COMPUTER APPLICATIONS IN MINING
Code	TMNU3792
NQF Level	7
Contact Hours	3L + 2T or 1PS /Week
NQF Credits	12
Assessment	Continuous 100% (At least 4 Lab Exercises, 4 Assignments, 2 Tests, and 1 Mini-project)
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:

1. Apply Computer Aided Drawing skills
2. Use GIS, Contouring packages and MATLAB in resource modelling
3. Apply software packages for mine design.

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 2, 3)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
3 Engineering Design (Course Outcomes 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 3)
9 Independent Learning Ability (Course Outcomes 1, 2, 3)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINERAL PROCESSING
Code	TMNS3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests and practical's) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TMNE3661 Introduction to Mining Engineering**

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:

1. Discuss the role of comminution in liberation of minerals
2. Discuss the processes involved in size reduction of minerals
3. Apply the principles of concentrating valuable minerals
4. Explain the principles involved in solid-liquid separation
5. Sketch simple flowsheets for mineral processing
6. Explain the basic methods of extracting metals from concentrated ores.

Contribution to Exit Level Outcome:

2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6)
3 Engineering Design (Course Outcomes 5)
4 Investigations, Experiments and Data Analysis (Course Outcomes 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 1, 2, 6)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	TECHNICAL VALUATION
Code	TMNU3742
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite(s)	**TEGS3691 Statistics for Engineers**

Contents: Statistical valuation methods: Overview of descriptive statistics; inference from normal distributions, estimation of mean and standard deviation, confidence levels on parameters, hypothesis testing. Student's T and F-ratio's tests, correlation and regression methods, tests of significance, multivariate regression and trend surface analysis, inference from lognormal distributions, estimation of mean and confidence levels. Grade/tonnage curves. **Geo-statistical valuation methods**: inverse distance techniques, calculation and modelling of semi-variograms, estimation of unknown values, ordinary and universal rigging, volume/variance relationships. **Geo-statistical applications**: valuation and mine economics; mine process flow; mining factors; economic effects of dilution and recovery; SAMREC code; reporting of resources and reserves; paylimits; economic and planning cut-off grades; grade control.

Learning Outcomes: On completing the course students should be able to:
1. Review statistical valuation methods
2. Analyse various geo-statistical models
3. Apply geo-statistical methods in ore valuations.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3)
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2, 3)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3)
11 Engineering Management (Course Outcomes 3)

ECN Exit Outcomes Assessed:

2. APPLICATION OF SCIENTIFIC AND ENGINEERING KNOWLEDGE

Apply knowledge of mathematics, natural sciences, Engineering fundamentals and an Engineering specialty to solve complex Engineering problems.

Assessment Strategies

Continuous (assignments, 2 Tests) 50%, Examination 50% (1 x 3 hour paper)

To pass this module a student should obtain a minimum final mark of 50% and also meet the requirement of ECN exit level outcome 2 assessed as follows:

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to apply knowledge of mathematics, basic science and Engineering sciences from first principles to solve Engineering problems. A 3 hour exam paper concentrating in the use of mathematical, numerical analysis and statistical knowledge and methods to bear on Engineering problems; physical laws and knowledge of the physical world as a foundation for the Engineering sciences and the solution of Engineering problems; techniques, principles and laws of Engineering science at a fundamental level and in at least one specialist area.

What constitute satisfactory performance?

After consideration the 3 hour exam paper, the student is expected to obtain a minimum of 50% of the total mark allocation for exam paper before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be allowed to take the supplementary exam, after which if the minimum competence is still not obtained, then the student is considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINE DESIGN
Code	**TMNS3732**
NQF Level	7
Contact Hours	4L + 2T or 1PS /Week
NQF Credits	16
Assessment	Continuous 50% (At least Assignments 2 and 3 Tests making **30%,** presentation (**10%**) and report (**10%**) on selected topics in Mining Engineering), Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMNS3791 Mine Equipment and Machinery

Contents: Factors affecting the selection of surface mining methods: .Different technological diagrams of surface mining methods Determination of parameters such as optimum depth of a quarry or open pit. **Design of Bench element:** Design of slopes. Determination of overall slope angle, Design of width or working platform of a bench, **Design of surface mines:** Feasibility study of granite or dimension stones quarries. **Selection of mine equipment and machinery:** Typical drilling and blasting pattern designs. Design and construction of explosive magazines Economic indices of surface mine design. Application of software packages to surface mine design. Design of transportation systems and haul roads.**Opening of mineral deposits and the design of mine**: Factors to be considered during the location of shafts, Shaft selection and location, Shaft design, construction. Development of mine fields (levels, panels, and combined methods). **Design of different underground mining methods for different types of deposits:** Design of ventilation circuits, Design of ventilation networks in an underground mine. Design of support systems: wood, bolt and nut, concrete and steel arch supports. Geological modelling of a coal deposit from borehole longs. Selection of transportation systems Application of software packages to mine design- Ventism software.

Learning Outcomes: Upon completion of this module, students should be able to:
1. Analyse surface mining systems
2. Evaluate the working platform and optimum depth
3. Design a surface mine e.g. a granite quarry
4. Design and construct explosive magazines magazine
5. Select of location of a shaft during the opening of a mine
6. Design or select an appropriate method of development of a mine
7. Design support systems in an underground mine
8. Design of ventilation system of a typical underground mine
9. Apply software packages in mine design

Contribution to Exit Level Outcome:

1 Problem Solving (Course Outcomes 1, 2)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
3 Engineering Design (Course Outcomes 3, 4, 6, 7, 8, 9)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 1, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
11 Engineering Management (Course Outcomes 1, 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Total Hours	Six (6) weeks preferably during the June/July break in Year 3 or Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	Continuous 100% (Daily Logbook Record 20%; Lecturer/Employer Evaluation 20% and Final Report 60%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: During Industrial Attachment II, students will work under company supervision at the level of **Technologist Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Distinguish the roles of technologists and technicians in an industrial setting and identify the associated reporting channels.
2. Discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3. Describe the main technical activities undertaken during the attachment.

Issue Date: September 2015
Next Revision: September 2019

YEAR 4 OF BSc IN MINING ENGINEERING

SEMESTER 1

Module Title:	SOCIETY AND THE ENGINEER
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).
Co-requisite(s)	**TEGT3742 Entrepreneurship**

Content: Engineering as a profession: Engineering societies and registration procedure for different / Engineering disciplines. **General principles of Engineering ethics:** statement of ethical principles, Engineering role and responsibility, whistleblowing, code of conduct. **Engineering Council of Namibia (ECN):** its establishment and role as a regulating body. **Engineering coding and standardisation. Introduction to the study of law:** basic procedural law; basic legal concepts; contractual capacity; law of contracts; commercial law; service contracts and employment law. **Laws of arbitration. Technology policy:** utilization of technology as an economic resource. Acquisition of technology as a resource-its role as a vehicle of monopolistic control. mechanism of technology transfer, institutional forms of foreign investment, bargaining for the acquisition of technological know-how. Technology policy-design and implementation in Namibia. **Health and safety at the workplace.** Impact of Engineering activity social, economic, cultural, environmental and sustainability.

Learning Outcomes: On completing the course students should be able to:

1. Discuss the role of various Engineering disciplines and societies
2. Discuss the importance of Engineering professional ethics and its enforcement by the regulating bodies
3. Discuss the use of Engineering codes and standards
4. Demonstrate general knowledge of procedural law, law of contracts, commercial law and employment law
5. Demonstrate knowledge of the laws of arbitration
6. Discuss the role of technology policy on the acquisition of technological know-how
7. Discuss the responsibility of an engineer to health and safety at the workplace
8. Discuss the impact of Engineering activity social, economic, cultural, environmental and sustainability

Contribution to Exit Level Outcome:

7 Sustainability and Impact of Engineering Activity (Course Outcomes 2 (ethics), 4 and 5 (Law), 7 (health and safety), 8)

10 Engineering Professionalism (Course Outcomes 1, 2, 3, 6)

ECN Exit Level Outcomes Assessed:

10 ENGINEERING PROFESSIONALISM

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Assessment Strategies

The assessment will constitute the following:

Continuous 100% (1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety).

Where and how is this exit outcome assessed?

To pass this course a student should obtain a minimum average continuous assessment mark of 60% in order to meet the requirement of ECN exit level outcome 10 which is assessed through 1 Assignment (7%), 1 term paper (20%) and 1 Test (7%) from each aspect of the course: Law, Professionalism, Health and Safety) i.e. 3 Assignments, 3 term papers and 3 tests in total. Students are expected to demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

What constitute satisfactory performance?

After consideration of the 3 term papers, 3 tests and 3 assignments, and with reference to evidence of showing awareness of the need to act professionally and ethically and to exercise judgment, the Lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Professionalism**" in a manner that is considered: "not satisfactory", "satisfactory" or "Excellent". The student is expected to obtain a minimum continuous assessment average mark of 60 before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

If the performance requirements as stipulated above are not met, the student will be considered to have failed and will have to repeat the course.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	PROJECT MANAGEMENT
Code	TEGM3881
NQF Level	8
Contact Hours	3L + 1T/Week
NQF Credits	12
Assessment	Continuous 100% (1 Group project plus presentation, 3 Tests, 4 assignments/case studies)
Pre-requisite(s)	**TEGT3761 Fundamentals of Economics**

Module Description: Basic principles of project management: Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. **Identification and scheduling of project resources**, resource allocation, project flow charts, critical path planning and reports evaluation. **Managing medium to large scale Engineering projects**: inception to completion, appropriate contacts; general conditions of contract for Engineering works. **Programme Evaluation** and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Issues of staff selection and team management. **Managing community-based development projects:** the implications of information technology and globalization on Engineering works **Interdisciplinary team project** that allows students to apply the principles and use the tools they learned.

Learning Outcomes: On completing the course students should be able to:

8. Discuss the principles of project management and project implementation including the importance of project time management, risk management and, performance monitoring and evaluation
9. Apply the processes, tools and techniques of project management in an Engineering context
10. Discuss the principles of managing medium to large scale Engineering projects
11. Discuss the principles of managing community-based development projects
12. Discuss the concepts of close-out phases of the project life cycle
13. Integrate and balance overall project management functions and apply available software tools for project management
14. Manage projects in multidisciplinary environments using techniques from economics, business management and project management as an individual or a member of a team

Contribution to Exit Level Outcome:

5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 6)
8 Individual, Team and multi-discipline Working (Course Outcomes 7)
11 Engineering Management (Course Outcomes 1, 3, 4, 5, 7)

ECN Exit Level Outcomes Assessed:

12 **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments

11 **ENGINEERING MANAGEMENT**
Demonstrate knowledge and understanding of Engineering management principles and economic decision-making.

Assessment Strategies

The assessment will constitute the following:

Continuous Assessment 100% (at least 2 Assignments: 20%, at least 2 Tests: 40%, group project presentation: 20% and group project report: 20%). Each group must consist of students from a minimum of two different disciplines.

To pass this course a student should obtain a minimum average continuous assessment mark of 60% and also meet the requirement of ECN exit level outcome 8 and 11 assessed in the group project presentation and submitted group project report.

ECN Exit Level Outcome 8 - **INDIVIDUAL, TEAM AND MULTIDISCIPLINARY WORKING**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. The group project presentation and group project report should show evidence of the student's ability: to work effective as an individual by Identifying and focusing on objectives, Working strategically, Executing tasks effectively and delivering completed woke on time; to work effective as a team by making individual contribution to team activity, Performing critical functions and delivering work on time, Enhancing work of fellow team members while benefiting from their support and communicating effectively with team members; to work in a multidisciplinary environment by acquiring a working knowledge of co-workers' discipline, using a systems approach to tackle Engineering problems and communicating across disciplinary boundaries.

What constitute satisfactory performance?

After consideration of the group Project Presentation and group project report, and with reference to evidence showing the ability for individual, in teams and in multidisciplinary environments, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of "**Individual, Team and Multidisciplinary Working**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the group project presentation and group project report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised project report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 11 - **ENGINEERING MANAGEMENT**

Where and how is this exit outcome assessed?

Students are expected to demonstrate knowledge and understanding of Engineering management principles and economic decision-making. The 2 tests and 2 assignments should clearly show evidence of the student's knowledge and understanding of Engineering project management principles and economic decision-making, using basic techniques from economics, business management and project management in a multidiscipline environment as well as perform techno-economic analysis.

What constitute satisfactory performance?

After consideration of the 2 tests and 2 assignments, and with reference to evidence showing the ability to use basic techniques and knowledge from economics, business management and project management to bear on Engineering practice, the lecturer will complete an assessment form to indicate whether the student has demonstrated evidence of " **Engineering Management**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"excellent".*** In addition, the student is expected to obtain a minimum of 50% of the total mark allocation for the 2 tests and 2 assignments before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?
The student will be given a supplementary test and assignment within the time as determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINE HEALTH, SAFETY AND ENVIRONMENT
Code	TMNU3831
NQF Level	8
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% **%** (At least 2 Assignments , 3 Tests , group project presentation and group project report) and Examination 50% (1 x 3 hour paper)
Co-requisite(s)	(TMNC3791 Mine Ventilation and Climate Control), (TMNS3762 Surface Mining)

Contents: Safety organization in mines; personal protective equipment, causes of mine accidents; accident statistics and records keeping; industrial hygiene; basic first aid; analysis of health and safety problems in the Namibian mining industry. **Surface and underground Mine safety precautions:** during stripping, drilling and blasting, extraction-loading and haulage, opening of stope driving of tunnels Safety precaution during mining with dredges. Safety precaution in the use and transportation of explosives and their accessories, Explosive magazines, **Mine environment**: Mine dust, mine gases, mine fires, mine water, noise, illumination, mine air, radioactive and toxic substances. Health, safety and environmental issues in the mining of radioactive substances like uranium. **Health Issues:** Different occupational diseases associated with mining, silicosis from fine silica dust, cancer associated with coal mining. Slope stability, Analysis of water and soil quality using ASTM standard and USEPA. **Mine Communication. Mine Law and Regulations**: Mining and the environment; mining legislation. Minerals (Prospecting and Mining) Act; mineral rights. **Environmental issues**: Environmental Impact Assessment (EIA); **Environmental pollution:** definitions, causes and interrelationships. Gaseous and particulate pollutants and their sources, **Mine atmosphere:** detection of mine gases, physiological effects, inflammation and detonation, gas layering and diffusion. Dust hazards. Pollution monitoring and control, methods of controlling gaseous and particulate pollutants, **Mine effluents**: effects on air, surface and ground water, and land. Spontaneous combustion, acidic mine drainage etc. Methods of effluent treatment, Impact of mining on mine environs effects on agriculture, surrounding habitats, etc. Mine drainage: water recovery and re-cycling mine reclamation and rehabilitation, mine closure and different types mine reclamation methods. **Case Studies**: Typical case studies on health and safety problems in mines. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:

1. Analyse safety and health issues at the mine and how to control them
2. Relate the knowledge of environmental issues of mining projects and how to control them
3. Relate occupational disease associated with mining and symptoms
4. Explain various techniques used in mine communication
5. Discuss basic knowledge of legal aspects of mining safety and the environment as stipulated in the Minerals (Prospecting and Mining) Act
6. Discuss mineral rights and the general mine law
7. Discuss procedures for carrying out environmental impact assessment (EIA) of mine projects and treatment of mine effluents

Contribution to Exit Level Outcome:

2	Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7)
6	Professional and Technical Communication (Course Outcomes 4, 5, 6, 7)
7	Sustainability and Impact of Engineering Activity (Course Outcomes 5, 6, 7)
9	Independent Learning Ability (Course Outcomes 5, 6, 7)
10	Engineering Professionalism (Course Outcomes 5, 6, 7)
11	Engineering Management (Course Outcomes 5, 6, 7)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	UNDERGROUND MINING
Code	TMNU3811
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
NQF Credits	16
Assessment	Continuous 50% (At least 2assignments, 3 Tests) 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite(s)	**TMNE3711 Excavation Engineering**

Contents: Historical and present-day methods of exploitation: of hard rock mineral deposits; selection of mining techniques; location of shafts. Shaft sinking; shaft station layouts. Major development layout; level, horizon and panels methods of development, Conventional and specialized development. **Mining systems**: Methods of extraction of deposits, short-walls and long-walls mining systems mine design parameters Mining processes in underground operations **Mechanization of operations and special technologies**: Design: practical design exercises for exploiting tabular ore deposits. **Exploitation of massive ore bodies**: open stopping, room and pillar mining, cut and fill stopping, shrinkage mining, post pillar cut and fill mining, block caving, continuous block caving, forced caving, sublevel caving, sundry mining methods. **Coal mining methods**: the safe and efficient exploitation of underground coal deposits by means of board and pillar, pillar extraction, rib-pillar, short wall, long wall and specialized thick- and thin-seam techniques. **Coal mining equipment**, panel design and production potential., market identification, plant design, mine design, layout scheduling **Trackless mining**: selection and operation of underground trackless equipment for massive mining. Practical design exercise.

Learning Outcomes: On completing the course students should be able to:
1. Explain shaft locations techniques
2. Explain mine development methods
3. Design and select mining methods and specify parameters for safe underground extraction
4. Design and analyse different design techniques and mechanical technologies used in massive mining
5. Discuss the mining systems and factors to be considered for safe working environment.

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5)
3 Engineering Design (Course Outcomes 3, 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 3, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 5)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	ROCK ENGINEERING
Code	TMNS3861
NQF Level	8
Contact Hours	2L + 1T or 1PS/Week
NQF Credits	8
Assessment	Continuous 50% (At least 2 assignments, 2 Tests) 50%, Examination 50% (1 x 2 hour paper)
Co-requisite(s)	TMNU3791 Soil and Rock Mechanics

Contents: Introduction to Rock Engineering: Definition of terms and importance of rock mechanics; applications of rock Engineering to Mining, Civil and Petroleum Engineering. **Physical and Mechanical properties:** Porosity Density; Permeability; Strength: Slaking and Durability: Sonic velocity as an index to degree of fissuring; **Classification and Index properties of rocks** – Geological classification of rocks (crystalline rocks, organic rocks); Classification of rock masses for Engineering purposes. Rock strength and Failure Criteria Modes of failure of rocks Common Laboratory strength tests (Uniaxial, Tri-axial, Brazilian, Flexural tests); Stress-Strain behaviour in compression; Effect of confining pressure; **Discontinuities in rocks**: crack, fissure, fracture, bedding plane. **Application of rock Engineering in surface mines** Slope stability analysis. Application of the complete Stress-Strain curve The Mohr Coulomb failure criterion; the effect of water; The influence of the principal Stress ration on failure; Empirical criteria of failure; Coulomb-Navier criterion of failure of rocks; Griffith brittle failure Criterion. Elastic properties, **Applications of rock Engineering in underground openings:** Support systems design and selection – caving and subsidence. Roof and ground control. Field Trip to surface and underground mines

Learning Outcomes: On completing the course students should be able to:
1. Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
2. Discuss strength and deformation characteristics of rock masses
3. Explain mechanical properties of rock masses
4. Discuss failure criteria for rocks and rock masses

Contribution to Exit Level Outcome:
2 Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4)
4 Investigations, Experiments and Data Analysis (Course Outcomes 4)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)

Issue Date: September 2015
Next Revision: September 2019

Module Title:	MINE MANAGEMENT PRINCIPLES AND FINANCIAL VALUATION
Code	TMNS3831
NQF Level	8
Contact Hours	4L + 2T /Week
NQF Credits	16
Assessment	Continuous 50% (At least 2 assignments, 3 Tests) 50%, Examination 50% (1 x 3 hour paper)
Co-requisite(s)	TMNU3742 Technical Valuation

Contents: Management Principles: History of management theory; managerial conceptual thinking; management work within the business. Organizing and determinants of organization, Planning and organization of mines, Controlling, leading, determination of shift, daily, monthly and yearly production, Managerial activities and tools; time management; attributes of a manager, industrial relations and legislation. **Risk management**: risk management terminology; functions and principles of risk management; introduction to risk assessment; due diligence; requirements of the Mine Health and Safety Act. **Introduction to financial analysis**: Introduction; financial statements; behaviour of costs; time value of money; capital value decisions; inflation; discounted cash flow models. **Funding**: sources of funding, cost of capital, gearing; **Revenue**: metals and minerals market, price influences, hedging and option pricing, margins and marginality; Reporting: annual reports, financial statements, competent persons report, valuations and acquisitions, takeovers. **Applied financial analysis**: financing of projects; depreciation and depreciation methods, replacement, taxation, applied valuation; evaluation of alternatives: organizational objectives, investor expectations, mining company growth, economic valuation of Investment alternatives, quantitative methods applied. **Decision making**; structure of decision making, feasibility studies, decision making criteria, economic value add, sensitivity analyses, comparative valuations, benchmarking and ranking. Investment analysis: techno-economic analysis of mining projects, financial analysis, intangible analysis, risk assessment and risk management. Financial valuation of a coal mine, **Coal as a commodity**: coal quality, coal utilization and marketing.

Learning Outcomes: On completing the course students should be able to:
1. Explain knowledge of general management principles
2. Discuss the planning an organisation of mines
3. Illustrate a simple organisation chart of a mine
4. Discuss techniques of time management
5. Explain the industrial relations and legislation pertaining to the mining industry.
6. Explain principles and functions of risk management
7. Analyse financial management and principles
8. Discuss various funding sources and funding mechanisms for mines
9. Apply financial analysis in the decision making process

Contribution to Exit Level Outcome:

2	Application of Scientific and Engineering Knowledge (Course Outcomes 1, 2, 3, 4, 5, 6, 7, 8, 9)
4	Investigations, Experiments and Data Analysis (Course Outcomes 7, 9)
7	Sustainability and Impact of Engineering Activity (Course Outcomes 5, 8)
10	Engineering Professionalism (Course Outcomes 4, 5, 8, 9)
11	Engineering Management (Course Outcomes 1, 4, 6, 7)

Issue Date:	September 2015
Next Revision:	September 2019

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMNR3892
NQF Level	8
Contact Hours	20 hours of Research Work per week (20 hours x 14 weeks = 280 notional hours or 28 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Dissertation.
NQF Credits	30
Assessment	Continuous 100% Two Seminar Presentations (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]
Co-requisite(s	TCER3891 Research Proposal, All third year modules

Contents A project of an investigation nature carried out either as an individual or as member of a small team, involving research, literature search, data collection, analysis and presentation. The presentation, in the form of a dissertation, is expected to include necessary technical information and to be in accordance with relevant codes of practice.

Learning Outcomes: On completing the course students should be able to:
1. Apply skills necessary to carry out a technological or Engineering investigation.
2. Formulate and defend a core area project proposal, clearly identifying objectives, proposed methodology and significance of the proposed project.
3. Independently acquire knowledge on previous solutions developed and/or presented by others in solving related problems and referencing such works.
4. Carry out research and present research findings in a concise and comprehensive report, clearly drawing reasonable conclusions and suggestions for future work.

Contribution to Exit Level Outcome:
4 Investigations, Experiments and Data Analysis (Course Outcomes 1, 2)
5 Engineering Methods, Skills and Tools, including Information Technology (Course Outcomes 3)
6 Professional and Technical Communication (Course Outcomes 5)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 4)
8 Individual, Team and multi-discipline Working (Course Outcomes 1, 6)
9 Independent Learning Ability (Course Outcomes 6)

ECN Exit Level Outcomes Assessed:

4. **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Demonstrate competence to formulate and conduct investigations and experiments.

5. **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Demonstrate competence to use appropriate Engineering methods, skills and tools, including those based on information technology.

9. **INDEPENDENT LEARNING ABILITY**

Demonstrate competence to engage in independent learning through well-developed learning skills.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: one Seminar presentation (**20%**); Final Oral Presentation of Research Report (**20%**); Final Research Report (**60%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 4, 5, 9 assessed as follows:

ECN Exit Level Outcome 4 - **INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the design and conductions of investigations and experiments. The final research report should contain the student's ability to plan and conduct investigations and experiments using appropriate equipment as well as analyze, interpret and derive information from data.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with **Investigations, Experiments and Data Analysis**, and with reference to the planning and conduction of the investigation and experiments as well as analysis, interpretation of results, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Investigations, Experiments and Data Analysis**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Investigations, Experiments and Data Analysis**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 5 - **ENGINEERING METHODS, SKILLS AND TOOLS, INCLUDING INFORMATION TECHNOLOGY**

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence in the use of appropriate Engineering methods, *skills* and tools, including those based on information technology. The final research report should show evidence of the student's ability to use computer packages for computation, design, modelling, simulation and information handling; use computers, networks and information infrastructures for accessing, processing, managing and storing information.

What constitute satisfactory performance?

After consideration of the section of the final research report that deals with Engineering methods, skills and tools, including information technology, and with reference to the use of computer, computer packages as well as computers networks and information infrastructures for accessing, processing, managing and storing information, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering Methods, Skills and Tools, including Information Technology" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering Methods, Skills and Tools, including Information Technology" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

ECN Exit Level Outcome 9 – INDEPENDENT LEARNING ABILITY

Where and how is this exit outcome assessed?

Students are expected to demonstrate competence to engage in independent learning through well-developed learning skills. In the course of the research project, students are supposed to show their ability to engage in independent learning through well-developed learning skills and awareness of up-to-date tools, techniques and new developments in Engineering and technology as well as the need to access, comprehend and apply knowledge acquired outside formal instruction and guidance from the supervisor.

What constitute satisfactory performance?

After consideration of student's individual conduct in the course of the research project, and with reference to evidence showing the ability to keep abreast with up-to-date tools, techniques and new developments in Engineering and technology outside formal instruction, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence of "**Independent Learning Ability**" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** The supervisor will be expected to give examples of cases where the student demonstrated independent learning skills in the course of the research project.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report to beef up independently learned components, within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date:	September 2015
Next Revision:	September 2019

Module Title:	**MINING DESIGN PROJECT**
Code	TMND3890
NQF Level	8
Contact Hours	20 hours of Design Work per week (20 hours x 16 weeks = 320 notional hours or 32 credits). Add 20 notional hours (2 credits) for Seminar Presentations and Oral Presentation of Design)
NQF Credits	34
Assessment	Continuous 100% Two Seminar Presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]
Co-requisite(s	**All third year modules**

Contents An essential element of Engineering is the creative solution of open-ended problems. This course provides students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing major design projects and presenting their proposed solutions in a concise technical manner. The designs should be accompanied with manual and/or computer-generated Engineering drawings or computer source codes consistent with professional Engineering practice. The design process will be conducted under the guidance of a Supervisor.

Learning Outcomes: On completing the course students should be able to:
1. Identify and formally state problems that can be solved using Engineering knowledge and skills.
2. Apply practical skills in the design of Engineering components, assemblies and/or systems.
3. Apply knowledge of creativity, innovation, safety, ergonomics and good Engineering practice in the design process.
4. Develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced.
5. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated Engineering drawings or source codes and any other relevant information.

Contribution to Exit Level Outcome:
1 Problem Solving (Course Outcomes 1, 2, 4, 6)
2 Application of Scientific and Engineering Knowledge (Course Outcomes 2, 3, 4)
3 Engineering Design (Course Outcomes 2, 4, 6)
4 Investigations, Experiments and Data Analysis (Course Outcomes 2, 3, 6)
5 Engineering Methods, Skills and Tools, Including Information Technology (Course Outcomes 2, 4)
6 Professional and Technical Communication (Course Outcomes 7)
7 Sustainability and Impact of Engineering Activity (Course Outcomes 3, 5)
8 Individual, Team and Multidisciplinary Working (Course Outcomes 4, 6)
9 Independent Learning Ability (Course Outcomes 2, 6)
10 Engineering Professionalism (Course Outcomes 4, 7)
11 Engineering Management (Course Outcomes 4, 6)

ECN Exit Level Outcomes Assessed:

1 **PROBLEM SOLVING**

Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively.

3 **ENGINEERING DESIGN**

Perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes.

6. **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Demonstrate competence to communicate effectively, both orally and in writing, with Engineering audiences and the community at large.

Assessment Strategies

The assessment will be **100% Continuous** constituting of the following: Two Seminar Progress report presentations of design (**30%**); Final Oral Presentation of Design Report (**20%**); Final Design Report (**50%**)]

To pass this course a student should obtain a minimum final mark of **50%** and also meet the ECN exit level outcome 1, 3, 6 assessed as follows:

ECN Exit Level Outcome 1 – **PROBLEM SOLVING**

Where and how is this exit outcome assessed?

Students are expected to competently Identify, formulate, analyze and solve complex Engineering problems creatively and innovatively. The final design report should show evidence of the student's ability to identify, analyze and formulate the design problem to satisfy user needs, and identify criteria for acceptable solution; identify necessary requirements and applicable skills relevant to the problem; Evaluate alternatives and preferred solutions and exercise judgment through a morphological chart – where independent design characteristics are listed in a chart, and different Engineering solutions are proposed for each solution; Formulate and present the solution in an appropriate form.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with problem solving, and with reference to the morphological chart, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "Problem Solving" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "Problem Solving" in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN exit level outcome </u>3 – **ENGINEERING DESIGN**

Where and how is this exit outcome assessed?

Students are expected to show the ability to competently perform creative, procedural and non-procedural design and synthesis of components, systems, Engineering works, products or processes. The final design report should show evidence of the student's ability to use applicable standards, codes of practice and legislation; plan and manage the design process by being able to focus on important issues and recognize and deal with constraints; acquire and evaluate the requisite knowledge, information and resources, apply correct principles, evaluate and use design tools; perform design tasks including analysis, quantitative modelling and optimization.

What constitute satisfactory performance?

After consideration of the section of the final design report that deals with Engineering ***Design***, and with reference to the design process, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in " Engineering ***Design***" in a manner that is considered: "*not satisfactory", "satisfactory" or* ***"Excellent".*** In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with " Engineering ***Design*** in the submitted final design report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised report within the time as determine by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

<u>ECN exit level outcome 6</u> - **PROFESSIONAL AND TECHNICAL COMMUNICATION**

Where and how is this exit outcome assessed?

Students are expected to demonstrate ability to effectively communicate the design logic and information in effective communication both orally and in writing, with Engineering audiences and the community at large. The final design report should show evidence of the student's ability to use appropriate structure, style and graphical support as well as applying methods of providing information for use by others involved in Engineering activity while the final oral presentation of design report should demonstrate effective oral communication with Engineering audiences and the community at large.

What constitute satisfactory performance?

After consideration of the section of the final research report and the final oral presentation of research report that deals with **Professional and Technical Communication**, and with reference to oral and written communication, the supervisor will complete an assessment form to indicate whether the student has demonstrated evidence in "**Professional and Technical Communication**" in a manner that is considered: "*not satisfactory", "satisfactory" or "Excellent".* In addition, the student is expected to obtain a minimum of 50% of the average scores by the examiners to the section dealing with "**Professional and Technical Communication**" in the submitted final research report before being declared to have met the requirement of this competency satisfactorily.

What strategy is to be followed in case where this exit outcome is not satisfactorily attained?

The student will be required to resubmit a revised research report within the time determined by the department. If the performance requirements as stipulated above are not met, the student will be considered to have failed the course.

Issue Date: September 2015
Next Revision: September 2019

Module Title:	**INDUSTRIAL ATTACHMENT III**
Code	TEGT3800
NQF Level	8
Total Hours	Six (6) weeks preferably during the June/July break in Year 4 of Engineering. About 6 hours/day x 5 days/week) x 6 weeks = 180 hours.
NQF Credits	Not assigned**.** The Module is required to be satisfactorily done before graduation.
Assessment	100% Continuous Assessment made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (25%), Seminar presentation (25%).
Co-requisite(s)	TEGT3700 Industrial Attachment II

Content: During Industrial Attachment III, students will work under company supervision at the level of **Engineer Trainee** and will undertake at least six weeks of attachment at an appropriate industry for hand-on practical training. Students will maintain a logbook of daily activities and will be required to submit a comprehensive final report supported by appropriate Engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. Students will be visited at their work places by their Lecturers at least once during attachment.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Distinguish the roles of engineers and technologists in an industrial setting and identify the associated reporting channels.
2. Critically discuss the main technical operations, including inputs, processes and outputs, associated with a specific industry or Engineering operation.
3. Discuss the role of engineers in the management and organization of Engineering enterprises
4. Discuss in details the main technical activities undertaken during the attachment

Issue Date: September 2015
Next Revision: September 2019

ENGINEERING POSTGRADUATE STUDIES

N. POSTGRADUATE TRAINING PROGRAMMES AT JEDS

N.1 School of Engineering and the Built Environment

- Master of Science (MSc) in Civil Engineering (Structures)
- Master of Science (MSc) in Civil Engineering (Transportation)
- : Master of Science (MSc) in Civil Engineering (Water)
- Master of Science in Water Resources Management **(No intake 2022)**
- Master of Science in Mechanical Engineering (by Thesis)
- Master of Science Electrical Engineering (by Thesis)
- Master of Science Electronics and Computer Engineering (by Thesis)
- Master of Science Metallurgical Engineering (by Thesis)
- Master of Science Mining Engineering (by Thesis)
- Master of Science (Civil Engineering) (by Thesis)
- Doctor of Philosophy in Engineering

TERMS OF REFERENCE OF THE POSTGRADUATE STUDIES COMMITTEES

1. COMPOSITION:

Members of the Faculty PGSC will be nominated by each department and approved by the relevant Faculty Board according to the following criteria:

(a) Chairperson: Faculty HoD for Postgraduate Studies.
(b) At least one member from each department/campus with a PhD, except departments without PhD holders where a Masters holder with extensive research experience may serve. Schools will function as departments with regards to representations at Faculty Committees.
(c) Secretary: Faculty Officer or Assistant Faculty Officer.
(d) Faculty or Campus Representative on URPC should be a member.
(e) Any other staff member, on invitation, as need arises.

2. QUORUM RULES:

The quorum of the Faculty Postgraduate Studies Committee shall be one half plus one of the members holding office at the time of the meeting.

3. TERMS OF REFERENCE:

(a) To ensure quality control of all research proposals in accordance with Postgraduate guidelines;
(b) To critically scrutinize and approve research proposals and submit approved research proposals for noting to the UNAM Postgraduate Studies Committee (UNAM PGSC);
(c) To organize postgraduate seminars for all postgraduate students admitted into the Faculty in accordance with Postgraduate guidelines;
(d) To ensure that submitted Master and Doctorate research proposals and theses/dissertations comply with the guidelines;
(e) To monitor progress of postgraduate students and make recommendations to the UPGSC for approval;
(f) To recommend the appointment of postgraduate examiners and supervisors to the UPGSC for approval;
(g) To submit notifications of intent to submit theses/dissertations for noting to the UPGSC.
(h) To recommend new and revised postgraduate programmes to the UPGSC;
(i) To compile and submit to the Centre for Postgraduate Studies (CPGS) annual reports on postgraduate activities (through the chairperson);
(j) To monitor equity and regional representation in postgraduate student admissions;
(k) To assist postgraduate students in obtaining ethical clearance certificates from RPC through their faculty representatives on RPC;
(l) To recommend Masters and Doctoral *Viva Voce* Panels to CPGS.
(m) To inspect the final bound copies and digital formats (in pdf format) of theses/dissertations of graduating students before they are submitted to the CPGS;
(n) To develop and maintain a faculty database of postgraduate students and their progress;
(o) To process and submit claim forms for payment of supervisors and examiners;
(p) To submit agenda items for UPGSC to the PGS secretariat (chairperson);
(q) To undertake any other duties that may be assigned to the Faculty PGC by the UPGSC or CPGS that relate to postgraduate studies.

O. REGULATIONS AND GUIDELINES FOR POSTGRADUATE PROGRAMMES

PREAMBLE

The guidelines and regulations presented in this prospectus are intended to familiarise Faculties, Schools, Centres and students with the University of Namibia's (UNAM's) Postgraduate programmes.

O.1. POSTGRADUATE TRAINING PROGRAMMES AT JEDS

Students who are on full time employment should take studies on a part time basis.

O.1.1. POSTGRADUATE DIPLOMA PROGRAMMES

1) UNAM makes provision for Postgraduate Diploma programmes in selected fields as approved by Senate.
2) Postgraduate Diploma programmes offer specialised training, which is career-oriented.
3) Postgraduate Diploma programmes have a minimum of **one year** duration for **full-time** students, and **two years** for **part-time** students; are **taught** programmes (i.e. involve lectures, seminars, practicals, written tests and examinations, etc); and also include a small independent research component.

O.1.2. MASTER'S DEGREE PROGRAMMES

1) Postgraduate training programmes at Master's degree level are of two types:
   (a) Master's degree by research culminating in a thesis.
   (b) Taught Master's degree involving at least one academic year of coursework followed by a mini thesis.
2) Students admitted to Master's degree programmes enrol on either a full time or part time basis. Master's degree programmes have minimum of two years duration for full-time students and three years for part-time students; and **a maximum of three years for full time students and maximum of five years for part-time students,** unless otherwise stipulated by programme specific regulations.

O.1.3. DOCTORAL PROGRAMMES

1) Doctoral programmes at UNAM are normally undertaken by research and the writing of a dissertation unless otherwise approved by Senate. The duration of a doctoral programme is a minimum of three for full-time studies and four years for part-time students; and **a maximum of four years for full time students and maximum of six years for part-time students.**
2) Doctoral study opportunities at UNAM are offered where the departments have the necessary qualifications for admission, where the relevant Department has the necessary research facilities and infrastructure, and where sufficiently qualified and experienced academics are available and ready to provide effective supervision.

O.1.4. APPROVAL OF POSTGRADUATE PROGRAMMES

All programmes should be considered by the UNAM Postgraduate Studies Committee to ensure that they adhere to the UNAM Postgraduate regulations and standards of quality, before these programmes are recommended by the Academic Planning Committee (APC) to Senate for approval.

O.2. REGULATIONS AND GUIDELINES GOVERNING POSTGRADUATE APPLICATIONS

O.2.1 ELIGIBILITY FOR ADMISSION/ PROCEDURES TO APPLY FOR POSTGRADUATE STUDIES

UNAM welcomes students with a range of qualifications from all over the world. Applicants must fulfil the minimum admission requirements for entry as well as English Language requirement (if relevant) as indicated. Competition for places in some programmes is extremely high, and the minimum requirement given may not be sufficient to be admitted. **Due to this, applicants may be requested to undergo further screening processes.**

O.2.2 POSTGRADUATE DIPLOMA

1) Prospective students must be in possession of a relevant Bachelor's degree from UNAM or any other recognised institution.
2) Students who do not comply with (1) above may also be considered according to the University approved Recognition of Prior Learning (RPL) Policy.

O.2.3 MASTER'S DEGREE

1) Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the chosen field of study.
2) In addition, prospective students must satisfy Faculty specific requirements as indicated in the admission requirements of the relevant programme (e.g. minimum two years teaching experience and a screening test for M.Ed. admission).

O.2.4 DOCTOR OF PHILOSOPHY DEGREE AND OTHER DOCTORAL PROGRAMMES

1) Prospective candidates must be in possession of a NQF level 9 Master's degree or equivalent from UNAM or any other recognised institution, in the chosen field of study.
2) Students who enrolled for a Master's degree by thesis only may be considered for upgrading into the Doctoral Programme if, during the second year of registration they demonstrate sufficient original contribution(s) to knowledge as motivated by the supervisors through the Faculty Postgraduate Studies Committee and approved by the UNAM PGSC.

O.3 APPLICATION PROCEDURES FOR POSTGRADUATE STUDIES

O.3.1 APPLICATION FORMS

Applications for postgraduate studies should be made on a University **postgraduate application form** which is available on request from the Office of the Registrar, Student Records Section, and can also be downloaded from the UNAM Webpage: http://www.unam.edu.na

Before completing the application form, applicants must familiarise themselves with all aspects pertaining to postgraduate studies as set out in this prospectus. Applicants must also acquaint themselves with the different modes of the programmes offered (e.g. taught programmes or by thesis/dissertation only, full time or part time). Applicants must ensure that all relevant documentation is submitted with the application form, together with a **non-refundable application fee**. Receipt of the application will be acknowledged by mail.

Prospective students with qualifications obtained from an institution outside Namibia (or non-accredited institutions in Namibia) must submit a Namibia Qualifications Authority (NQA) evaluation for such qualification together with their application forms compulsory. Please Note: this process takes at least 30 days and proof of submission to NQA will NOT be accepted.

All Master's by Thesis and Doctorate by Dissertation must submit a research topic concept note (maximum two pages) together with the application form. No consideration will be given to applications without the concept note.

Incomplete applications will not be considered.

The closing date for taught Master's and taught Doctoral applications is end of **July** of each year or as advertised **(No late applications will be accepted).**

Application for Master's and Doctoral programmes by thesis/dissertation only, will be accepted throughout the year.

O.3.2 PROCESSING OF APPLICATIONS

The completed application forms will be processed and forwarded by the Student Records Section to the Centre for Postgraduate Studies which will in turn forward the applications to the relevant Faculty/School/Department Admission Committees.

O.3.3 ADMISSION OF STUDENTS

The Department/School recommends admission through the Faculty to the Centre for Postgraduate Studies taking into account the applicant's fulfilment of the minimum admission requirements, availability of supervisors and space. A provisional admission letter indicating further conditions to be met as applicable will be issued to prospective student.

Master's by Thesis and Doctoral programmes by Dissertation

The relevant Faculty PGSC will recommend Supervisor(s) according to the applicant's area of study to the UNAM PGSC for approval.

Upon approval of the supervisor(s) by the UNAM Postgraduate Studies Committee and verification of other conditions, an admission letter is issued by the Centre.

It is the responsibility of the student to ensure that the supervision agreement (Annex 1) is signed with the supervisor. After verification of this agreement by the Faculty PGS Officer the student may register during the next registration period (first week of the month).

Master's and Doctoral Programmes by coursework

Upon recommendation by the relevant Department/School, the FPGSC will recommend a supervisor(s) according to the applicant's area of study to the UNAM PGSC for approval, at least six months before the start of the research component.

O.3.4 STUDY PERMIT REQUIREMENTS

According to the Immigration Control Act of 19 August 1993, all International students (SADC and Non-SADC) must be in possession of a valid approved Study Permit and Visa before entering Namibia for the purpose of studying. All prospective (first and senior) students are required to apply for a Study Permit and Visa on the prescribed forms obtainable from the University of Namibia or at the Namibian Embassy in any country or the nearest Namibian Embassy or Ministry of Home Affairs and Immigration (Namibia) website.

Only persons with permanent Namibian Residence, Refugees or Asylum Seekers and Diplomatic representatives are exempted from applying for a Study Permit and Visa. The mentioned categories are exempted on condition that they provide the relevant documentation (i.e. Permanent Residence Permit, approved and endorsed Refugee/ Political Asylum Seekers status, a Courtesy Visa which confirms diplomatic status) to the University of Namibia.

Study Permits, Work Permits and Tourist Visas are not interchangeable. Kindly note that candidates in possession of a work permit will need to apply for a study permit if offered provisional admission to the University of Namibia.

The University of Namibia and the Ministry of Home Affairs and Immigration (Namibia) have a temporary arrangement that students may apply for their Study Permits during the duration of the scheduled registration period.

O.4 REGULATIONS AND GUIDELINES GOVERNING REGISTRATION OF ADMITTED STUDENTS

O.4.1 REGISTRATION FOR MASTER'S/DOCTORAL BY THESIS/DISSERTATION ONLY

O.5.1.1 Registration of admitted students

1) All postgraduate students are expected to adhere to the deadline dates for registration as stipulated in the Faculty, Postgraduate and General Regulations Prospectuses.
2) All Postgraduate Students shall be required to register for the **compulsory module on "Academic Writing for Postgraduate Students".**
3) Students who apply for Masters/Doctoral may be required to enrol in selected modules, which will help to bridge any gaps in their earlier training or expose them to new developments in their study disciplines, as may be recommended by relevant FPGSC and approved by the UNAM PGSC. Students must pass these modules before they qualify for graduation.
4) All Postgraduate Students shall be required to register **every year** for the duration of the specific programme, unless approval has been granted for a break in studies.
5) Students who fail to register for any particular academic year will have to apply for re-admission to the programme and provide valid reasons why he/she could not register for the particular academic year.
6) A registered student may be allowed to transfer to the University of Namibia (from another institution) subject to written approval of the supervisor(s) and the relevant Postgraduate Studies governing bodies from both Universities involved. Registration is subject to the availability of suitable supervisors and all relevant processes and regulations of the University of Namibia.
7) A registered student may be allowed to transfer from the University of Namibia subject to written approval of the supervisor(s) and the relevant Postgraduate Studies governing bodies from both Universities involved.
8) No student shall be admitted as a candidate for more than one qualification at the same time without the special permission of Senate. Likewise, no student registered at the University of Namibia shall be permitted to enroll as a student at another university at the same time.
9) Senate may, after consultation with Faculties, restrict the number of candidates who may be permitted to register for a particular course of study, in which case Faculties may, from amongst the candidates qualified to register for such a course of study, select those who will be permitted to register.

O.4.2 REGISTRATION FOR MASTER'S/DOCTORAL PROGRAMMES BY COURSEWORK

Registration of admitted students

1) All postgraduate students are expected to adhere to the deadline dates for registration/addition of modules as stipulated in the Faculty, Postgraduate and General Regulations Prospectuses.
2) Students who are registered in programmes involving coursework and a thesis/dissertation will be required to enrol for **core** and **elective** (optional) modules, as prescribed in the relevant Faculty Prospectus and in the Centre for Postgraduate Studies Prospectus under the relevant Faculty.
3) Before registering for the research component, students must sign an agreement with the approved supervisor (Annexure 1) **not later than six (6) months** before the scheduled start of the research project, as reflected in the curriculum.

O.4.3 APPROVAL OF RESEARCH PROPOSAL

Within three (3) months of signing the agreement with the approved supervisor the research proposal accompanied by all supporting documents (e.g. informed consent form, interview guide etc) must be presented to the Faculty PGSC. The Faculty PGSC makes one of three recommendations:

Within six (6) months of registration for a Master's and within nine (9) months of registration for a Doctoral programme, the research proposal accompanied by all supporting documents(informed consent form, interview guide etc) must be presented to the Faculty PGSC. The Faculty PGSC makes one of three recommendations:

1. Approves the research proposal and recommends it, as well as the Ethical Clearance Certificate obtained from the CRP, to the UNAM PGSC for noting and issuing of the Research Permission Letter by the Director: Postgraduate Studies;
2. Rejects the research proposal and recommends de-registration of the student to the UNAM PGSC.
3. Grants an extension period of three (3) months for re-submission after which the Faculty PGSC makes one of the following recommendations:

3.1 Approves the research proposal and recommends it, as well as the Ethical Clearance Certificate obtained from the CRP, to the UNAM PGSC for noting and issuing of the Research Permission Letter by the Director: Postgraduate Studies;

3.2 Rejects the research proposal and recommends de-registration of the student to the UNAM PGSC;

3.3 Recommends registration at a lower level for a PhD candidate (Master's by Thesis only).

O.5 COLLABORATIVE POSTGRADUATE TRAINING

1) Through collaborative arrangements, students may undertake part of their training with other institutions of higher learning that the University is collaborating with.
2) Registration of students on collaborative programmes will be guided by the particular Memorandum of Understanding.
3) The implementation of collaborative programmes should adhere to terms and conditions stipulated in the Memorandum of Understanding.

O.6 CANCELLATION AND EXEMPTION OF MODULES

1) All postgraduate students are expected to acquaint themselves with the deadline dates for cancellation and exemption of modules as stipulated in the Faculty, Postgraduate and General Rules and Regulations Prospectuses.
2) No module cancellations or cancellation of studies will be effected without the completion of the required cancellation form signed by the student and Faculty Officer: Postgraduate Studies.
3) Students have to submit a complete exemption application form before the stipulated due dates to the Centre for Postgraduate Studies after recommendation by the relevant lecturer and Head of Department.

O.7 APPLICATION FOR BREAK IN STUDIES

1) Students who are unable to register for a specific year are expected to apply before **31 October** for break in studies for the subsequent academic year, to the UNAM Postgraduate Studies Committee through the Faculty Postgraduate Studies Committee for a maximum period of one academic year. Reasonable justifications for the leave of absence should be provided.
2) When a student is on approved break in studies, the year of non-registration will not count as part of the duration of the study. However, students must re-apply before the closing date of applications for admission to activate their registration for the subsequent academic year.
3) A student who takes a break studies for a period of one (1) years will be required to:
4) Apply for re-admission to the University and Faculty/program.
5) Satisfy all requirements for admission, and
6) Start the programme from the first year.

O.8 APPLICATION FOR LEAVE OF ABSENCE

In order to be admitted to examinations, students are required to attend at least 80% of the lectures and to complete the required elements that make up the continuous assessment mark. Students who are unable to attend classes/tests for any reason, must complete the necessary application form (obtainable from the Office of the Registrar), and supply the necessary documentation. The application must be seen by all lecturers concerned, who will provide their comments and signatures. Final approval rests with the Registrar's Office. It will be the responsibility of the student to make up for missed events/complete the relevant requirements (including tests).

O.8.1 ABSENCE DUE TO MATERNITY

Students who request absence from classes/tests for the purpose of delivery, must apply beforehand (application form obtainable from the Office of the Registrar), and provide a medical certificate, signed by a Medical Practitioner, indicating the expected date of delivery. Students will be expected to attend classes two weeks prior to and after the date of delivery. Should the date of delivery differ from the expected date students, on resumption of classes, will be expected to furnish a medical certificate stating the new date. A new, late application for absence from classes must be completed by the student in such cases.

O.8. 2 ABSENCE DUE TO FUNERALS

Students who miss classes/tests due to funeral attendance must, prior to departure, apply for absence from classes (application form obtainable from the Office of the Registrar). On return, the student must supply satisfactory proof which confirms that the student attended the funeral. On receipt of the above mentioned, the application will be processed further. Students should note that absence from classes/tests should not exceed one week.

O.8.3 ABSENCE DUE TO ILLNESS & OTHER REASONS

- Students who miss classes/tests due to illness, must produce a valid medical certificate, signed by a Medical Practitioner, stating the period of absence and nature of the illness. An application for absence from classes must be completed by all students before or not later than five days after the illness, depending on the circumstances (application form obtainable from the Office of the Registrar). Students who are in possession of surgery dates, etc. will be expected to apply for absence from classes prior to their leave of absence. Permission will only be granted for emergency cases. The Registrar's Office reserves the right to reject such applications if the illness does not warrant absence from classes/tests.
- Students should note that reasons such as over-sleeping, car trouble, transport problems, misreading the examination timetable, etc. will not be considered as valid reasons for missing tests / classes / examinations.

O.9 COURSEWORK EVALUATION AND GRADING

1) Students who are registered for postgraduate programmes by coursework will be examined according to procedures approved by Senate.
2) In all Faculties, the meaning attached to letter grades awarded by examiners is as follows:

Grade	Interpretation	% Equivalence
A	Distinction	80 and above
B	Very Good	70 – 79
C	Good	60 - 69
D	Satisfactory	50 - 59
E	Fail	49 and below

3) Before a student can proceed to the thesis/dissertation research phase (in the case of coursework programmes), s/he must first pass all coursework modules. Subject to faculty regulations, a student with one module outstanding may register for the research project, provided that the outstanding module is not Research Methodology or module that deals with research or data analysis.

O.10 THESIS/DISSERTATION RESEARCH

1) Students who successfully complete the coursework phase, or who are registered for postgraduate studies by thesis/dissertation alone, undertake research in an approved research topic, and write a thesis/dissertation. This shall be after a specified period set by the relevant Committees and approved by Senate.
2) **Thesis** and **Dissertation** research may include an artistic/aesthetic component, presented in the form of a composition, a theatre/musical performance, and/or an exhibition of original works, as a partial fulfilment of the requirements for a **Master's** or **Doctoral** degree, respectively.
3) As a standard practice, every thesis/dissertation shall be accompanied by a declaration stating that it has not been submitted for a similar degree in any other university (Annex 2).
4) The thesis must contain a concise and comprehensive **abstract** of between 200-300 words and 300-400 words for the dissertation, indicating the main findings and major conclusions of the research. The abstract should be Times New Roman, font size 12, and 1.5 line spaced.

O.11 REGULATIONS ON THE TEACHING AT POSTGRADUATE LEVEL

1) To teach and supervise students at the master's and doctoral programme levels, a member of staff shall have a doctoral degree or equivalent in the discipline of the postgraduate programme being offered.
2) To teach and supervise students at the postgraduate diploma programme levels, a member of staff shall have a Master's or equivalent in the discipline of the postgraduate programme being offered.

3) Members of staff without PhD or equivalent qualifications but with specialised expertise can co-teach with members of staff holding doctoral degrees.

O.12 GUIDELINES ON THE RESEARCH SUPERVISION OF POSTGRADUATE STUDENTS

O.12.1 ASSIGNMENT OF SUPERVISORS

1) Every postgraduate student shall be assigned a supervisor/supervisors (at least **one** (1) supervisor for Master's students and **two (2)** supervisors for Doctoral candidates) nominated by the relevant Department, recommended by the relevant Faculty Postgraduate Committee and approved by the UNAM Postgraduate Studies Committee on recommendation of the Faculty Postgraduate Studies Committee.
2) Where the student's research topic is multidisciplinary in nature, or where there is need for additional expert supervision in the same discipline, or where the student's postgraduate training programme involves sandwich arrangements, one or more additional supervisors may be appointed.
3) Postgraduate student supervisors will be appointed from suitably qualified members from UNAM Faculties/Centres; where there is a need to appoint an external supervisor there should be another supervisor from UNAM.
4) A supervisor for Master's and Doctoral students must have a doctoral degree and expertise in the field of study that he/she is expected to supervise. In addition, the supervisor must have relevant research and publication experience.
5) For purposes of mentorship, the co-supervision at all levels is strongly recommended. A supervisor without a doctoral degree will be considered to supervise Master's students (normally as a co-supervisor) subject to approval by the UNAM PGSC.

O.12.2 GENERAL DUTIES AND RESPONSIBILITIES OF POSTGRADUATE SUPERVISORS

1) The supervisor must have a thorough understanding of the University's Postgraduate Regulations and Guidelines, in order to effectively guide the student towards attaining the stipulated standards.

2) The supervisor has the responsibility of ensuring that their students make progress in their studies. Where there are problems affecting the student's research progress, these shall be communicated to the UNAM Postgraduate Studies Committee through the Head of the relevant Department and the Faculty Postgraduate Studies Committee.

3) Supervisors should understand that:

   (a) The Master's thesis research programme is designed as a **training** course, whereby it is intended that the student will:

   * be exposed, acquire and apply fundamentals of research,
   * acquire certain new techniques and methods of research,
   * learn how to present the results of research in a scholarly manner, and
   * make some contribution to knowledge.

   (b) Master's students require close and careful supervision because they usually lack previous research experience, especially during the early stages of their theses (when learning about research methodology, experimental design and research technique) and also when preparing the initial drafts of their theses.

4) The supervisor of a Doctoral candidate should recognise that the candidates, in most cases, will have acquired some research experience when they were Master's degree students. What is expected of the Doctoral candidate is thus qualitatively and quantitatively more than outlined above for Master's degree students. Here the supervisor expects the candidate to:

   * make a **distinct and original contribution** to **knowledge**, of fact and/or theory;
   * produce a considerable amount of **original work**;
   * undertake a more critical and extensive review of the relevant literature than is the case for Master's students, and
   * exercise considerable initiative in conducting the research.

5) After completion of a research proposal, the doctoral candidate should be able to work **independently** and be **guided** rather than be directed by his/her supervisor. It is, nevertheless, the supervisor's responsibility to guide the candidate in the right direction.

6) During the initial phase, the supervisors have the responsibility of assisting their candidates in the design and formulation of appropriate postgraduate research projects.

7) Supervisors should be able to determine, through their previous research experience, potential impediments to the research problem and advise the students on what can be achieved meaningfully, within the time allocated for the study.

8) The supervisors have the responsibility of monitoring the student's research progress throughout the research period:

   (a) Both the supervisor and the student must submit **compulsory** report on the progress of the student to the relevant Departmental HoD before the end of each semester (Annex 3A and 3B). The Faculty PGSC will study the reports and take the necessary steps to resolve problems (where necessary).

   (b) Where the departmental HoD is the supervisor, the deputy dean of faculty should sign.

   (c) A summary report of all progress reports received and recommendations from the Faculty PGSC on problems identified and actions taken must be tabled during the **July and November** UNAM PGSC meetings.

   (d) In order to ensure that the thesis/dissertation research proposals benefit from inputs from other academics in the Departments, every Faculty offering postgraduate programmes shall, in consultation with the supervisors, arrange at least one

compulsory research seminars, which will enable the candidates to refine and improve the research proposal, report on progress and learn from others.

9) The supervisor has the ultimate responsibility of assisting the student to give an appropriate title to the thesis/dissertation, and to guide him/her on the presentation of the research results in the form of a scholarly thesis/ dissertation, in accordance with the set guidelines.

10) The supervisor and student should have regular meetings to discuss progress on the research project.

11) Although the writing of the postgraduate thesis/dissertation is the responsibility of the student, it is the supervisor's role to ensure that the standards set by the University are adhered to. The supervisor should:

   (a) be accessible to the student during the critical stage of thesis/dissertation writing;

   (b) discuss the drafts of the thesis/ dissertation with the student throughout the process;

   (c) read the student's thesis/ dissertation carefully and critically, indicating where improvements are needed, e.g., where there is paucity of information, and where the important findings could be published, , etc.;

   (d) at the conclusion of the work, read the entire thesis/ dissertation, and advise whether or not it is in a form suitable for presentation to examiners;

   (e) but should not be responsible for personally editing language usage in the thesis, or correcting typographical errors. He/she should however, point out language and typographical errors.

12) If the student has two or more supervisors, one of these should be appointed as main supervisor and the rest as co-supervisor(s).

13) Should a supervisor be away from the University for more than three consecutive months, an acting supervisor must be appointed. In the case of absence of main supervisor, the co-supervisor will act. Where a student has only one supervisor an acting supervisor must be appointed by UNAM PGSC on recommendation of the FPGSC.

14) Where continued supervision is a condition of sabbatical or extended research leave, the Head of Department must ensure that these conditions are adhered to.

15) Where a supervisor retires or resigns from the University, he/she shall cease from supervising any student(s) under his charge, unless there is an agreement in writing for the continued supervision of the student(s).

16) If, in the course of the student's research, a situation develops whereby:
   (a) there is a breakdown in communication between the student and the supervisor;
   (b) there are personal clashes and conflicts between the two;
   (c) the student refuses to follow the supervisor's advice;
   (d) a change will enhance the progress of the student the case should be reported in writing to the Head of the relevant Department by either the supervisor or the student. The Head of Department has the responsibility to hear both sides of the case (that is, from the supervisor and the student) with a written report and recommendation to the FPGSC for possible action. The FPGSC will study the report and take action or make a recommendation (where applicable) to the UPGSC.

17) Staff members from research institutions will be allowed to supervise ten (10) students; the main supervision will be counted as 1 and co-supervision as 0.5 students, respectively. To ensure adequate supervision, a single staff member shall not supervise more than five (5) postgraduate students at any given time. Staff members' supervision responsibilities should be taken into consideration by Heads of Departments when other teaching duties are assigned.

O.12.3 REMUNERATION OF SUPERVISORS

All supervisors will be remunerated upon approval of the graduation of the student by AEC, according to the tariffs determined by the University from time to time (Annex 17). Progress reports of the student during the duration of the study, signed by the supervisor(s), should accompany the claim form (Annex 18).

O.13 REGULATIONS AND GUIDELINES GOVERNING THE SUBMISSION OF THESES AND DISSERTATIONS FOR EXAMINATION

O.13.1 NOTICE OF INTENT TO SUBMIT THE THESIS/DISSERTATION FOR EXAMINATION

1) At least **three (3) months** prior to the scheduled date for the submission of the **thesis** and **four (4) months** prior to the scheduled date for the submission of the **dissertation**, the respective postgraduate students shall, through their supervisors, Departments and Faculty PGSC, submit a written notice, to the UPGSC, declaring their intention to submit their theses/dissertations (Annex 4A). This is in order to allow sufficient time to organise the appointment of examiners before the submission of the thesis/dissertation.

2) Students who submit a notice of intent within a shorter period than specified in paragraph 1 above should note that the examination might be delayed.

3) Students who fail to submit their theses or dissertations within the time period indicated in the notice of intent should note that the examination of their thesis/dissertation may be delayed as new examiners may need to be appointed.

4) The abridged curriculum vitae of internal and external examiners nominated by relevant Faculty PGSC and Annex 4B shall be submitted together with the notice as per Annex 4A for approval by the UNAM Postgraduate Studies Committee (see Annex 5 for the format of the abridged curriculum vitae).

5) Student shall submit **three** ring bound copies of the Master's thesis and **four** ring bound copies of the doctoral dissertation (including soft copy in word version) through the relevant HoD postgraduate studies to the Centre for Postgraduate Studies for examination by the **end of October of each year**. The submission of the bound copies should be accompanied by a signed form (Annex 6).

6) Students submitting the thesis or dissertation after the due date may not graduate and must re-register and **pay the required fees** for the subsequent academic.

7) Students with no re-admission statuses must appeal for re-admission for the subsequent academic year, irrespective of the fact that the thesis or dissertation might have been submitted for examination.

O.13.2 APPOINTMENT OF EXAMINERS

1) Every Master's thesis submitted shall be examined by at least two examiners approved by the UNAM Postgraduate Studies Committee on recommendation by the Faculty Postgraduate Studies Committee. At least one of the examiners in each case must be external to the University of Namibia, except when the student is a staff member in which case **all** examiners must be external. **The supervisor(s) should not be one of the examiners.**

2) Upon receipt of the notice of intent from the student, the Head of the Department should complete and submit Annex 4B together with the abridged CV's of the potential examiners to the FPGSC for recommendation and approval by the UNAM PGSC. Heads of Departments must declare any potential conflict of interest in the nomination and appointment of examiners. **Examiners may NOT be selected from the pool of moderators already approved for modules in the specific taught programme.**

3) In the case of doctoral dissertations, at least three examiners shall be appointed, of whom two must be external to the University, except **when the student is a staff member in which case all examiners must be external. The supervisor(s) should not be one of the examiners.**

4) Internal and External Examiners will be appointed on the basis of their expertise, independent from appointment of external moderators already approved for modules in the specific programme.

5) The examiner should not have any direct involvement in the research project of the student and must declare any past or present (personal or professional) connections with the student. Before final appointment the examiner should declare any direct conflict of interest by signing Annex 7.

6) An examiner for Master's students and Doctoral candidates must have a doctoral degree and expertise in the field of study that he/she is expected to examine. In addition, the examiner must have relevant research and publication experience.

7) The Director: Centre for Postgraduate Studies shall issue a letter of appointment to the thesis or dissertation examiners (Annex 8).

   Examiners shall complete examination in the following periods: Mini thesis (Master's) = 6 weeks; Thesis (Master's) by research = 6 weeks; and Doctoral dissertation = 8 weeks.

O.14 REGULATIONS AND GUIDELINES GOVERNING THE EXAMINATION OF THE SUBMITTED MASTER'S THESES AND DOCTORAL DISSETATIONS

O.14.1 EXAMINATION OF MASTER'S THESES AND DOCTORAL DISSERTATIONS

1) Each examiner shall be required to examine the thesis or dissertation in detail and submit his/her comprehensive assessment under the following headings:
   (a) **Appropriateness of the thesis title.** Comment on the appropriateness of the title as it relates to the content of the thesis or dissertation.

   (b) **Introduction:** comment on the validity of the research problem, the extent to which the questions or objectives address the identified research problem and the justification for the study.

   (c) **Completeness of the Literature Review**. Comment on the ability of the student to describe other researcher's contributions to similar problems. The literature review should lead the reader to a good understanding of what is already known about the research topic, what gaps of knowledge exist, what the study was intended to contribute, and what hypotheses guided the study. The examiners should comment on the candidate's familiarity with the literature.

   (d) **Research Methods**: The examiners should also comment on the appropriateness of the research methods (and instruments, where relevant) employed in the study. Where applicable, comment on ethical considerations should be included.

   (e) **Presentation of the Results**: The examiners should comment on the manner in which the findings of the study are presented. If tables of data are provided, are they reduced statistically? Are the statistical analyses appropriate? If illustrations are provided, are they of publishable quality? Is the description of the research results of adequate clarity and scholarship?

   (f) **Discussions and Conclusions**: Are the conclusions clearly presented? Are they logical and supported by data? Has the candidate sufficiently indicated how his/her results compare with those of others, as cited in the literature? From the thesis/dissertation, is his/her contribution to new knowledge clearly brought out? In the case of Doctoral dissertations, is there evidence of sufficient originality? If there are weaknesses in the thesis/ dissertation, what are the shortcomings?

   (g) **Recommendations:** Are the recommendations formulated address what was not reported in the thesis? Will the recommendations lead to addition of new knowledge to the current study?

   (h) **Language and Technicalities:** Is the language used clear and concise? Are there major typographical errors? Is a language editor needed? (Where applicable).

   (i) **References:** Are all the references cited in the text recorded on the reference list (and vice versa)? Are recent references used? Are the references used appropriate to the study? Is there consistence in the style of referencing used?

Summary: The examiner should present a summary indicating whether s/he recommends the thesis or dissertation for a postgraduate degree award. Exam should allocate marks for the thesis by following guidelines in Annex 9, and complete the Summary Form (Annex 10 & 11).

2) All examination reports must be submitted to the Director: Centre PGS within a stipulated time from the date of receipt of the documents. If the assessments are not received within two months, new examiners may be appointed.

3) The Director: Centre for Postgraduate Studies will forward the reports to the relevant HoD PGS, who will be responsible for distributing the reports to the supervisor.

4) Once the relevant HoD PGS has received **all** the reports for a particular student he/she removes the names and affiliation of the examiner as well as the allocated marks and distributes the amended report to the supervisor.

5) The supervisor will share the reports with the student to make the indicated corrections. Where the reports contain conflicting recommendations, the supervisor will guide the student in addressing them.

6) The revised thesis or dissertation together with a comprehensive table of corrections must be submitted to the supervisor to verify that all corrections have been made before the thesis or dissertation is bound.

7) Upon evaluation of the thesis, the examiner will recommend one of the following:
   a) PASSES subject to MINOR corrections ($\geq$ 50%)
   b) PASSES subject to MAJOR corrections ($\geq$ 50%)
   c) RE-SUBMIT FOR RE-EXAMINATION (no mark allocated)
   d) FAIL (< 50%)

   A thesis re-submitted for re-examination shall be re-examined by the same examiner and awarded a maximum mark of 50%.

8) Upon evaluation of the dissertation, the examiner will recommend one of the following:
   a) PASSES subject to MINOR corrections
   b) PASSES subject to MAJOR corrections
   c) RE-SUBMIT FOR RE-EXAMINATION
   d) FAIL

   No marks should be allocated for the dissertation. A dissertation re-submitted for re-examination shall be re-examined by the same examiner.

9) (a) Where a Master's thesis is recommended for re-submission, **it must be re-submitted within 6 months,** failure to do so the student will be deemed to have failed the thesis and will not be re- admitted.
   (b) Where a Doctoral dissertation is recommended for re-submission**, it must be re-submitted within 12 months,** failure to do so the student will be deemed to have failed the dissertation and will not be re- admitted.

10) Where a thesis or dissertation is submitted for re-examination, the examiner should indicate whether the student has satisfactory addressed the identified shortcomings in the first submission.

11) In cases where the examiners of the thesis disagree in their recommendations (fail versus pass), Faculty PGSC should recommend an independent external examiner to the UNAM PGSC for approval to serve as arbiter on the thesis.

12) Where two examiners fail a dissertation the student will be deemed to have failed the dissertation and will not be re- admitted.

13) Where one examiner fails a dissertation, Faculty PGSC should recommend an independent external examiner to the UNAM PGSC for approval to serve as arbiter on the thesis or dissertation.

14) For both theses and dissertations the assessment of the arbiter will be FINAL.

15) A **copy of the first version** of the thesis or dissertation submitted for examination will be sent to the arbiter.

16) In cases where the difference in the pass marks allocated for a thesis, by the internal and external examiner, is **20% or more**, the Departmental Head must set up a departmental committee (excluding the supervisor and internal examiner) to study the case and recommend a mark for the thesis and provide a motivation on the decision to the UNAM PGSC, through the Faculty PGSC. Where the departmental Head is the supervisor or the examiner, the Dean shall appoint an independent person to study the case and recommend a mark for the thesis and provide a motivation for his/her decision to the UNAM Postgraduate Studies Committee.

17) **All examination reports**, including any reports that recommended a fail must be submitted by the faculty PGS HoD to the UNAM Postgraduate Studies Committee for recommendation to AEC.

18) A postgraduate student, who disagrees with the results of the examination as approved by AEC, may appeal to the HoD PGS within two weeks after the release of the results giving reasons and evidence to support the appeal.

O.14.2 PUBLICATION FROM A THESIS OR DISSERTATION

Students are encouraged to publish work from their thesis/dissertation in accredited journals. The following acknowledgements must be included in such publications:

"This work forms part of a Master/PhD study undertaken at the University of Namibia".

Any publication from thesis/dissertation must show UNAM as the student's affiliation.

A list of publications and conference presentations by the student, that was part of their study, should be listed in the thesis immediately after the abstract.

O.14.3 VIVA VOCE EXAMINATION FOR STUDENTS REGISTERED BY THESIS OR DISSERTATION

1) In addition to writing a thesis or dissertation, the postgraduate students who are registered for Master's by Thesis and all Doctoral students, shall appear for a *viva voce* examination, to defend the submitted work before a panel of specialists on the subject.

2) The Centre for Postgraduate Studies is responsible for administering the *viva voce* examinations for doctoral students while the respective Faculties/departments are responsible for administering the *viva voce* examinations for master's students.

3) The *viva voce* examination shall take place only after the UNAM PGSC is satisfied that the thesis or dissertation submitted by the student is considered by the examiners to be of an acceptable standard.

4) The questions to be asked in the *viva voce* examination shall primarily be focused on the student's thesis or dissertation research area. **The public can attend and WILL BE PERMITTED to ask questions.**

5) The ***viva voce* panel** shall consist of the examiners and supervisors of the thesis or dissertation.

6) The Chairperson of the *viva voce* panel shall be a senior academic (at least at the rank of Associate Professor for Doctoral students and Senior lecturer for Master's students) and shall not be one of the supervisors or examiners. The *viva voce* panel (including the chairperson) shall be approved by **the Director of the CPGS** on recommendation of the relevant HoD PGS.

7) The main supervisor must provide the relevant HoD PGS with an electronic copy of the corrected thesis or dissertation, who will distribute it, together with copies of the examiners' reports to the panel members at least two weeks before the date of the *viva voce* examination.

8) All members of the *viva voce* panel must acquaint themselves with the postgraduate processes and procedures.

9) The functions of the *viva voce* panel shall be:

   (a) to ascertain that:

   * the thesis/dissertation presented (the data, methodology, analysis and findings) is the original work of the student
   * the shortcomings identified during the examination process have been addressed.
   * the broader subject area in which the study is based is fully grasped by the student.
   * any weaknesses in the thesis/dissertation can be adequately clarified by the student,

   (b) to make a definite recommendation to AEC through the UNAM PGSC, as to whether the student be deemed to have **passed** or **failed** the study (Annex 12).

10) The *viva voce* panel shall, as far as possible, endeavour to reach a unanimous decision on the student's performance. Where the panellists are unable to reach a consensus as to whether the student passes or fails, a vote may be taken to arrive at a reasonable decision. A majority vote shall be required for passing the *viva voce* examination.

11) (a) At the end of the viva voce, the panel shall sign a *viva voce* Examination Results Form (Annex 12) making a specific recommendation to AEC through the UNAM PGSC on the student's performance.

   (b) The Chairperson of the panel shall also submit to the UNAM PGSC a **comprehensive report** (Annex 13) signed off by the *viva voce* panellists. This should be done within one week of the examination. The report should include, an attendance register, challenges faced with the *viva voce* examination, a summary of the presentation, the discussion during the *viva voce* examination, any strong/weak points identified during the presentation and discussions, including any specific recommendations to the student.

12) The duration of the *viva voce* shall be **two hours for masters and three hours for PhD**.

13) The Chairperson of the *viva voce* Panel should announce the recommended outcome of the examination to the audience; but the qualification can only be awarded after approval by AEC.

O.14.4 SUBMISSION OF FINAL BOUND THESES OR DISSERTATIONS

After all the corrections as recommended by the examiners (including those from the viva where applicable) have been made to the satisfaction of the supervisor(s), **five** fully bound copies of the theses or dissertations shall be submitted to the Faculty PGSC for inspection before submission to the Centre for Postgraduate Studies. Where a student has been supervised by more than one supervisor, an additional copy for each additional supervisor must be provided. In addition, an electronic version of the thesis or dissertation compiled as a single document in **PDF** format shall be submitted. Please note that the final thesis or dissertation must be in the format as prescribed in B19.

O.14.5 PRESENTING STUDENTS FOR GRADUATION

The Faculty Officer: will only submit the names of students for graduation approval by AEC on recommendation of the UNAM PGSC when the following conditions have been met:

1) Updated academic record reflecting the eligibility of the student for graduation.
2) Completed checklist confirming, amongst others, that corrections have been effected after receipt of examiners reports and *viva voce* examinations, (including a table of corrections), where applicable.
3) All signed examination reports (including, where applicable, arbiter/failed examination report).
4) Five (5) bound copies and one (1) electronic copy (in PDF format) of the Thesis or Dissertation has been submitted as per Regulation B.16.4.

O.14.6 REMUNERATION OF EXAMINERS

All examiners will be remunerated upon receipt of the examination report compiled using the examination guidelines in B.16.1, according to the tariffs determined by the University from time to time.

O.14.7 AWARDING OF A QUALIFICATION AT A LOWER LEVEL

1) A student who is de-registered for a taught Masters programme due to failure to successfully complete the research component, may be awarded a relevant and existing Postgraduate Diploma in the field provided that all the taught modules are passed and the research component is re-written and passed as a research project/paper. Award of this PGD is subject to approval by AEC on recommendation of the UNAM PGSC.
2) A student who was awarded a Postgraduate Diploma according to paragraph (1) above, will not be allowed to register for the same taught master programme at a later stage.
3) A student who fails a Masters by research, may be allowed to re-apply for re-registration on a completely different topic or a taught Masters programme.
4) A student who fails a PhD, may be allowed to re-write the dissertation in the format of a thesis incorporating all the recommended amendments and corrections of the examiners within a period of 12 months after the release of the results. The re-submitted thesis will be examined according to the regulations of Masters degrees.
5) A Student who was awarded a Master's degree according to paragraph (4) above, and wish to apply for a Doctoral programme at a later stage, will have to choose a different topic.

O.15 POSTGRADUATE FEES

All registered students shall pay the various categories of fees as approved by the University Council on recommendation of appropriate Committees of UNAM (Refer to Student Fees booklet and PG Studies Fees brochure).

O.16 GUIDELINES ON THE WRITING OF POSTGRADUATE WORK

O.16.1 GUIDELINES ON THE WRITING OF RESEARCH PROPOSALS

Outline of the proposal

All research proposals must be prepared according to the following layout:

Title of the proposed study (refer to Annex 14 for the format of the title page)

The title of the mini thesis/thesis/dissertation research proposals should be clear and concise. From the title, one should be able to infer clearly the subject of the mini thesis/thesis/dissertation. This means that the title should be self-explanatory and limited to the scope of the study.

1. Introduction

1.1 **Background of the study**
Give a general overview and background of the research problem.

1.2 **Statement of the problem**
Students should concisely formulate their research problems by clearly indicating research issues they would like to investigate in their studies. This should include the purposes of their studies

1.3 **Either objectives of the study or research questions (NOT BOTH)**
Based on the statement of the problem, students should state either objectives or research questions of their studies. They should do this unambiguously.

1.4 **Hypotheses of the study (where applicable)**
Where applicable, particularly in the Natural Sciences, students should state unequivocal and testable hypotheses that are based on theory and on the statement of the problem. Each hypothesis should have a clear rationale.

1.5 **Significance of the study**
Students should state the importance of their studies, the anticipated contribution of such studies to knowledge and to socio-economic progress.

1.6 **Limitation of the study**
Students should indicate the logistical, resource and other limitations of their studies and indicate the possible impact of such limitations.

1.7 **Delimitation of the study**
Students should indicate the specific scope of the study, providing the rationale for such delimitation.

2. Literature Review and where applicable, the theoretical framework

Students should prepare critical, synthesised and integrated literature reviews that should demonstrate the need and justification of their studies. The reviews should show gaps in knowledge, theoretical and methodological shortcomings, need for further research, unanswered questions, and disagreements in literature and theoretical frameworks that may need to be revised to resolve controversies. In addition, the reviews should demonstrate what has been done in research areas of interest and what remains to be investigated.

3. Research Methods

3.1 Research Design

Students should provide clear statements on either quantitative or qualitative research designs they intend to use. It is not necessary to provide the definitions of the research designs. However, they should specify how they intend to use particular research designs in their studies. They should not merely provide the distinction between the two generic designs.

Population (where applicable)

Students should, where applicable, specify the population to which they would like to confine their research/studies.

3.2 Sample (where applicable)

Students should clearly explain how they intend to draw samples from the target populations. They should specify how they intend to appropriately use either quantitative or qualitative sampling techniques to draw research samples. Merely describing what these sampling techniques are is inadequate.

3.3 Research Instruments (where applicable)

Research instruments and measures that would be used to collect data should be clearly provided under this section.

3.4 Procedure

The manner in which data would be collected should be explained here. How research instruments would be used to collect data should be specified in this section.

3.5 Data analysis (where applicable)

In this section, students should provide specific descriptive and/or statistical tests that they would employ to analyse their data, and rationale. Mere reference to particular quantitative data analysis statistical packages and electronic qualitative data analysis procedures would not be sufficient.

3.6 Budget (where applicable)

3. Research Ethics

Students should provide detailed information about ethical issues and *how* they will address potential ethical dilemmas when conducting their research.

4. References

Students should use the referencing format approved by respective faculties/departments. Where there is no prescribed referencing format by faculty/department, the ***American Psychological Association*** **(APA)** becomes the default. There must be consistency between sources cited in the text of the proposal and sources of information indicated in reference lists. Unless critical in the area of research, primary and secondary sources of information cited shall not be more than 10 years old. Students should use refereed/verifiable sources of information.

Research proposals submitted for consideration by the Faculty Postgraduate Studies Committee shall capture the above information in a clear and concise manner and not exceed the maximum page number stated below:

a) Master's by coursework (mini thesis) shall not exceed 6 pages
b) Master's by research shall not exceed 8 pages.
c) Doctoral Degree shall not exceed 10 pages.

In all cases the research proposal should be **Times New Roman, font size 12, double spaced** and on one side of the paper.

The faculty PGSC recommends the research proposal to UNAM PGSC for noting after evaluating the proposal using Annex 15, and issuing of the Research Permission Letter (Annex 16) by the Director: Postgraduate Studies;

De-registration of postgraduate students who fail to make progress

Faculties shall deregister postgraduate students who fail to make progress as stipulated under B.6.2.

O.17. REGULATIONS AND GUIDELINES FOR WRITING AND PRESENTATION OF POSTGRADUATE THESES AND DISSERTATIONS

Broad Guidelines on Mini Thesis/Thesis/Dissertation Manuscript Preparation

Typing/Word-processing

The document must be typed and printed on good quality white A4 paper. The typescript must be clear, Times New Roman, font size 12, double spaced and on one side of the paper.

Pagination

The preliminaries (i.e., parts preceding the Introduction) must be in lower case Roman numerals (i.e.: (i), (ii), (iii), (iv)...), beginning with the title page which should not be numbered. The pages in the main body of the document should be numbered in Arabic numerals (i.e.: "1", "2", "3", "4"...) consecutively throughout. The page numbers should be centred in the lower margin.

Margins

The left margin must be 4.0 cm; the right hand margin must be 2.5 cm; the top margin must be 2.5 cm, and the bottom margin must be 2.5 cm.

The title page must be organised according to (Annex 14)

Components of the preliminary pages (<u>Each starting on a separate page</u>)

Abstract

Following the title page, the mini thesis/thesis/dissertation shall contain an abstract which concisely and comprehensively summarises the essential points and conclusions emanating from the research. The abstract should be between 200-300 words (not exceeding 1 page) in the case of Master's theses, and 300-400 words (not exceeding 2 pages) for Doctoral dissertations. Furthermore, it should include the purpose of the study, a brief overview of the methodology used, the main findings, major conclusions and recommendations. The abstract should not contain headings with 1.5 line spaced.

List of Publication(s)/Conference(s) proceedings

A list of publications and conference presentations by the student, that was part of their study, should be listed in this section. Any publication from thesis/dissertation must show UNAM as the student's affiliation.

Table of Contents

The Table of Contents shall be generated to include level three subheadings.

List of Tables

If there is a list of Tables, these should be consecutively numbered in Arabic numerals following the guidelines of the relevant department/faculty approved referencing style.

List of Figures

If there is a list of Figures, these should be consecutively numbered in Arabic numerals following the guidelines of the relevant department/faculty approved referencing style.

List of Abbreviations and/or Acronyms

Acronyms and non-standard abbreviations should be listed alphabetically in bold; the definitions should not be bolded.

Acknowledgements

The document shall also contain an Acknowledgements section, in which the candidates express their appreciation and gratitude to all the people and institutions which rendered help in the course of the study.

Dedication

If the candidate wishes to dedicate the document to any person, the dedication should be concisely written, and should appear in the preliminaries.

Declarations

The document shall contain the various declarations as outlined in (Annex 2)

Body of the Thesis/Dissertation

a) Master Theses should broadly follow the outline in the proposal (B18.1). In addition it should include results, discussions, conclusions and recommendations as detailed below.

Tables, text figures, diagrams and photographic illustrations should be numbered in separate sequence, and be referred to by number in the text. Each table and figure should have a concise but comprehensive caption. The illustrations should be of publishable quality (600 dpi or higher).

Results:

- Data should be presented in a clear and concise and informative manner.
- A variety of forms might be used to present data, however the same data **must not** be presented in more than one form(for example tables and figures)
- Where applicable primary data should be attached as an appendix and not appear in this section

Discussions:

- It should not merely be a description of the findings (tables and figures)in words
- This section forms the core of the document and therefore need to be a critical analysis of the results and demonstrate insight and understanding of the findings.
- Results and findings must be discussed in context and linked to literature and the stated research aims.
- The discussion must address the objectives and/or questions of the study

Conclusions:

- This should not be a repeat of the results and /or discussion
- It should relate directly to the main objective(s) of the study.
- It must indicate whether the problem was solved, what was learned through the research, what remains to be learned, weaknesses and shortcomings of study, strengths of study as well as possible applications of study (how it can be used).

Recommendations

- Must emanate from the research findings and must be feasible
- Gives opinion on what measures should be adopted to solve the problem based on the conclusions made.
- May endorse the research findings as the solution to the problem or may propose an alternative route.
- Identify information gaps or inconsistences and suggest further studies to address these.

References

Should follow the department/faculty specific referencing style

Appendices

Should be numbered sequentially and can include the following:

- Ethical clearance certificate
- Research permission letter
- Other relevant permissions (where applicable), e.g., collection permits, informed consent documents, etc.
- Data collection Instruments such as questionnaires, interview protocols, pre and post-tests etc.
- Any other relevant data such as supplementary information, raw data etc.

b) Doctoral Dissertations should follow a **stand-alone chapter** (journal publication) approach.

Tables, text figures, diagrams and photographic illustrations should be numbered in separate sequence, and be referred to by number in the text. Each table and figure should have a concise but comprehensive caption. The illustrations should be of publishable quality (600 dpi or higher).

Introduction Chapter (Chapter 1)

This chapter must introduce the study and provide a comprehensive overview of the research problem, and broadly follow the guidelines as indicated above.

Literature Review (Chapter 2)

- This chapter must provide a comprehensive literature review and broadly follow the guidelines as indicated in (B.19).
- This should demonstrate critical understanding and comprehension of the current state of knowledge in the area of research and lead to the motivation for the study.
- The literature should focus on recent developments in the area of study.

Stand-alone chapters

Each Faculty and/or department has a choice to decide whether to use a stand-alone chapter or use the guidelines for Master thesis.

Guidelines for stand-alone chapters are as follows:

Each of these chapters **introduces and represents an independent research aim/objective/question** and should follow the outline below:

Title, Abstract, Keywords, Introduction, Materials and Methods, Results and Discussion, Conclusion, and References (Should follow the approved department /school/ faculty specific referencing style).

Concluding chapter

This chapter integrates all findings of the study and conclusions with feasible recommendations/reflections. Original contribution(s) to knowledge must be clearly pointed out.

Appendices

Should be numbered sequentially and can include the following:

- Ethical clearance certificate
- Research permission letter
- Other relevant permissions (where applicable), e.g., collection permits, informed consent documents, etc.
- Data collection Instruments such as questionnaires, interview protocols, pre and post-tests etc.
- Any other relevant data such as supplementary information, raw data etc.

Language

The presentation of the thesis or dissertation shall be in English. The use of a language other than English requires approval of the UNAM PGSC. In such cases, the abstract must be in both English and the approved language.

Length of Theses/Dissertations

The suggested guidelines are as follows (A4 double spacing):

(a) **Master's theses for coursework programmes(Mini Theses)**: The recommended length of Mini theses for coursework programmes is as follows:
- Mini Theses with less than 100 credits: a minimum of 15,000 words and a maximum of 22,000 words (not exceeding 90 pages).
- Mini Theses between 100–140 credits: a minimum of 18,000 words and a maximum of 30,000 words (**not exceeding 120 pages**).
- Mini Theses above 140 credits: a minimum of 30,000 words and a maximum of 37,000 words (not exceeding 150 pages).

(b) **Master's theses (by research)**:

- The recommended length of a Master's thesis is a minimum of 30,000 words and a maximum of 45,000 words (**not exceeding 180 pages**).

(c) **Doctoral dissertations**:
- o The recommended length of a Doctoral dissertation is a minimum of 46,000 words and a maximum of 75,000 words (**not exceeding 300 pages**).

Binding of Theses/Dissertations

(a) Candidates should ensure that when binding the theses/dissertations, the spine shall contain the name of the candidate, the degree for which it was submitted, and the year of degree award **(graduation year).**

(b) The colour of the cover for Master's theses shall be **red** and that for Doctoral Dissertations shall be **black**.

Note: The thesis/dissertation MUST be subjected to plagiarism software i.e. Urkund.

ANNEX 1

SUPERVISION AGREEMENT BETWEEN GRADUATE STUDENT AND SUPERVISOR

This **supervision agreement** between

Name of student: …………………………………………………………………..

Student number: ……………………………………………………….…………

Faculty: …………………………………………………………………….………

Department: ………………………………………………………….……………

and (on behalf of UNAM)

Name of supervisor: ……………………………………………………………………………………………….

Department: ………………………………………………………………………………..

And (if applicable)

Name of co- supervisor: ……………………………………………………….……

Department: ……………………………………………………………….…………

Regarding post-graduate research for the degree of: ……………………………………..

Research topic: ……

……

……………………………………………………………………………………………...

By signing this document, both student and supervisor(s) acknowledge their understanding and obligations of the general expectations and responsibilities regarding the supervision of the thesis/dissertation as contained in the UNAM Postgraduate Studies regulations prospectus.

…………………………………………….	…………………………………………….	…..…………
Name of Student	**Signature**	**Date**
……………………………………………..	…………………………………………….	…………………………………
Name of Supervisor	**Signature**	**Date**
…………………………………………….	……………………………………	……………………………………
Name of co-supervisor (where applicable)	**Signature**	**Date**
…………………………………………….. …………………………………………	…………………………………………….	……………………………
Name of Department HoD	**Signature**	**Date**
……………………………………………..	…………………………………………….	………………………………
Name of Faculty HoD: PGS	**Signature**	**Date**

ANNEX 2

DECLARATIONS WHICH MUST BE CONTAINED IN THE SUBMITTED THESES/ DISSERTATIONS

Format of declarations to be included in every thesis/dissertation:

DECLARATIONS

I, [student's name], hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

No part of this thesis/dissertation may be reproduced, stored in any retrieval system, or transmitted in any form, or by means (e.g. electronic, mechanical, photocopying, recording or otherwise) without the prior permission of the author, or The University of Namibia in that behalf.

I, [student's name], grant The University of Namibia the right to reproduce this thesis in whole or in part, in any manner or format, which The University of Namibia may deem fit.

………………………………………………..	………………………………………	……………
Name of Student	**Signature**	**Date**

ANNEX 3A:	PROGRESS REPORT

(To be completed by student for main and co-supervisors)

CENTRE FOR POSTGRADUATE STUDIES

Semester……, 20……..

Student Name: ………

Student Number: ……

Postgraduate Programme Student is enrolled in: ………………………………………………………………………………

Student Contact Details Tel and Email Address: ………………………………………………………………………………..

Mode of study: Full Time/Part Time: ……………………………………………………………………………………………….

Academic year of first registration: ……………………………………………………………………………………………

Research Title: ……..

Supervisor's Name: ………..

PROGRESS TO DATE:

a) On a scale of 1 to 5 (with 1 being poor and 5 excellent), indicate your progress according to your plan of study. If you rate 1-2, please provide details on a separate page.	1	2	3	4	5
b) Please indicate the frequency of your face to face academic consultation **this semester** with your supervisor	0	1-3	4-6	>6	
c) Please indicate the frequency of other forms of academic communication with your supervisor (never, less frequent, more frequent)	Telephone				
	e-mail				
	Social media				
d) Are there any other problems/issues that you would like to draw to the attention of the Faculty/Centre for Postgraduate Studies?	YES	NO			
If yes, have you discussed these problems with your Supervisor or Head of Department?	YES	NO			
Has the problem been resolved?	YES	NO			
Do you require any further intervention to address these issue(s)? If yes, please provide details on a separate page.	YES	NO			

Comments: (You may use a separate page for your comments)

…………………………………………… ……………….. ……………………

Name of student **Signature** **Date**

…………………………………………… ………………….. ……………………

Name of Departmental HOD **Signature** **Date**

ANNEX 3B: **PROGRESS REPORT**

(To be completed by each supervisor, main and co-supervisors)

CENTRE FOR POSTGRADUATE STUDIES

Semester……20……

Student Name: …….............

Student Number: ………

Postgraduate Programme Student is enrolled in: ……………………………………………………………………………….

Student Contact Details Tel and Email Address: …………………………………………………………………………………

Mode of study: Full Time/Part Time: ………………………………………………………………………………………….

Academic year of first registration: ………………………………………………………………………………………….

Research Title: ……….

Supervisor's Name: ……………………………………………………………….

PROGRESS TO DATE:

a) On a scale of 1 to 5 (with 1 being poor and 5 excellent), indicate student progress according to plan of study. If you rate 1-2, please provide details on a separate page.	1	2	3	4	5
b) Please indicate the frequency of your face to face academic consultation **this semester** with your student	0	1-3	4-6	>6	
c) Please indicate the frequency of other forms of academic communication with your student(never, less frequent, more frequent)	Telephone				
	e-mail				
	Social media				
d) Are there any other problems/issues that you would like to draw to the attention of the Faculty/Centre for Postgraduate Studies?	YES	NO			
If yes, have you discussed these problems with the student or Head of Department?	YES	NO			
Has the problem been resolved?	YES	NO			
Do you require any further intervention to address these issue(s)? If yes, please provide details on a separate page.	YES	NO			

Comments: (You may use a separate page for your comments)

……………………………… ……………… ……………………

Name of Supervisor **Signature** **Date**

……………………........... ……………….. ……………………

Name of Department HoD **Signature** **Date**

ANNEX 4A: NOTICE OF INTENTION TO SUBMIT THESIS/DISSERTATION FOR EXAMINATION

(To be completed by student)

Date …………………………

The UNAM Post Graduate Committee

The University of Namibia

Private Bag 13301

WINDHOEK

Namibia

Dear Director,

NOTICE OF INTENTION TO SUBMIT THESIS/DISSERTATION FOR EXAMINATION

I, ____ (Student no :______________________) hereby notify the Postgraduate Studies Committee of my intention to submit my thesis / dissertation on ________ e) for examination. the abstract of my thesis/dissertation.

The title of my thesis/dissertation is:--

……………………………………………. ……………………………………………. …..…………

Name of Student **Signature** **Date**

…………………………………………….. ……………………………………………. …………….

Name of Supervisor (Main/Co-) **Signature** **Date**

ANNEX 4B: REQUEST FOR APPOINTMENT OF EXAMINERS

CENTRE FOR POSTGRADUATE STUDIES

Student Number:			
Surname and Initials:			
Department and Faculty			
Degree (Masters/PhD)			
Title of thesis/dissertation:			
Main Supervisor		Affiliation:	
Co-Supervisor		Affiliation:	
Co-Supervisor		Affiliation:	
Co-Supervisor		Affiliation:	
External Examiner		Affiliation:	
External Examiner		Affiliation:	
External Examiner		Affiliation:	
Internal Examiner		Affiliation:	

I hereby declare that there is no conflict of interest in the nomination of the abovementioned examiners.

…………………………………………….. ……………………………………………. …..…………

Name of HOD: Department **Signature** **Date**

Recommended by FPGSC on………………………………………….. **Resolution no**:………………………….**.**

………………………………………………..   ……………………………………………….   ……………

Name of HOD: PGS   **Signature**   **Date**

ANNEX 5:

RECOMMENDED FORMAT OF SUMMARIZE CURRICULUM VITAE

CENTRE FOR POSTGRADUATE STUDIES

Title:		**Initials:**
Surname:		
Name/s:		
Academic or equivalent institution to which affiliated:	**Past:**	**Present:**
Present Academic Rank	**Professor**	
Work and employment experiences	**Past:**	**Present:**
Physical Contact Details (Courier Delivery Address):		
Telephone numbers	**Office:**	**Cell:**
Email address/		
Academic Qualifications and Year Obtained/Institution	**Qualification/s & Year/s Obtained**	
Area/s of Expertise/Specialisation	**Primary**	**Secondary**

Record of publications in the last 10 years	
ARTICLES IN PEERED REVIEWED JOURNALS/PROCEEDINGS	
Title & Authors: Journal/Proceedings Name	
NATIONAL AND INTERNATIONAL CONFERENCES	
Title & Authors & Conference	
CONTRIBUTION IN BOOKS, CHAPTERS IN BOOKS ECT.	
Title & Authors	Book & ISBN
List of **key research projects** undertaken or coordinated for the last 10 years, starting with the most recent:	
Record of **postgraduate student supervision** for the last 10 years, starting with the most recent:	
Title or Student Role Main/Co Supervisor	
Examiner of post graduate studies	

Title/Student & M/PhD
Other Academic related experiences/achievements

The abridged CV should not be more than three pages long

ANNEX 6

CHECKLIST FOR SUBMITTING THESIS/DISSERTATION TO THE SCHOOL

(To be completed by the supervisor)

Faculty: ....

Department:...

Degree registered for: ....

Name of Student: ....

Student Number:..

Title of thesis/dissertation: ....

Name(s) of supervisor(s):..

……..…………

……………………………………………………………………………………………………

Date when the thesis/dissertation was sent to examiners: ………………………………

Date when comments on the thesis/dissertation were received from examiners: …………………………….

Table of corrections received from student: Yes……… No…………

Supervisor(s) checked the thesis/dissertation to verify that the student made the revisions according to the table of corrections
Yes……… No…………

Supervisor checked the thesis/dissertation for conformity with regards to formatting before binding:

Yes……… No……….

……………………………………	……………………………………	…..………
Name of Supervisor	**signature**	**Date**
……………………………………	……………………………	……………
Name of HOD: department	**signature**	**Date**

Date when the bound copies of the thesis/dissertation were submitted to Faculty Postgraduate Studies Committee for inspection and noting…………………………………..

…………………………………… ……………………………………… ……………

Name of HOD: FPGS **signature** **Date**

All conditions pertaining to the submission of thesis/dissertation have been met

…………………………………… ……………………………………… ……………

Name of Faculty Officer CPGS **signature** **Date**

ANNEX 7

WILLINGNESS TO SERVE AS AN EXAMINER AND DECLARATION OF POSSIBLE CONFLICT OF INTEREST

I , ………………………………………………………………….. am willing to serve as examiner for student ………………………….. and hereby declare the following possible areas of conflict of interest regarding the examination of the thesis/dissertation titled:

……

……

………..

POSSIBLE AREA OF CONFLICT	**DETAILS**
Family (e.g. cousin, in-law)	
Other Personal relationship (e.g. friend)	
Professional (e.g. colleague, research collaborator, co-author)	
Others	
None	

……………………………… ……………………………. ……..………

Name of Examiner **Signature** **Date**

ANNEX 8

EXAMINER APPOINTMENT LETTER

Date

Examiner Physical Address

Telephone

E-mail

Dear Prof/Dr XXX

Examination of Thesis/Dissertation: Mr/Ms XXX

I am pleased to inform you that you have been appointed as an examiner for the above mentioned student. The manuscript is enclosed herewith. Attached, also find the guidelines for the compilation of the report and the relevant forms to be filled in.

Please return the comprehensive report and completed forms in electronic format within **8 weeks from the date of receipt of the manuscript** to the **Director, Centre for Postgraduate Studies** (directorpgs@unam.na). If there is a need to return the hardcopy of the manuscript, kindly do so via DHL to the return address provided. However, note that no reports or forms should accompany the manuscript.

Please acknowledge receipt of the manuscript. Should you be unable to complete the examination by the indicated time frame, given your other commitments, kindly inform me accordingly.

Best regards

Dr PT Johannes

Associate Dean: School of Engineering and the Build Environment

Tel: +264 65 2 324022

E-mail: pjohannes@unam.na

Cc. HOD: Postgraduate Studies (e-mail)

ANNEX 9

MARK ALLOCATION OF MASTER's THESIS

Name of Student: ……......

Student Number: ………..

Thesis title: ………

………..

Assessment Criteria	**Allocated mark**	**Maximum mark**
Title: (appropriateness, clear and informative)		2
Abstract: (concise, outlines aims of study, methodology, findings and conclusions)		4
Introduction: background/orientation of study (sufficient and relevant)		3
Introduction: problem statement (clear and logical progression from literature to aims of the study)		3
Introduction: objectives/hypothesis/research questions (well formulated and relevant to the problem statement)		3
Literature review: (relevant, recent, critical, comprehensive and logically/theoretical integrated)		10
Research methods: (clear, detailed, informative, appropriate and supported by literature)		10
Results: Data collected (adequate and relevant)		7
Results: Data analysis (appropriate, relevant to aims and objectives/hypotheses/research questions)		10
Results: Data presented (technical aspects , appropriate, concise, informative and clear)		7
Discussions: Critical, comprehensive, logically integrated, linked to literature, acknowledgment and discussion of limitations, significance and implications of the findings		25
Conclusion and recommendations: clear, concise and supported by data, findings must relate/respond to the objectives/hypotheses/research questions. Recommendations must be linked to the findings		5
Contribution to knowledge: originality and relevance to subject area		3
References: Appropriate format, consistency between in-text citation and reference list		5
Language and technicalities: clear and legible language use and format		3
TOTAL		**100**

…………………………………………….. …………………………………………… ………………………….

Name of Examiner **Signature** **Date**

ANNEX 10

SUMMARY OF EXAMINATION RESULTS (MASTER THESIS)

Name of student: …………………………………………………………………………………………………

Thesis title: ……

………..

………..

Faculty:………………………………………………………………………………………...

	EXAMINERS RECOMMENDATIONS	**(X)**
1.	Thesis PASSES subject to MINOR corrections Mark allocated: ……….. (≥ 50%)	
2.	Thesis PASSES subject to MAJOR corrections as indicated in the report Mark allocated: ……….. (≥ 50%)	
3.	Thesis MUST BE RE-SUBMITTED FOR RE-EXAMINATION after one or more of the following (specify): **(No mark to be allocated)**	
	3.1 Additional literature review	
	3.2 Additional data collection	
	3.3 Additional data analysis	
	3.4 Thesis re-write	
	3.5 Other (specify in Main Report)	
4.	Thesis FAILED (reasons specified in Main Report). Mark allocated: ……….. (≤ 50%)	

…………………………………………….. ……………………………………………. ………………………….

Name of Examiner **Signature** **Date**

Interpretation of the grading scale:

% Equivalence	**Interpretation**
80 and above	Distinction
70 – 79	Very Good
60 – 69	Good
50 – 59	Satisfactory
49 and below	Fail

ANNEX 11

SUMMARY OF EXAMINATION RESULTS (PhD/DOCTORAL DISSERTATION)

Name of student: ………………………………………………………………………………………………………

Dissertation Title: ………

………..

………..

Faculty:…………………………………………………………………………………………..

	EXAMINERS RECOMMENDATIONS	**(X)**
1.	Dissertation PASSES subject to MINOR corrections	
2.	Dissertation PASSES subject to MAJOR corrections as indicated in the report	
3.	Dissertation MUST BE RE-SUBMITTED FOR RE-EXAMINATION after one or more of the following (specify):	
	3.1 Additional literature review	
	3.2 Additional data collection	
	3.3 Additional data analysis	
	3.4 Dissertation re-write	
	3.5 Other (specify in Main Report)	
4.	Dissertation FAILED (reasons specified in Main Report).	

…………………………………………….. ……………………………………………. …………………………..

Name of Examiner **Signature** **Date**

ANNEX 12

VIVA VOCE **EXAMINATION RESULTS FORM (NO MARK SHOULD BE ALLOCATED – ONLY PASS/FAIL)**

(To be attached to the detailed report by the Viva Voce Chairperson)

Name of Student: ………………………………………………………………………………………………………

Degree registered for: ……………………………………………………………………

Thesis/Dissertation Title: ………………………………………………………………………………………………

……......

………

Date: ……………………………

No.	**EXAMINERS' RECOMMENDATION**	**(X)**
1.	**PASS**	
1.1	Student PASSES and no additional adjustments are required.	
1.2	Student PASSES SUBJECT TO minor corrections and revisions	
2.	**FAIL**	
2.1	Student FAILS, but should be given another chance of defending the thesis/dissertation after rectifying the identified weaknesses	
2.2	Student FAILS OUTRIGHT	

Name*	**Designation**	**Affiliation**	**Signature**
	Chairperson		
	External Examiner		
	External Examiner		
	External/Internal Examiner		
	Main supervisor		
	Co-supervisor		
	Co-supervisor		

	Other		

- The *VIVA VOCE* Panel Chairperson should prepare a more detailed report according to instructions contained in **B.16.3 under *Viva voce* Examinations**.
- *In case of disagreement, each panellist shall show against his/her signature which recommendation (e.g., 1.1, 1.2, 2.1 or 2.2) s/he prefers.*

ANNEX 13

***TEMPLATE FOR VIVA VOCE* CHAIRPERSON REPORT**

Name of Student: ……..

Degree registered for: …………………………………………………………………………………

Thesis/Dissertation Title: ……………………………………………………………………………………………….

………

…………………………………………………………………………………………………

Date of Viva Voce examination : ……………………………

1. **Panel members in attendance**
2. **Challenges faced with the examination (e.g. logistical arrangements)**
3. **Summary of the presentation by the student**
4. **Summary of the discussions during the examination**
5. **Strong and/or weak points identified during the presentation and discussions**
6. **Specific recommendations to the student where applicable**

We hereby declare that this report is a true reflection of the Viva Voce examination:

Name*	**Designation**	**Affiliation**	**Signature**
	Chairperson		
	External Examiner		
	External Examiner		
	External/Internal Examiner		
	Main supervisor		
	Co-supervisor		
	Co-supervisor		
	Other		

External panellists who are unable to sign off the report must acknowledge approval of the report via e-mail

ANNEX 14

(Research Proposal/Summary/Mini Thesis/Thesis/Dissertation title page)

EVALUATION OF SELECTED NAMIBIAN MEDICINAL PLANTS FOR ANTI-HIV PROPERTIES

A RESEARCH PROPOSAL/ A MINI THESIS/THESIS/DISSERTATION SUBMITTED IN PARTIAL FULFILMENT/FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE (SPECIFIC DEGREE NAME IN FULL)/DOCTOR OF PHILOSOPHY IN SCIENCE (BIOLOGICAL SCIENCES)

OF

THE UNIVERSITY OF NAMIBIA

BY

....
(NAME OF STUDENT)

....
(STUDENT NUMBER)

....
MONTH AND YEAR OF GRADUATION

MAIN SUPERVISOR: Name (Affiliation)……………………………………………………………………………………

CO-SUPERVISOR(S): Name (Affiliation)……………………………………………………………………………………

NB: INDICATE **IN FULFILMENT** WHEN THERE IS NO COURSEWORK AND IN **PARTIAL FULFILMENT** WHEN THERE IS COURSEWORK

ANNEX 15

POSTGRADUATE STUDIES

CHECKLIST FOR APPROVAL OF RESEARCH PROPOSALS (TO BE COMPLETED BY THE SUPERVISOR)

Faculty: …………………………………………………………………… **Department:** ……..……………………………

Postgraduate Programme Student is enrolled in: ……………………………………………………………………..

Name of Student: ……………………………………………………………… **Student number:** ..……………

Title of Study to be conducted: ………………………………………………………………………………………….

Instructions: Tick (√) **YES** or **NO** in the space provided to indicate whether particular actions and tasks were undertaken. In addition, indicate the dates when the actions or tasks were undertaken.

	NATURE OF ACTION TAKEN	RESPONSE CHOICES				DATE WHEN ACTION WAS TAKEN
1	The student is registered at UNAM for the current academic year	YES		NO		
2	The research proposal has been prepared under the guidance of a supervisor or supervisors.	YES		NO		
3	The student successfully completed the seminar at department and/or faculty level.	YES		NO		
4	The research proposal has been considered and recommended at departmental level.	YES		NO		
5	The research proposal has been considered by the Faculty Postgraduate Studies Committee the following resolution was taken: **RESOLUTION NUMBER: ……………………………………………**	Approved				
		Rejected				
		Extended				
6	Where extension was granted and the proposal re submitted, the research proposal has been considered by the Faculty Postgraduate Studies Committee the following resolution was taken: **RESOLUTION NUMBER: ……………………………………………**	Approved				
		Rejected				
7	The research proposal has been submitted to the UNAM PGSC for noting.	YES		NO		

……………………………………………………………… ……………………………………………….. ……………….

Name of the Main Supervisor **Signature of the Main Supervisor** **Date:**

……………………………………………………………. ……………………………………….. …………………

Name of the Co-Supervisor **Signature of the Co- Supervisor** **Date:**

Name and Signature of the School Chairperson: …………………………………………………………….

Date:…………………………………….

ANNEX 16

RESEARCH PERMISSION LETTER

Student Name

Student number

Programme

Approved research title

TO WHOM IT MAY CONCERN

I hereby confirm that the above mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

-- ………………………………..

Dr PT Johannes **Date**

Associate Dean: School of Engineering and the Build Environment

Tel: +264 65 2 324022

E-mail: pjohannes@unam.na

ANNEX 17

POSTGRADUATE TARIFFS LIST

A. PhD EXAMINATION AND SUPERVISION

	Examination	Supervision
Internal	N$ 2,500	N$ 4,000
External	N$ 5,000	N$ 10,000

B. MASTER EXAMINATION AND SUPERVISION

	Examination	Supervision
Internal	N$ 2,000	N$ 2,000
External	N$ 2,500	N$ 5,000

ANNEX 18

POSTGRADUATE CLAIM FORM FOR EXAMINATION/SUPERVISION

SECTION A	**PERSONAL DETAILS**
NAME OF CLAIMANT & TITLE (Prof/Dr/Mr/Mrs/Ms)	
STAFF NUMBER (**UNAM STAFF ONLY**)	
RESIDENTIAL/PHYSICAL ADDRESS (**NB**) ERF: STREET NAME: TOWN/CITY:	
SECTION B	**DETAILS OF SERVICE PROVIDED**
NAME OF STUDENT	
FACULTY	
TITLE OF THESIS/DISSERTATION	
DEGREE (PhD / Masters)	
TYPE OF SERVICE (Examination / Supervision)	
AMOUNT CLAIMED	**N$**
SECTION C	**FULL BANK DETAILS**
BANK & COUNTRY (**NB**)	
BRANCH NAME	
BRANCH CODE	
TYPE OF ACCOUNT	
ACCOUNT NUMBER	
FULL NAME AND SURNAME OF ACCOUNT HOLDER	
BANK PHYSICAL ADDRESS	

IBAN NUMBER (INTERNATIONAL BANK ACCOUNT NUMBER)		
SWIFT CODE (required for foreign banking)		
SECTION D	**CLAIMANT SIGNATURE AND DATE**	
SIGNATURE______________________________	DATE:__________________	
SECTION E	**OFFICIAL VERIFICATION**	
	SIGNATURE	DATE
Checked by HOD: Department		
Checked by HOD: PGS		
Approval by Director: CPGS		
Finance Department:		

*** ALL CLAIMS MUST BE ACCOMPANIED BY RELEVANT EVIDENCE ON THE SERVICE BEING CLAIMED FOR:**

Examiner: Detailed examination report

Supervisor: Bi-annual progress reports for the duration of the study

Note: Claimants outside Namibia and South Africa, must please attach a copy of ID or Passport

Please note there is NO payment for chairing or participating in a *viva voce* examination panel.

P. SCHOOL OF ENGINEERING AND THE BUILT ENVIRONMENET

☏ (264 65) 232 4004 🖷(+264 65) 232 4085 💻 pnshivute@unam.na ✉ P O Box 3624 ONGWEDIVA, NAMIBIA

M.5. The School of Engineering and the Built Environment may award the following postgraduate qualifications:

Qualification Code	Qualification Name	Study Period
19MCVS	Master of Science (MSc) in Civil Engineering (Structures)	2 FT & 3 PT
19MCVT	Master of Science (MSc) in Civil Engineering (Transportation)	2 FT & 3 PT
19MCVW	Master of Science (MSc) in Civil Engineering (Water)	2 FT & 3 PT
19MELE	Master of Science in Engineering (Electrical Engineering) (by Thesis only)	2
19MECE	Master of Science in Engineering (Electronics & Computer Engineering) (by Thesis only)	2
19MMEC	Master of Science in Engineering (Mechanical Engineering) (by Thesis only)	2
19MMET	Master of Science in Engineering (Metallurgical Engineering) (by Thesis only)	2
19MMIN	Master of Science in Engineering (Mining Engineering) (by Thesis only)	2
19MSCE	Master of Science in Civil Engineering (By Thesis)	2
19MWRM	Master of Science in Water Resources Management **(No intake 2022)**	2
19DPEG	Doctor of Philosophy in Engineering	3

P CURRICULUM FOR THE MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (STRUCTURES)

P. 1 .DEGREE NAME: MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (STRUCTURES) 19MCVS

P.2 PURPOSE AND RATIONALE OF THE PROGRAMME

The **purpose** of the degree programme for **Master of Science in Civil Engineering (Structures**) of the University of Namibia is to offer advanced training to civil engineers so as to prepare them to become specialists in Structural Engineering. The MSc Civil Engineering (Structures) degree programme covered here consists of advanced taught courses plus one year of research by thesis at Level 9 of the National Qualifications Framework (NQF) in Namibia.

Graduates of the MSc Civil Engineering (Structures) degree programme will be equipped with knowledge and skills to work in industry, do consultancy or carry out further research in the areas of structural engineering. The students will gain an advance knowledge in the planning, analysing, design and management (maintain, repair, rehabilitate and retrofit) of civil engineering structures such as houses, high rise buildings, high volume containers, storage silos and bridges, amongst others.

The **rationale** of this qualification is based upon the fact that the Department of Civil Engineering has produced over 130 graduate engineers and there are many other Civil engineering graduates from other national and international institutions. These Civil Engineers need to further their studies in the field of Civil Engineering. Having demonstrated the success of its Bachelor's degree programme, and having received confirmation from the Engineering Council of Namibia that these graduates are registerable as Professional Engineers, the Faculty has developed a curriculum for the degree of Master of Science in Civil Engineering to enable its Graduate Engineers and holders of Bachelor of Science in Civil Engineering from other institutions to undertake further studies in the field of Civil engineering and thereby build capacity for research and consultancy in this field.

P.3 CRITERIA FOR ADMISSION

Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the field of Civil Engineering.

P.4 MODE OF DELIVERY

Full time and part time on a blended learning approach at JEDS Campus

P.5 DURATION OF STUDY

The minimum duration for the Master of Science in Civil Engineering degree programme is two (2) years of full-time study or three (3) years of part time study. The degree must be completed within four (4) years of full-time study or five (5) years of part time study.

P.6 ASSESSMENT CRITERIA

- Reference is made to the University's General Information and Regulations Prospectus and Guidelines for Postgraduate Students for detailed examination and promotion rules.
- For assessment purposes, all courses shall normally carry a component of Continuous Assessment and University Examination. Continuous Assessment (CA) shall normally consist of **Written Tests plus Assignments and/or Lab, and Reports/Mini Projects.**
- Unless otherwise specified, the CA Mark shall be made up of **50%** Written Tests and **50%** Assignments and/or Lab Reports/Mini Projects.
- A candidate will be eligible to write a University Examination (UE) in a given course only if he/she has obtained the required Continuous Assessment Mark of at least 40% in that course unless state otherwise in the Faculty prospectus.
- University Examinations will be administered at the end of thesemester.
- Courses with 18 or more credits shall have **3-hour** examination papers. Courses with 12 credits shall normally have **2-hour** examination papers.
- The Final Examination Mark shall normally be made up of **50%** Continuous Assessment and **50%** University Examination.
- The minimum Pass Mark in any course as determined by the Final Examination Mark is **50%.**

P.7 MAXIMUM NUMBER OF MODULES PER YEAR

	Full Time	Part Time
First year:	144 Credits	90 Credits
Second year:	144 Credits	84 Credits
Third Year:		150 credits

P.8 ADVANCEMENT AND PROGRESSION RULES MASTER OF SCIENCE IN CIVIL ENGINEERING (STRUCTURER)

1. First Year to Second Year of Study (Full Time Students)

Full Time students must have passed at least 120 Credits, including Statistics and Research Method to be able to proceed from Year 1 to Year 2 of study.

2. First Year to Second Year of Study (Part Time Students)

Part Time students must have passed at least 74 Credits to be able to proceed from Year 1 to Year 2 of study.

3. Second Year to Third Year of Study (Part Time Students)

Part Time students must have passed all 90 credits of Year 1, and at least at total of at least 30 Credits of Year 2, including Statistics and Research Method to be able to proceed from Year 2 to Year 3 of study.

P.9 No Re-admission Rule

A student must meet the following minimum requirements in a given year of study to be readmitted into the programme.

1. Minimum requirements for Full time Students

First year:	60 Credits
Second year:	Passed all first-year courses (144 Credits) plus SEBE Board approved thesis proposal

2.Minimum requirements for Part time Students

First year:	42 Credits
Second year:	Passed all first-year courses (90 Credits) and passed 24 credits from Second year courses.
Third Year:	Passed all first- and second-year courses (144 credits) plus SEBE Board approved thesis proposal

P.10 Maximum Number of Credits per Year

	Full Time	Part Time
First year:	144 Credits	90 Credits
Second year:	144 Credits	84 Credits
Third Year:		150 credits

P.11 Requirements for Qualification Award

A student can graduate with the degree of **Master of Science in Civil Engineering** only if he/she has earned the **264 NQF Credits** prescribed in the curriculum.

COMPULSORY COURSES (STRUCTURES PROGRAM) - YEAR 1 OF FULL TIMESTUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Structural Dynamics	**CVS5991**	9	18	3L +2T or 2P	None
1	Advanced Structural Analysis and FEM	**CVM5951**	9	24	4L +2T or 2P	None
1	Advanced Concrete Technology	**CVC5921**	9	12	2L +1T or 1P	None
1	Statistics and Research Methods	**EGT5981**	9	18	3L+2T or 2P	None
1	Academic Writing for Post Graduate Studies	**UAE5819**	8	18*	4L	None
	Total Credits Semester 1			**72**		
2	Advanced Structural Concrete Design	**CVM5972**	9	24	4L +2T or 2P	None
2	Advanced Structural Steel Design	**CVS5932**	9	24	4L +2T or 2P	None
2	Maintenance of Concrete Structures	**CVM5912**		24	4L +2T or 2P	None
	Total Credits Semester 2			**72**		
	Total Credits Year 1			**144**		

**credits not included in the overall course credits*

COMPULSORY COURSES - YEAR 2 FOR FULL TIME STUDENTS (STRUCTURES PROGRAM)

YEAR 3 SEMESTER 1 & 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1&2	Thesis	**EGT5990**	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total Credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Key: *L – Lecture; T – Tutorial; P – Practical; S – Seminar Discussion; FW – Field Work (Fieldtrip).*

Note: Where Block Release is done, the following shall apply:

24 Credits: Block of 3 weeks in total
18 Credits: Blocks of 2 weeks in total, including Saturdays
12 Credits: Block of 1 week and 2 days

COMPULSORY COURSES (STRUCTURES PROGRAM) – YEAR 1 PART TIMESTUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Structural Dynamics	**CVS5991**	9	18	3L +2T or 2P	None
1	Advanced Structural Analysis and FEM	**CVM5951**	9	24	4L+2T or 2P	None
	Total Credits Semester 1			**42**		
2	Advanced Structural Concrete Design	**CVM5972**	9	24	4L +2T or 2P	None
2	Advanced Structural Steel Design	**CVS5932**	9	24	4L +2T or 2P	None
	Total Credits Semester 2			**48**		
	Total Credits Year 1			**90**		

COMPULSORY COURSES (STRUCTURES PROGRAM) - YEAR 2 OF PART TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Advanced Concrete Technology	**CVC5921**	9	12	2L +1T or 1P	None
1	Statistics and Research Methods	**EGT5981**	9	18	3L+2T or 2P	None
	Total Credits Semester 1			**30**		
2	Maintenance of Concrete Structures	**CVM5912**	9	24	4L+2T or 2P	None
2	Academic Writing for Post Graduate Studies	**UAE5819**	9	18*	3L +2T or 2P	None
	Total Credits Semester 2			**24**		
	Total Credits Year 2			**54**		

**credits not included in the overall course credits*

COMPULSORY COURSES - YEAR 3 OF PART TIME STUDENTS (STRUCTURES PROGRAM)

YEAR 3 SEMESTER 1 & 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1&2	Thesis	**EGT5990**	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total Credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Key: *L – Lecture; T – Tutorial; P – Practical; S – Seminar Discussion; FW – Field Work (Fieldtrip).*

Note: Where Block Release is done, the following shall apply:

- 24 Credits: Block of 3 weeks in total
- 18 Credits: Blocks of 2 weeks in total, including Saturdays
- 12 Credits: Block of 1 week and 2 days

Course Title	**ADVANCED STRUCTURAL ANALYSIS AND FEM**
Course Code	**CVM5951**
NQF Level	9
Notional Hours	240
Contact hours	4 hours lecture plus 2-hour tutorial or 3 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

The aim of this course is to advance the students' knowledge of solving statistically indeterminate structures using various methods and to master the use of the finite elements method software in structural analysis.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Solve forces and moments in static structures and statically indeterminate structures and trusses using the different matrix methods such as the flexibility and stiffness method.
2. Apply the slope deflection method to assess the elastic stability and second-order response of structures.
3. Evaluate elastic deformation, as well as non-linear deformation using methods of continuum visco-elastic, plasticity, damage and fracture mechanics.
4. Apply basic concepts of numerical methods used to solve different models of mechanics for structures with complex geometries.
5. Model thin and solid structures and assess linear and nonlinear problems in FEM
6. Apply numerical techniques to solve engineering problems using Finite Elements Method (FEM) computer programs.

Course Content

This course mainly deals with matrix analysis of structures by extending the basic stiffness method of analysis. It includes the review of basic **concepts of structural analysis** and **matrix algebra**, and to how the latter provides an excellent mathematical framework for the former, **Indeterminate structures, matrix concepts** and **matrix analysis of structures**. This is followed by detailed descriptions, and demonstrations through many examples, of how **matrix methods** can be applied to **linear static analysis of skeletal structures** (plane and space trusses; beams and grids; plane and space frames) by the **stiffness method**, and also the **flexibility method**. The course concludes with, the **analysis of elastic instability** and **second-order response (**Effects of axial force on flexural stiffness, solution by slope deflection method and solution by matrix method)**.** This course is also expected to enable a good understanding of how apply the matrix method to analyze statically indeterminate linear 3D frames and trusses.

Introduction to Principles of FEM, Degree of freedom / support conditions / cut principle / Equilibrium; Internal Forces / Loading and Actions / Specific load cases / Safety factors; Basic stresses / Principle stresses and failure criteria; Material parameter with failure strength and hypothesis; Stresses and deformation of thin- / thick -walled structures; FE-modelling ofthin and solid structures as 1D-, 2D and 3D model; Linear and nonlinear problems with analysis; Typical Finite Elements (1D, 2D and 3D) for deformable objects; Example of rod, beam and shell element with matrix equation.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work, computer practical and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbooks

None

Recommended Textbooks

(i) Lamaitre, J. (1991). Damage Mechanics, By Jean Lemaitre, Springer-Verlag.
(ii) Gurtin ME. (1981). An Introduction to Continuum Mechanics. Academic Press, New York
(iii) Leigh DC. (1968). Nonlinear Continuum Mechanics. McGraw-Hill, New York.

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Course Title	**ADVANCED CONCRETE TECHNOLOGY**
Course Code	**CVC5921**
NQF Level	9
Notional Hours	120
Contact hours	2-hours lecture plus 1-hour tutorial or 1 practical session per week for one semester
NQF Credits	12
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course explores the materials science of concrete, bring about the advanced understanding of concrete behaviour.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Evaluate the impacts of concrete ingredients on concrete performance
2. Plan and execute laboratory testing on coarse and fine aggregate, water, admixture used in concrete
3. Select cement admixtures and supplementary cementitious materials for producing concrete with specific and or special requirements
4. Evaluate the performance of various cement-based materials including normal and high strength concrete as well as special cement composites
5. Devise concrete mixture design for high strength concrete and special concrete and specify associated testing for fresh and harden concrete.
6. Compare different special concrete available and how they are made.

Course Content

Characterization of basic ingredients for normal concrete. Important properties for fine and course aggregate, cement, water, admixtures, and supplementary cementitious materials and their effects on concrete properties and effects of admixtures, admixture side effects. Concrete **mix design**. Mixture proportioning with and without cement additives. **Concrete testing**. Testing of desirable properties for concrete in both plastic and hardened state, including strength, creep, shrinkage, elastic modulus and durability. **Concrete modelling**. Predicting and modelling concrete structural properties; concrete failure and fracture; **Quality control**. Concrete quality control, deterioration mechanisms. **Special concretes** such as high strength concrete, self-compacting concrete and fiber reinforced concrete.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, laboratory practicals, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 written test and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of project based assignments, tests and examination

Prescribed Textbooks

None

Recommended Textbooks

(i) A.M. Neville (2011). “Properties of Concrete”, 5th Ed., Pearson Education Limited, Edinburg Gate, Harlow, Essex CM20 2JE, England, ISBN: 978-0-273-75580-7

(ii) P.K. Mehta and P.J.M. Monteiro (2006). “Concrete – microstructure, properties and materials”, 3rd Ed., McGraw Hill, New York.

(iii) Fulton's (2009) Fulton's Concrete Technology (9th edition). Edited by Gill Owens, Cement & Concrete Institute, Midrand, South Africa, ISBN 978-0-9584779-1-8.

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Next Revision: 2025

Course Title	**STATISTICS AND RESEARCH METHODS**
Course Code	**EGT5981**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 computer-based practicals per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to equip students with the advanced skills needed to identify and to conduct reliable advanced research and statistical analysis as required in scientific research and industrial practice.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Define the responsibilities of a researcher, including scientific ethics, and data and code management requirements.
2. Formulate appropriate research questions/hypothesis and select appropriate research designs;
3. Apply concepts of probability, random variables, statistical inference, hypothesis testing and regression in engineering.
4. Manipulate data and use statistic software to perform statistical analysis and probability calculations
5. Develop and write scientific research proposals

Course Content

The course has three sections. The first section focused on **Research Methods**. This section will provide students with an advanced knowledge and skills to initiate, structure and conduct excellent, publishable research. It will advance research concepts covered at an undergraduate level, such as research design, research methodology and research validation. Both qualitative and quantitative research methods will be covered at an advanced level. Concepts such as problem identification, formulation of appropriate research questions/ hypothesis, conducting related literature search and evaluation, development of a research plan, research design, data analysis, disseminate the results and development of a research proposal will be covered at an advanced level. This section will be concluded with **Research Ethics**: different citation methods and styles, importance of referencing and research ethic codes.

The second section will focus on **experimental methods and statistics**. **Statistical Data Analysis:** Introduction to statistical experimental design, ANOVA analysis, error or residue analysis, simple and multiple linear regression analysis, maximum flow theory, probability theory, discrete and continuous probability distribution, reliability and decision analysis. Use of Statistical Software**:** Use of statistical software such as SPSS, R, Mini Tab, etc.

The last section is **Research Proposal Writing:** Students apply what they have learn to write Research Proposals for research work in their fields of interest under the supervision of an academic member of staff and present the Research Proposal for assessment.

Contribution to Assessment of Exit Programme Outcome:

(3) Research capability at work or towards PhD studies

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions. Each topic covered in the lectures will be followed by exercises analyzing real data in practical computing classes using statistical software.

Assessment Strategy

Continuous Assessment **100%**, involving at least 2 written tests **25%**; Assignments **20%**; Research Proposal and Proposal Presentation **50%.**

Quality Assurance Arrangements

Research proposal and statistics components are moderated internally. Students complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Thiel, D. (2014). An introductory note for instructors. In *Research Methods for Engineers*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139542326.002

(ii) Peter RN, Coffin M, Copeland KAF. (2003). Introductory Statistics for Engineering Experimentation. Academic Press, Technology &Engineering

(iii) Jeff Wu C.F, Michael S. Hamada. (2011). Experiments: Planning, Analysis, and Optimization. John Wiley & Sons. Edition 2, illustrated. ISBN 1118211537, 9781118211533 & Sons

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Next Revision: 2025

Course Title	ACADEMIC WRITING FOR POST GRADUATE STUDIES
Course Code	UAE5819
NQF Level	8
Notional Hours	56 contact hours
Contact hours	4 hours per week for one semester
NQF Credits	18 (course is required but does not contribute any credits)
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 & 2
This course aims to equip students with further knowledge of academic writing skills.	
Learning Outcomes: Upon completion of this course, students should be able to: 1. Access various academic sources 2. Analyse a text critically 3. Use a process approach when research writing 4. Write an academic text utilizing proper rhetoric and style 5. Format a written academic text in APA (American Psychological Association) style	

Course Content

This course is a post-graduate course designed to empower students with skills and knowledge to access and critique academic sources and to synthesize information from these sources to assist them in the substantiation and development of their own claim when writing an academic paper in their respective fields of specialization. Additionally, this course will empower students when with the capacity to undertake the challenges of academic writing by exposing them to the different rhetorical and stylistic elements typical of academic texts. Finally, students will be introduced to the American Psychological Association (APA) witting style and will be equipped with the necessary skills to format an academic paper in APA style.

Contribution to Assessment of Exit Programme Outcome:

(4) Engagement in independent scholarly works through publications or conference presentations

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions.

Assessment Strategy

Continuous Assessment: 100% (critical reading assignment, annotated bibliography, term paper

Quality Assurance Arrangements

Internal and external moderation of test papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments and tests

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Next Revision: 2025

Course Title	**STRUCTURAL DYNAMICS**
Course Code	**CVS5991**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 practical session per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

Course Aim: The aim of this course is to introduce advanced concepts of dynamic loading and the response of structures to such loads, and then uses these concepts to illustrate applications in practical structure.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Apply basic concepts of structural dynamic (SD)
2. Evaluate the response of SDOF systems with and without damping to free vibration, harmonic, and arbitrary excitations
3. Compute the dynamic response of structural components (like beams, walls, and columns) and structural systems under dynamic loads such as blast and earthquake excitations
4. Solve SD problem by applying numerical evaluation of dynamic response of SDOF Systems
5. Apply numerical techniques to engineering problems using Finite Elements computer programs
6. Design structures resistant to systemic seismic loading, blast and impact, and wind loading

Course Content

Structural Dynamics: Types of dynamic loads; Basic background of methods available and motivation for structural dynamics. **Important mathematical concepts.** Complex numbers and Fourier analysis., matrix and vector algebra. **Dynamics of Single Degree-of-Freedom Structures**: Dynamic equation of equilibrium; Free vibration of single degree of freedom, Forced vibration: harmonic and periodic loadings; Dynamic response functions, force transmission and vibration isolation; SDOF response to arbitrary functions. systems; **Numerical Evaluation of Dynamic Response of SDOF Systems**: Time domain analysis: finite difference methods; Frequency domain analysis: basic methodology. **Earthquake Response of SDOF Systems**: Earthquake excitation, response history and construction of response spectra; Response spectrum characteristics, tripartite plot, and design spectrum. **Multi Degree of Freedom Systems - Basics**: Dynamic equations of equilibrium, static condensation; Symmetricplan and plan-asymmetric systems. **Free Vibration Response of MDOF Systems**: Undamped systems: natural modes and their properties; Numerical solution for the eigenvalue problem; Solution of free vibration response for undamped systems; Free vibration analysis of systems with damping. **Dynamic Analysis of Linear MDOF Systems**: Introduction, modal analysis; Response-history for earthquake excitations using modal analysis; Response spectrum analysis for peak responses; Concept of Caughey damping as a general type of proportional damping. **Generalized Single Degree of Freedom Systems**: Basic concepts, mass-spring system; Lumped mass systems; Systems with distributed mass and elasticity; Rayleigh's method, shape function selection. **Introduction to Dynamics of Continuous Systems**: Equations of motions for axial vibration of a beam; Equations of motion for flexural vibration of a beam; Free vibration analysis; Introduction to forced vibration analysis using modal superposition method.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work, computer practicals and class discussions.

Assessment Strategy

Examination 50% (1 x 3 hours paper and 30 min oral examination per student); **Continuous 50%** (at least 2 written tests and 3 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbooks

None

Recommended Textbooks

(i) Anil K. (2007). “Dynamic of Structures, Theory and Applications to Earthquake Engineering”. Chopra, 3rd edition (2007), Prentice Hill

(ii) Biggs J.M. (1964). Introduction to Structural Dynamics” McGraw-Hill

(iii) FEMA 450 (2003) “NEHRP Recommended Provisions for Seismic Regulations foe New Buildings and Other Structures” available at www.fema.gov

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Next Revision **2025**

Course Title	**ADVANCED STRUCTURAL CONCRETE DESIGN**
Course Code	**CVM5972**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2
Course Aim: The aim of this course is to develop an advanced understanding of the behaviour and design of reinforced concrete (RC) structures.	

Learning Outcomes: Upon completion of this course, students should be able to:

1. Assess and design and concrete structures under general conditions.
2. Execute advanced design of reinforced concrete structures and structural elements subjected to different types of individual and or combined loading.
3. Design Pre-cast and pre-stressed concrete structures and structural element and different loading
4. Optimize the design of various structural elements and systems.
5. Design of concrete structures for special accidental conditions such as fire, seismic/vibration loading and structural connections.
6. Specify methods for repair and strengthening of concrete structures
7. Design concrete bridges

Course Content

Reinforced concrete (design for torsion and combination of shear, torsion and bending; punching; design of slender columns and unbraced frames; strut and tie modelling; cracking and deflections; analysis and design of slab system, yield line methods for design of slabs, strip method for slab design, Design of walls and shear walls; Design of framed structure, design of building structures; Design for Serviceability Limit State: Deflection; Design for Serviceability Limit State: Crack). **Pre-cast** and **Pre-stressed concrete** (fundamental mechanics of the stress and deflection behaviour; creep and shrinkage, loss in pre- stressing force; continuous beams; fatigue verification). **Structural optimization**. **Accidental design situations** (structural fire design, fire resistance of concrete structures; seismic design of concrete structures, seismic/vibration behaviour and design of beams, columns, frames, connections and structural walls). **Special topics: Design of bridges:** bridge loading, design of simply supported and continuous spans; practical fatigue design; analysis of long span bridges and; **Design of liquid retaining structures.**

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 assignments as technical reports, 1 structural concrete design project and one field trip)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination.

Prescribed Textbooks

None

Recommended Textbooks

(i) Paulay T, Priestley MJN, (1992). Seismic Design of Reinforced Concrete and Masonry Buildings. Wiley: Hoboken, NJ..
(ii) ACI Committee 318, 2014. ACI 318-14 building code requirements for structural concrete and commentary.
(iii) American Society of Civil Engineers, 2010. ASCE 7-10 Minimum design loads for buildings and other structures.

First Issue 2020

Next Revision: 2025

Course Title	**ADVANCED STRUCTURAL STEEL DESIGN**
Course Code	**CVS5932**
NQF Level	9
Notional Hours	240
Contact hours	4 hours lecture plus 2 hours tutorial or 3 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

Course Aim: The aim of this course is to provide advanced training in the design, analysis and assessment of steel and composite (steel/concrete) structures.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Differentiate between AISC's three design approaches: ASD, LRFD, and Inelastic Design
2. Explain the unique purpose of code documents related to structural steel design including the AISC Steel Construction Manual, ANSI/AISC 360, ANSI/ASTM 303, COSP, and ASCE/SEI 7
3. Describe the mechanics of steel as it relates to elastic and inelastic behaviour, flexural buckling, torsional buckling, flexural-torsional buckling, lateral torsional buckling, and local buckling
4. Apply probabilistic foundation of LRFD in designing economical and reliable structures, and demonstrate how the code changed to a unified design philosophy for ASD/LRFD
5. Describe the sources of nonlinear behaviour in members and frames, including the sources of material and geometric nonlinear effects.
6. Apply nonlinear effects in a steel analysis model.
7. Design structurally stable steel frames using the following methods- Effective Length, Direct Analysis, and First-Order Analysis.
8. Recognize the role of modern computer analysis in the job of a structural engineer and understand the steps necessary to perform an essential Quality Assurance peer review
9. Analyse open and closed steel members for torsion loading
10. Design of I-shaped, doubly symmetric plate girders
11. Distinguish between the three types of connection design options as described in the COSP
12. Calculate the design strength of bolt, weld, and connecting element limit states
13. Determine for beam-to-column shear and moment connections the applicable limit states
14. Design simple and moment resisting connections using bolts and welds
15. Explain how seismic risk is quantified by the International Building Code by using a Maximum Considered Earthquake ground motion (MCER)
16. Explain seismic building performance to owners & communities to manage expectations and provide options. Understand how ductility and fuse members are used as the basis of steel seismic design per the code "AISC 341 Seismic Provisions for Steel Buildings
17. Describe the seismic design behaviour of moment and braced frames such as Special, Intermediate, and Ordinary per "AISC Seismic Provisions for Steel Buildings"

Course Content

Steel components and design of steel buildings (member and frame stability, structural analysis; local buckling, cross-section classification, fundamentals of torsion theory, design of combined stresses, plate girders in bending and in shear, shear moment and moment connection design and steel systems for seismic design, design of tension members, steel connections; plastic design, secondary effects, tension flange restraint; trusses and built-up columns; bracing requirements; methods of cladding; design of semi-rigid frames; industrial buildings, multi-storey buildings. **Composite construction** (design basics; construction elements: slabs, beams, beams on elastic foundations, columns; joints). **Accidental design situations** (fire design of steel structures, methods of fire protection; seismic/vibration analysis and design of steel structures).

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, and group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 assignments as technical reports and 1 structural steel design project project)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbooks

None

Recommended Textbooks

(i) Ram C. (1992) "Design of Steel Structures, Vol-2", Standard Book House, 10th Edition.
(ii) American Institute of Steel Construction (AISC). "Steel Construction Manual - Load and Resistance Factor Design (LRFD)," 13th edition, 2005.

First Issue 2020

Next Revision: 2025

Course Title	**MAINTENANCE OF CONCRETE STRUCTURES**
Course Code	**CVM5912**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hour tutorial or 3 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 or 2
The aim of this course is to provide students with a fundamental and practical understanding on condition assessment of concrete structures and concrete repair and service life extension methods	
Learning Outcomes: Upon completion of this course, students should be able to: 1. Assess and identify distress and damages to concrete and masonry structures using various tests. 2. Execute condition assessment on damaged to concrete structures and interpreted concrete deterioration processes. 3. Measure the serviceability and durability of concrete structures and materials 4. Plan and implement maintenance activities for concrete structures. 5. Select and evaluate the properties of various types of repair materials. 6. Specify various repair techniques and or rehabilitation strategies for damaged or deteriorating concrete structures.	

Course Content

Concrete deterioration processes and damage to concrete structures: Reinforcement corrosion, chemical and physical attack, structural damage, fire damage, cracking, and construction defects. **Serviceability and durability of concrete.** Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness and cracking. **Condition assessment of concrete structures:** planning and strategies for condition assessments, on-site diagnostic testing and visual assessment methods, non-destructive testing methods and interpretation of results, laboratory-based testing of samples and prediction of residual service life. **Repair and rehabilitation of concrete structures** philosophies and strategies for concrete repair and rehabilitation, repair methods, materials and systems, repair principles for reinforcement corrosion damaged structures, concrete surface protection and coatings, bonded concrete overlays and patch repair, principles, methods and materials for concrete crack repair, repair guidelines according to the Eurocode, service life extension methods, repair contractor's perspective, material supplier's perspective and forensic engineering: philosophy and added value.

Contribution to Assessment of Exit Programme Outcome:

(5) Engagement in independent scholarly works through publications or conference presentations
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments as technical reports and 1 concrete maintenance or concrete rehabilitation project)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Textbooks

None

Recommended Textbooks

(i) Denison Campbell, Allen and Harold Roper (1991). "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK.
(ii) Dov Kominetzky.M.S. (2001). " Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001
(iii) Ravishankar.K., Krishnamoorthy.T.S, (2004). " Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers.

First Issue 2020

Next Revision: 2025

Course Title	**THESIS**
Course Code	EGT5990
NQF Level	9
Notional Hours	1200
Contact hours	4 hours per week average for consultation with supervisorsAbout 20 hours per week of student individual work
NQF Credits	120
Pre-requisite **Co-requisite**	EGT5980 None
Compulsory/Elective	Compulsory
Semester Offered	Final Year Semester 1 and 2

The course aims to make the students demonstrate the ability to carry out fundamental research on a well-structured proposal and to present results and conclusions backed by available literature and appropriate scientific theories for an industrial based project.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Identify, assess and solve open-ended engineering problems creatively and innovatively
2. Apply knowledge of mathematics, basic science and structural engineering sciences from first principles to solve structural engineering problems
3. Design structural components, systems and processes while dealing with constraints, assessing financial and social costs and benefits, and taking other impacts into account
4. Plan and conduct investigations and experiments
5. Analyse and interpret data and derive information from data
6. Exercise limited structural engineering judgement
7. Use modern structural engineering methods, skills and tools to assess their outputs
8. Communicate effectively in writing and orally with supervisors, peers and subordinates
9. Recognise the impact of structural engineering activity on society and the environment
10. Be aware of the importance of engaging in lifelong learning and holding lifelong learning as a professional value
11. Recognise the need to act professionally and ethically within their own area of competence

Course Content:

Development of Thesis Document. Identify authentic research problem, formulate objectives and develop appropriate research questions or hypothesis. Identify and critically analyse and synthesise relevant literatures. Design appropriate research methods including design of experiments using appropriate statistical methods. Present data in a systematic, and well structures approach using different data presentation tools. Perform relevant statistical analysis in a manner that supports or explain the data presented or responds to the hypothesis presented. Discuss results in a way that convert data to information and draw appropriate conclusions and recommendation. Convert thesis into journal papers.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.

(3) Research capability at work or towards PhD studies.

(5) Engagement in independent scholarly works through publications or conference presentations.

Methods of Facilitation of Learning

The course will be facilitated through a well-structured research and thesis writing under the supervision of at least one senior academic member of staff.

Assessment Strategy

Continuous Assessment (100%). The thesis will be evaluated by one Internal Examiner and one External Examiner. Qualifications of Examiners as per UNAM Post Graduate Studies Committee guidelines.

Quality Assurance Arrangements

Internal and external examination of thesis as per procedures of the Post Graduate Studies Committee (PGSC)

First Issue 2020

Next Revision: 2025

Q CURRICULUM FOR THE MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (TRANSPORTATION)

Q. 1. DEGREE NAME: MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (TRANSPORTATION) 19MCVT

Q.2. Purpose and Rationale

The **purpose** of the degree programme for **Master of Science in Civil Engineering (Transportation**) of the University of Namibia is to offer advanced training to Civil engineers so as to prepare them to become specialists in Transportation Engineering. The MSc Civil Engineering (Transportation) degree programme covered here consists of advanced taught courses plus one year of research by thesis at Level 9 of the National Qualifications Framework (NQF) in Namibia.

Graduates of the MSc Civil Engineering (Transportation) degree programme will be equipped with knowledge and skills to work in industry, do consultancy or carry out further research in their areas of Transportation engineering. The students will gain an advance knowledge in the planning, analysing, design and management (maintain, repair and rehabilitate) of sustainable transport systems, design roads and railway systems with appropriate safety measures, supervise road construction, design airport runways and manage transport logistics.

The **rationale** of this qualification is based upon the fact that the Department of Civil Engineering has produced over 130 graduate engineers and there are many other Civil engineering graduates from other national and international institutions. These Civil Engineers need to further their studies in the field of Civil Engineering. Having demonstrated the success of its Bachelor's degree programme, and having received confirmation from the Engineering Council of Namibia that these graduates are registerable as Professional Engineers, the Faculty has developed a curriculum for the degree of Master of Science in Civil Engineering to enable its Graduate Engineers and holders of Bachelor of Science in Civil Engineering from other institutions to undertake further studies in the field of Civil engineering and thereby build capacity for research and consultancy in this field.

Q.3 Criteria for Admission

Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the field of Civil Engineering.

Q.4 Articulation Options

This qualification serves as an entry to PhD in Civil Engineering.

Q.5 Mode of Delivery

Full time and part time using blended learning approach, at JEDS Campus

Q.6 Duration of study

The minimum duration for the Master of Science in Civil Engineering degree programme is two (2) years of full time study or three (3) years of part time study. The degree must be completed within four (4) years of full-time study or five (5) years of part time study.

Q.7 Assessment Criteria

- Reference is made to the University's General Information and Regulations Prospectus and Guidelines for Postgraduate Students for detailed examination and promotion rules.
- For assessment purposes, all courses shall normally carry a component of Continuous Assessment and University Examination. Continuous Assessment (CA) shall normally consist of **Written Tests plus Assignments and/or Lab, and Reports/Mini Projects.**
- Unless otherwise specified, the CA Mark shall be made up of **50%** Written Tests and **50%** Assignments and/or Lab Reports/Mini Projects.
- A candidate will be eligible to write a University Examination (UE) in a given course only if he/she has obtained the required Continuous Assessment Mark of at least 40% in that course unless state otherwise in the Faculty prospectus.
- University Examinations will be administered at the end of the semester.
- Courses with 18 or more credits shall have **3-hour** examination papers. Courses with 12 credits shall normally have **2-hour** examination papers.
- The Final Examination Mark shall normally be made up of **50%** Continuous Assessment and **50%** University Examination.
- The minimum Pass Mark in any course as determined by the Final Examination Mark is **50%.**

Q.8 ADVANCEMENT AND PROGRESSION RULES 19MCVT (TRANSPORT)

1.First Year to Second Year of Study (Full Time Students)

Full Time students must have passed at least 120 Credits, including Statistics and Research Method to be able to proceed from Year 1 to Year 2 of Study.

2.First Year to Second Year of Study (Part Time Students)

Part Time students must have passed at least 60 Credits to be able to proceed from Year 1 to Year 2 of Study.

3 Second Year to Third Year of Study (Part Time Students)

Part Time students must have passed all 78 credits of Year 1, and at least at total of at least 42 Credits of Year 2, including Statistics and Research Method to be able to proceed from Year 2 to Year 3 of study.

Q.9 NO RE-ADMISSION RULE

A student must meet the following minimum requirements in a given year of study to be readmitted into the programme.

1.Minimum requirements for Full time StudentsFirst year:

60 Credits

Second year: Passed all first-year courses (144 Credits) plus FEIT Faculty Board approved thesis proposal

2.Minimum requirements for Part time Students

First year:	42 Credits
Second year:	Passed all first-year courses (78 Credits) and passed 24 credits from Second year courses.
Third Year:	Passed all first- and second-year courses (144 credits) plus FEIT Faculty Board approved thesis proposal

3. Maximum Number of Credits per Year

	Full Time	Part Time
First year:	144 Credits	78 Credits
Second year:	144 Credits	102 Credits
Third Year:	-	144 credits

Q.10 Requirements for Qualification Award

A student can graduate with the degree of **Master of Science in Civil Engineering** only if he/she has earned the **264 NQF Credits** prescribed in the curriculum.

Summary Table for all Courses in the MSc Civil Engineering (19MCVT) Program for Full Time Students

COMPULSORY COURSES (TRANSPORTATION PROGRAM) - YEAR 1 OF FULL TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Transport Policy andRegulations	**CVR5961**	9	12	2L +1T or 1P	None
1	Transport Modelling	**CVM5979**	9	24	4L +2T or 2P	None
1	Statistics and Research Methods	**EGT5981**	9	18	3L +2T or 2P	None
1	Urban Transport Engineering	**CVT5919**	9	24	4L+2T or 2P	None
1	Academic Writing for PostGraduate Studies	**UAE5819**	8	18*	4L	None
	Total Credits Semester 1			**78**		
2	Advanced Road Design and Safety Management	**CVT5959**	9	24	4L +2T or 2P	None
2	Public Transport Systems Design and Operations	**CVT5989**	9	18	3L +2T or 2P	None
2	Advanced Pavement Engineering	**CVT5932**	9	24	4L+2T or 2P	None

**credits not included in the overall course credits*

COMPULSORY COURSES - YEAR 2 FOR FULL TIME STUDENTS (TRANSPORTATION PROGRAM)

YEAR 3 SEMESTER 1 & 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1&2	Thesis	EGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total Credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Summary Table for all Courses in the MSc Civil Engineering (19 MCVT) Program for PartTime Students

COMPULSORY COURSES (TRANSPORTATION PROGRAM) - YEAR 1 OF PART TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Academic Writing for PostGraduate Studies	**UAE5819**	8	18*	4L	None
1	Transport Policy and Regulations	**TCVR5961**	9	12	2L+1T or 1P	None
1	Transport Modelling	**CVM5979**	9	24	4L +2T or 2P	None
	Total Credits Semester 1			**36**		
2	Advanced Road Design and Safety Management	**CVT5959**	9	24	3L +2T or 2P	None
2	Public Transport Systems Design and Operations	**CVT5989**	9	18	3L+2T or 2P	None
	Total Credits Semester 2			**42**		
	Total Credits Year 1			**78**		

**credits not included in the overall course credits*

COMPULSORY COURSES (TRANSPORTATION PROGRAM) - YEAR 2 OF PART TIME STUDENTS

SEM	COURSE NAME *(ELECTIVES)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Statistics and Research Methods	**TEGT5980**	9	18	3L+2T or 2P	None
1	Urban Transport Engineering	**TCVT5919**	9	24	4L+2T or 2P	None
	Total Credits Semester 1			**42**		
2	Advanced Pavement Engineering	**TCVT5932**	9	24	4L+2T or 2P	None
	Total Credits Semester 2			**24**		
	Total Credits Year 2			**66**		

COMPULSORY COURSES - YEAR 3 FOR PART- TIME STUDENTS (TRANSPORTATIONPROGRAM)

YEAR 3 SEMESTER 1 & 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1&2	Thesis	TEGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total Credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

PART B-2: COURSE SPECIFICATION: MSc Civil Engineering Programme 19 MCVT *(Transportation)*

YEAR 1 SEMESTER 1

Course Title:	**TRANSPORT POLICY AND REGULATION**
Course Code	**CVR5961**
NQF Level	9
Notional Hours	120
Contact hours	2-hours lecture plus 1-hour tutorial or 1 practical session per week for one semester
NQF Credits	12
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to: provide students with a theoretical understanding the formulation of policies that guide the development of integrated multi-modal systems; explore integrated approaches to the planning and regulation of urban land use and transport systems

Learning Outcomes: Upon completion of this course, students should be able to:

1. Manage complex dynamics of urban land use and transport systems;
2. Identify the operating characteristics of alternative transport modes, and be able to assess the appropriateness of different modes to different urban contexts, demand conditions and operating environments;
3. Recognize the essential nature of the planning process and its key moments;
4. Select the components of transport management processes;
5. Assess important policy challenges and debates facing the reform, regulation and subsidisation of transport systems;
6. Select alterative competition regulation systems based on their relative strengths and weaknesses.

Course Content

Transport in urban systems: conceptual framework: the role of transport in urban activity systems; travel need and travel behaviour; systems of urban transport provision; urban activity systems and land use patterns: the role of the urban land market and urban planning; conceptualisation of the land use-transport connection; generic city forms and associated transport networks. **Planning intervention in urban activity and transport systems**: rationale for planning intervention as a field of public action/policy; evolution of approaches to planning and associated planning processes and methods in both the land use and transport planning arenas. **Approaches to integrated land use-transport planning**: emerging approaches to integrated land use-transport planning: current concepts (transit-oriented development, public transport corridors); selected case studies of integrated land use-transport planning in practice. **Transport management**: the development of transport management approaches; organisational and legislative frameworks for transport management; theoretical perspectives on travel choice, behavioural change and traffic flow; road space management; travel demand management. **Regulation and competition**: policy debates on subsidisation and competition regulation; mode alternatives analysis; industry structures; approaches to regulation and competition; licensing and contracting.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(5) Engagement in independent scholarly works through publications or conference presentations
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures and written assignments.

Assessment Strategy

Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 written tests and 2 assignments as technical reports)

Prescribed Textbooks

None

Recommended Textbooks

NA

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

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Next Revision: 2025

Course Title:	**TRANSPORT MODELLING**
Course Code	**CVM5979**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to teach principles of transport systems analysis with a focus on mathematical methods and models to analyse transport systems at various scale levels (microscopic, mesoscopic and macroscopic) and the integration between them.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Apply the fundamentals of transport systems analysis.
2. Apply various transport modelling methods to various stages of the transport planning process.
3. Use the key mathematical and statistical foundations of transport modelling, including for calibration and validation.
4. Assess microscopic, mesoscopic and macroscopic transport modelling approaches, and operate them;
5. Synthesise various transport data survey techniques and devise them to be used transport modelling;
6. Select appropriate modelling tools for specific transport problems, and evaluate the basic operation of these modelling tools;
7. Setup and run transport models;
8. Interpret and justify the results generated by different modelling tools.

Course Content

Travel data collection and processing: Different methodological approaches to data collection, including big data approaches; potential measurement problems; different ways to process and analyse data, and to fulfil mathematical and statistical requirements. **Traffic flow theory**: Techniques for calculating Levels-of-Service; understanding fundamental traffic speed-flow-density diagrams; modelling traffic flows; traffic impact assessment methods. **Transport modelling**: Strategic and policy appraisal models; macroscopic (conventional four-stage model), mesoscopic and microscopic models; mathematical theory; the calibration, validation and verification process; appropriateness of the use of models for different purposes and theoretical critiques. **Mathematics and statistics**: network optimization; network heuristics; choice modelling.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures and computer exercises.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 modelling assignments as technical reports and a group design project)

Prescribed Textbook
None

Recommended Textbooks
NA

Quality Assurance Arrangements
Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

First Issue 2020

Next Revision: 2025

Course Title	**STATISTICS AND RESEARCH METHODS**
Course Code	**EGT5981**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 computer-based practicals per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1
This course aims to equip students with the advanced skills needed to identify and to conduct reliable advanced research and statistical analysis as required in scientific research and industrial practice.	
Learning Outcomes: Upon completion of this course, students should be able to: 1. Define the responsibilities of a researcher, including scientific ethics, and data and code management requirements. 2. Formulate appropriate research questions/hypothesis and select appropriate research designs; 3. Apply concepts of probability, random variables, statistical inference, hypothesis testing and regression in engineering. 4. Manipulate data and use statistic software to perform statistical analysis and probability calculations 5. Develop and write scientific research proposals	

Course Content

The course has three sections. The first section focused on **Research Methods**. This section will provide students with an advanced knowledge and skills to initiate, structure and conduct excellent, publishable research. It will advance research concepts covered at an undergraduate level, such as research design, research methodology and research validation. Both qualitative and quantitative research methods will be covered at an advanced level. Concepts such as problem identification, formulation of appropriate research questions/ hypothesis, conducting related literature search and evaluation, development of a research plan, research design, data analysis, disseminate the results and development of a research proposal will be covered at an advanced level. This section will concluded with **Research Ethics**: different citation methods and styles, importance of referencing and research ethic codes.

The second section will focus on E**xperimental Methods and Statistics**. **Statistical Data Analysis:** Introduction to statistical experimental design, ANOVA analysis, error or residue analysis, simple and multiple linear regression analysis, maximum flow theory, probability theory, discrete and continuous probability distribution, reliability and decision analysis. Use of Statistical Software**:** Use of statistical software such as SPSS, R, Mini Tab, etc.

The last section is **Research Proposal Writing:** Students apply what they have learn to write Research Proposals for research work in their fields of interest under the supervision of an academic member of staff and present the Research Proposal for assessment.

Contribution to Assessment of Exit Programme Outcome:

(3) Research capability at work or towards PhD studies

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions. Each topic covered in the lectures will be followed by exercises analyzing real data in practical computing classes using statistical software.

Assessment Strategy

Continuous Assessment **100%**, involving at least 2 Tests **25%**; Assignments **20%**; Research Proposal and Proposal Presentation **50%.**

Quality Assurance Arrangements

Research proposal and statistics components are moderated internally. Students complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(iv) Thiel, D. (2014). An introductory note for instructors. In *Research Methods for Engineers*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139542326.002

(v) Peter RN, Coffin M, Copeland KAF. (2003). Introductory Statistics for Engineering Experimentation. Academic Press, Technology &Engineering

(vi) Jeff Wu C.F, Michael S. Hamada. (2011). Experiments: Planning, Analysis, and Optimization. John Wiley & Sons. Edition 2, illustrated. ISBN 1118211537, 9781118211533 & Sons

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Next Revision: 2025

Course Title	ACADEMIC WRITING FOR POST GRADUATE STUDIES
Course Code	UAE5819
NQF Level	8
Notional Hours	56 contact hours
Contact hours	4 hours per week for one semester
NQF Credits	18 (course is required but does not contribute any credits)
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 & 2

This course aims to equip students with further knowledge of academic writing skills.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Access various academic sources
2. Analyse a text critically
3. Use a process approach when research writing
4. Write an academic text utilizing proper rhetoric and style
5. Format a written academic text in APA (American Psychological Association) style

Course Content

This course is a post-graduate course designed to empower students with skills and knowledge to access and critique academic sources and to synthesize information from these sources to assist them in the substantiation and development of their own claim when writing an academic paper in their respective fields of specialization. Additionally, this course will empower students when with the capacity to undertake the challenges of academic writing by exposing them to the different rhetorical and stylistic elements typical of academic texts. Finally, students will be introduced to the American Psychological Association (APA) witting style and will be equipped with the necessary skills to format an academic paper in APA style.

Contribution to Assessment of Exit Programme Outcome:

(5) Engagement in independent scholarly works through publications or conference presentations

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions.

Assessment Strategies

Continuous Assessment: 100% (critical reading assignment, annotated bibliography, term paper)

Quality Assurance Arrangements

Internal and external moderation of test papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments and tests

First Issue 2020

Next Revision: 2025

Course Title:	ADVANCED ROAD DESIGN AND SAFETY MANAGEMENT
Course Code	CVT5959
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

The aim of this course is to equip students with advanced knowledge of road infrastructure safety management tools at different levels (network, road sections, intersection) and development (planning and design) of infrastructure safety measures.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Design a road alignment and cross section based on, but not limited to, road safety considerations
2. Preform road traffic accident analysis.
3. Develop road infrastructure safety management (Network Safety Management, Road Safety Audit, Road Safety Inspection, Blackspot Management).
4. Apply Accident Prediction Models (APM) and crash modification factors (CMF).
5. Plan, design and assess measures to improvement traffic safety at sections or junctions.
6. Evaluate and use specific road design software tools.

Course Content

Geometric Design: Principles and objectives of geometric design, design challenges, safety effects of road geometry. **Road Traffic Accident Analysis:** Differentiation of accident severity, types of accidents, kind of accidents and causes of accidents, analysis of traffic accident reports. **Road Infrastructure Safety Management**: Methods to calculate and rank the safety level of road stretches (Network Safety Management); Organisation and tools for analysing the possible qualitative impact of design elements on road traffic safety of all road user groups (Road Safety Audit); Organisation and tools to assess the road elements and condition important for road traffic safety (Road Safety Inspection); Define and analyse sections and junctions with a high accident load, develop and asses (CBA) counter measures (Blackspot Management). **Accident Prediction Model and Crash Modification Function**: Knowledge and application of different APM and CMF. **Road Infrastructure Safety Improvements:** Plan, design and asses Road Infrastructure Improvements Measures. **Road Design Tools:** Knowledge and application of software tools for the design of roads.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Textbooks

None

Recommended Textbooks

N/A

First Issue 2020

Next Revision: 2025

Course Title:	PUBLIC TRANSPORT SYSTEMS DESIGN AND OPERATIONS
Course Code	CVT5989

NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 1 practical session per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	2

This course aims to develop an advanced understanding of public passenger transport system design, operations management and governance.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Provide an overview of the theory and practice associated with the design and operations of public transport systems
2. Identify and address key challenges of public transport systems design and operations
3. Select specific design, operations and management components that make up bus and rail based public transport systems
4. Justify the interactions between the different components of public transport design and operations, i.e. service quality, passenger demand, infrastructure, transit operations and evaluation;
5. Apply mathematic methods and techniques to design and optimize public transport systems and networks, to calculate public transport capacity, and to derive time tables and crew schedules
6. Compare challenges of public transport systems design and operations management in Namibia / Southern Africa and formulate their implications for the competitiveness of public transport

Course Content

Service quality: public transport systems, mobility and public transport use in Namibia, required service qualities, public transport systems hierarchy and networks. **Urban planning and passenger demand**: transit, land use and urban structure, public transport network design, transit-oriented development (TOD), public transport demand, public transport demand modelling. **Bus and rail infrastructure:** bus infrastructure and bus rolling stock, capacity of bus systems, bus system capacity, rail infrastructure and rail rolling stock, capacity of rail systems. **Stations and operations**: operational aspects, time table scheduling, intermodal stations. **Evaluation:** operational cost coverage, financial analysis, economic cost benefit evaluation. **Governance:** role and responsibilities of different stakeholders**.**

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(3) Research capability at work or towards PhD studies
(4) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 written tests, 2 modelling assignments as technical reports and a group design project)

Prescribed Textbooks

Reader with articles

Recommended Textbooks

N/A

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

First Issue 2020

Next Revision 2025

Course Title:	**URBAN TRANSPORT ENGINEERING**
Course Code	**CVT5919**
NQF Level	9
Notional Hours	240
Contact hours	4-hours lecture plus 2-hours tutorial or 2 practical session per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1

The aim of this course is to equip students with advanced knowledge of the planning, design and operations of urban transport. It covers a range of topics that are essential for the transportation engineer to manage urban transport problems, including for peri-urban spaces.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Analyse urban transport and the role of advanced planning and engineering therein
2. Evaluate transport sustainability, including related to transport equity
3. Develop traffic management and travel demand management (TDM)
4. Assess urban road safety
5. Formulate design decisions for non-motorized transport, including around universal access
6. Perform traffic flow calculations, including for pedestrians
7. Compute capacity/level of service of junctions, roundabouts, stretches and networks using appropriate software
8. Plan and design intersections with advanced traffic light systems (adapted and coordinated systems) using appropriate software
9. Calculate and visualize area-wide mobility and accessibility measures in a geographical information system, and comment on the level of transport equity
10. Perform statistical tests on transport data and critically comment on transport data survey approaches
11. Select and conduct appropriate impact assessment methods to various urban transport problems
12. Critically rate measures to improve urban roadsafety.
13. Conduct integrated transport planning and set up a design for a defined case study

Course Content

Urban Transport: State-of-knowledge on urban transport systems, including informal systems. **Non-Motorized Transport:** principles, geometric design, universal design **Network Design:** network structures, network analysis, models **Traffic Flow Theory**: vehicle following, pedestrian flow models, queuing theory, shockwaves, gap acceptance **Transport Management**: Intelligent Transport Systems, Traffic management systems, Parking management, Mobility management, Road pricing. **Sustainable Transport:** low-carbon transport, resilient transport systems, equitable transport systems, Mobility As A Service (MAAS). **Road Engineering:** theory of capacity and level of service methodology; application of capacity calculation for junctions, roundabouts, stretches and networks; design of traffic lights operation systems; application of relevant software. **Transport Justice:** Operationalizing accessibility and equity concepts **Urban Road Safety:** urban black spot management; measures of improving road safety; vulnerable road users. **Transport data**: Survey design, Statistics of transport data, visualizing transport data. **Impact assessment:** EIA/SEA/TIA, CBA/MCA/SMCA in an urban context.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, written assignments, practical sessions, group work and class discussions.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (written 2 tests and 2 assignments as technical reports)

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examinations.

Prescribed Textbooks

Reader with articles

Recommended Textbooks

N/A

First Issue 2020

Next Revision: 2025

Course Title	**ADVANCED PAVEMENT ENGINEERING**
Course Code	**CVT5932**
NQF Level	9
Notional Hours	240
Contact hours	4 hours lecture plus 2 hours tutorial or 2 practicals per week for one semester
NQF Credits	24
Pre-requisites	None
Compulsory/Elective	Elective
Semester Offered	2

This course aims to help students gain advance knowledge of pavement engineering including advance pavement materials and pavement design methods.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Apply knowledge of pavement materials behaviour to creatively select, specify and monitor construction of pavement materials.
2. Compile, review and interpret results of standardized and advanced testing of highway materials.
3. Evaluate important materials properties used in pavement design methodologies.
4. Carryout site inspection inspections and implement quality control/quality assurance of pavement materials
5. Apply pavement design methodologies creatively to design different types of pavement structures for different field conditions.
6. Identify and appraise best practices to gather data necessary for successful pavement design.
7. Compile design report emanating from for pavement designactivities.
8. Identify and recommend sources of information about new and advanced design methodologies.

Course Content

Pavement materials: Soils-Aggregate Mixtures: The use of natural soils, stabilized aggregate soil mixtures and crushed rocks as road foundation and layer work in pavement structures. Relevant climatic consideration and problem areas. Compaction theory, practise and laboratory versus field consideration. Laboratory and field testing of materials that are processed, modified, stabilized or cemented. **Bituminous Materials**: types of bituminous binders, rheological properties and effects on pavement performance and binder specification methods. **Aggregate for Asphalt mixtures**: Physical properties, graduation requirements, test methods and design specification requirements. **Asphalt Mixtures**: Mixture design methodologies and testing, visco-elastic and failure properties, thermal properties and durability. **Materials for rigid pavements**: Cement production, cement compound, strength, special requirements, concrete mixture proportion, water cement ratio, curing and volume change, aggregate requirements and admixtures **Pavement Design:** Importance of highways, pavement types and behaviour underloading, pavement design concepts and design factors. **Stress and Strain Calculation**: learn about stress, strain and deflection calculation in pavements for single and multi-layered systems, visco-elasticity systems under a moving load, and stresses, deflections, dowels and joints in rigid pavements. **Traffic**: Traffic volume and loading analysis and ESAL calculations. **Materials characterisation**. Key material properties used in pavement design, including fatigue and rutting properties. **Pavement Design**: Design of flexible and rigid pavements (AASHTO Method, Asphalt Institute Method, PCA and other upcoming or commonly used pavement design methods in Southern Africa). **Drainage Design**. Importance of pavement drainage design and commonly used drainage solutions. **Design of surface treatments**: Chip seals, slurry seals and micro-surfacing. Pavement maintenance and rehabilitation strategies and pavement evaluation**.**

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.
(2) Design and synthesis of engineering structures and systems.
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc.

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, laboratory practicals, group work and class discussions.

Assessment Strategy

CA 10**0%** at least 2 written tests, 3 assignments as technical reports and an advanced pavement design project.

Quality Assurance Arrangements

Internal and external moderation of exam papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination

Prescribed Textbook

(i) Hauang Y. (2004). Pavement Analysis and Design, Second Edition, Y. Huang, Prentice Hall.

Recommended Textbooks

(i) Yoder E.J & Witczak, NY. (1975). Principles of Pavement Design, 2nd Ed, John Wiley & Sons, Inc., USA
(ii) Roberts FL, PS Kandhal, DY Lee, TW Kennedy and NAPA. (1997). Hot Mix Asphalt Materials, Mixture Design, and Construction. NAPA Education Foundation.
(iii) South African National Roads Agency (SANRA) (2014),South African Pavement Engineering ManuaL,2nd Ed, SANRA SOC LTD, available at: http://www.nra.co.za/live/content.php?Session_ID=a174daae18dc519c4d22747165c9ea3c&Category_ID=148

First Issue	2020
Next Revision:	2025

Course Title	**THESIS**
Course Code	EGT5990
NQF Level	9
Notional Hours	1200
Contact hours	4 hours per week average for consultation with supervisorsAbout 20 hours per week of student individual work
NQF Credits	120
Pre-requisite **Co-requisite**	EGT5980 None
Compulsory/Elective	Compulsory
Semester Offered	Final Year Semester 1 and 2

The course aims to make the students demonstrate the ability to carry out fundamental research on a well-structured proposal and to present results and conclusions backed by available literature and appropriate scientific theories for an industrial based project.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Identify, assess and solve open-ended transportation engineering problems creatively and innovatively
2. Apply knowledge of mathematics, basic science and transport engineering sciences from first principles to solve transport engineering problems
3. Design transport components, systems and processes while dealing with constraints, assessing financial and social costs and benefits, and taking other impacts into account
4. Plan and conduct investigations and experiments
5. Analyse and interpret data and derive information from data
6. Exercise limited transportation engineering judgement
7. Use modern transport engineering methods, skills and tools to assess their outputs
8. Communicate effectively in writing and orally with supervisors, peers and subordinates
9. Recognise the impact of transportation engineering activity on society and the environment
10. Be aware of the importance of engaging in lifelong learning and holding lifelong learning as a professional value
11. Recognise the need to act professionally and ethically within their own area of competence

Course Content

Development of Thesis Document. Identify authentic research problem, formulate objectives and develop appropriate research questions or hypothesis. Identify and critically analyse and synthesise relevant literatures. Design appropriate research methods including design of experiments using appropriate statistical methods. Present data in a systematic, and well structures approach using different data presentation tools. Perform relevant statistical analysis in a manner that supports or explain the data presented or responds to the hypothesis presented. Discuss results in a way that convert data to information and draw appropriate conclusions and recommendation. Convert thesis into journal papers.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.
(3) Research capability at work or towards PhD studies.
(5) Engagement in independent scholarly works through publications or conference presentations.

Methods of Facilitation of Learning

The course will be facilitated through a well-structured research and thesis writing under the supervision of at least one senior academic member of staff.

Assessment Strategy

Continuous Assessment (100%). The thesis will be evaluated by one Internal Examiner and one External Examiner. Qualifications of Examiners will be as per UNAM Post Graduate Studies Committee guidelines.

Quality Assurance Arrangements

Internal and external examination of thesis as per procedures of the Post Graduate Studies Committee (PGSC)

First Issue 2020

Next Revision: 2025

R CURRICULUM FOR THE MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (WATER)

R. 1. DEGREE NAME: MASTER OF SCIENCE (MSC) IN CIVIL ENGINEERING (WATER) 19MCVW

R. 2. Purpose and Rationale

The **purpose** of the degree programme for **Master of Science in Civil Engineering (Water**) of the University of Namibia isto offer advanced training to civil engineers so as to prepare them to become specialists in Water Engineering. The MSc Civil Engineering (Water) degree programme covered here consists of advanced taught courses plus one year of research by thesis at Level 9 of the National Qualifications Framework (NQF) in Namibia.

Graduates of the MSc Civil Engineering (Water) degree programme will be equipped with knowledge and skills to work in industry, do consultancy or carry out further research in their areas of water/ hydraulic engineering. The students will gain an advance knowledge in the planning, analysing, design and management of water supply systems, waste water treatment systems, flood control systems such as dams and channels. The students will be capable to apply hydraulic engineering approaches and manage water flow in rivers, channels, spillways, stilling basins, pressurised systems and for hydro-power utilisation.

The **rationale** of this qualification is based upon the fact that the Department of Civil Engineering has produced over 130 graduate engineers and there are many other Civil engineering graduates from other national and international institutions. These Civil Engineers need to further their studies in the field of Civil Engineering. Having demonstrated the success of its Bachelor’s degree programme, and having received confirmation from the Engineering Council of Namibia that these graduates are registerable as Professional Engineers, the Faculty has developed a curriculum for the degree of Master of Science in Civil Engineering to enable its Graduate Engineers and holders of Bachelor of Science in Civil Engineering from other institutions to undertake further studies in the field of Civil engineering and thereby build capacity for research and consultancy in this field.

R.3 Criteria for Admission

Prospective students must be in possession of a NQF (Namibian National Qualifications Framework) Level 8 Bachelor (honours) degree qualification or equivalent, with an overall grade average of 60% (and above) from UNAM or any other recognised institution, in the field of Civil Engineering.

R.4 Articulation Options

This qualification serves as an entry to PhD in Civil Engineering.

R.5 Mode of Delivery

Full time and part time using blended learning approach at JEDS Campus

R.6 Duration of study

The minimum duration for the Master of Science in Civil Engineering degree programme is two (2) years of full-time study or three (3) years of part time study. The degree must be completed within three (4) years of full-time study or four (5) years of part time study.

R.7 Assessment Criteria

- Reference is made to the University’s General Information and Regulations Prospectus and Guidelines for Postgraduate Students for detailed examination and promotion rules.
- For assessment purposes, all courses shall normally carry a component of Continuous Assessment and University Examination. Continuous Assessment (CA) shall normally consist of **Written Tests plus Assignments and/or Lab, and Reports/Mini Projects.**
- Unless otherwise specified, the CA Mark shall be made up of **50%** Written Tests and **50%** Assignments and/or Lab Reports/Mini Projects.
- A candidate will be eligible to write a University Examination (UE) in a given course only if he/she has obtained the required Continuous Assessment Mark of at least 40% in that course unless state otherwise in the Faculty prospectus.
- University Examinations will be administered at the end ofthe semester.
- Courses with 18 or more credits shall have **3-hour** examination papers. Courses with 12 credits shall normally have **2-hour** examination papers.
- The Final Examination Mark shall normally be made up of **50%** Continuous Assessment and **50%** University Examination.
- The minimum Pass Mark in any course as determined by the Final Examination Mark is **50%.**

R.8 Advancement and Progression Rules 19MCVW (Water)

1.First Year to Second Year of Study (Full Time Students)

Full Time students must have passed at least 120 Credits, including Statistics and Research Method to be able to proceed from Year 1 to Year 2 of Study.

2.First Year to Second Year of Study (Part Time Students)

Part Time students must have passed at least 52 Credits to be able to proceed from Year 1 to Year 2 of Study.

3.Second Year to Third Year of Study (Part Time Students)

Part Time students must have passed all 66 credits of Year 1, and at least at total of at least 52 Credits of Year 2, including Statistics and Research Method to be able to proceed from Year 2 to Year 3 of study.

R.9 No Re-admission Rule

A student must meet the following minimum requirements in a given year of study to be readmitted into the programme.

1.Minimum requirements for Full time Students

First year: 60 Credits
Second year: Passed all first-year courses (144 Credits) plus FEIT Faculty Board approved thesis proposal

2.Minimum requirements for Part time StudentsFirst year:

30 Credits
Second year: Passed all first-year courses (66 Credits) and passed 36 credits from Second year courses.
Third Year: Passed all first- and second-year courses (144 credits) plus FEIT Faculty Board approved thesis proposal

3.Maximum Number of Credits per Year

	Full Time	Part Time
First year:	144 Credits	66 Credits
Second year:	144 Credits	114 Credits
Third Year:	-	144 edits

R.10 Requirements for Qualification Award

A student can graduate with the degree of **Master of Science in Civil Engineering** only if he/she has earned the **264 NQF Credits** prescribed in the curriculum.

Summary Table for all Courses in the MSc Civil Engineering (Water) (19MCVW) Program for Full Time Students
COMPULSORY COURSES (WATER PROGRAM) - YEAR 1 OF FULL TIMESTUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO- REQUISITE*
1	Advanced Hydraulics	**CVW5921**	9	12	2L+1T or 1P	None
1	Advanced Water Supply and Wastewater Treatment	**CVE5931**	9	24	4L+2T or 2P	None
1	Surface and Groundwater Quality	**CVE5961**	9	12	2L+1T or 1P	None
1	Statistics and Research Methods	**EGT5981**	9	18	3L+2T or 2P	None
1	Academic Writing for Post Graduate Studies	**UAE5819**	8	18*	4L	None
	Total Credits Semester 1			***66***		
2	Integrated Water Resources Management	**CVW5999**	9	18	3L+2T or 2P	None
2	Advanced Hydro-Engineering	**CVW5912**	9	24	4L+2T or 2P	None
2	Hydrology and Hydrogeology	**CVW5989**	9	18	3L+2T or 2P	None
2	Drought and Flood Risk Management	**CVW5992**	9	18	3L + 2T + 3 days FW	None
	Total Credits Semester 2			***78***		
	Total Credits Year 1			**144**		

** This course does not contribute any credits because it is at NQF Level 8.*

COMPULSORY COURSES (WATER PROGRAM) - YEAR 2 OF FULL TIME STUDENTS

YEAR 3 SEMESTER 1 & 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1&2	Thesis	EGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total Credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Summary Table for all Courses in the MSc Civil Engineering (Water) Program for Part Time Students
COMPULSORY COURSES (WATER PROGRAM) - YEAR 1 OF PART TIMESTUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	CONTACT HRS/WEEK	PRE-REQUISITE *CO-REQUISITE*
1	Statistics and Research Methods	**EGT5980**	9	18	3L+2T or 2P	None
1	Surface and Groundwater Quality	**CVE5961**	9	12	2L+1T or 1P	None
1	Academic Writing for Post Graduate Studies	UAE5819	8	18 *	4L	None
	Total Credits Semester 1			**30**		
2	Integrated Water Resources Management	**CVW5999**	9	18	3L+2T or 2P	None
2	Hydrology and Hydrogeology	**CVW5989**	9	18	3L+2T or 2P	None
	Total Credits Semester 2			**36**		
	Total Credits Year 1			***66***		

** This course does not contribute any credits because it is at NQF Level 8.*

COMPULSORY COURSES (WATER PROGRAM) - YEAR 2 OF PART TIME STUDENTS

SEM	COURSE NAME *(ALL COMPULSORY)*	CODE	NQF LEVEL	NQF CREDITS	EQUIVALENT CONTACT HOURS	PRE-REQUISITE *CO-REQUISITE*
1	Advanced Hydraulics	**CVW5921**	9	12	2L+1T or 1P	None
1	Advanced Water Supply and Wastewater Treatment	**CVE5931**	9	24	4L+2T or 2P	None
	Total Credits Semester 1			**36**		
2	Advanced Hydro-Engineering	**CVW5912**	9	24	84 Hours	None
2	Drought and Flood Risk Management	**CVW5992**	9	18	3L+2T + 3 days FW	None
	Total Credits Semester 2		**42**			
	Total Credits Year 2			***78***		

COMPULSORY COURSES - YEAR 3 OF PART TIME STUDENTS (WATER PROGRAM)

YEAR 3 SEMESTER 1 & 2 OF PART TIME STUDENTS						
SEM	**COURSE NAME** ***(ALL COMPULSORY)***	**CODE**	**NQF LEVEL**	**NQF CREDITS**	**CONTACT HRS/WEEK**	**PRE-REQUISITE** *CO- REQUISITE*
1&2	Thesis	EGT5990	9	120	4 hours Consultation per month /presentation	**EGT5980**
	Total Credits Year 3			**120**		
TOTAL NQF CREDITS FOR THE PROGRAMME				**264**		

Key: L – Lecture; T – Tutorial; P – Practical; S – Seminar Discussion; FW – Field Work (Fieldtrip).

Note: Where Block Release is done, the following shall apply:

24 Credits:	Block of 3 weeks in total
18 Credits:	Blocks of 2 weeks in total, including Saturdays
12 Credits:	Block of 1 week and 2 days

Course Title:	**ADVANCED HYDRAULICS**
Course Code	**CVW5921**
NQF Level	9
Notional Hours	120
Contact Hours	2-hours lecture plus 1-hours of tutorial 1 practical sessions per week for one semester
NQF Credits	12
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to provide depth knowledge of advanced hydraulics and advanced flow phenomena as well as to apply approaches to characterise and determine complex flows based on the theoretical governing equations.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Describe properties of fluids and conditions for relative equilibrium in fluids
2. Illustrate fluid properties and applications of Bernoulli equation to fluids
3. Distinguish the characteristics of laminar flow and turbulent flow in fluids
4. Compare and identify the flow characteristics in pipes and channels
5. Demonstrate skills for flow measurements
6. Solve advanced hydraulic systems with respect to energy changes, pipe friction, loss coefficient, pressure oscillations and free surface profiles.
7. Execute numerical simulation software, including pre- and post-processing of the data and interpretation of the results

Course Content

Advanced review of Fluid Mechanics: Fluid properties; hydrostatics; and advanced hydrodynamics. The governing differential equations; pressure distributions, pressure measurement; fluids in relative equilibrium (including acceleration); forces on submerged surfaces; buoyancy (Bernoulli equation, force, momentum, flux equation, continuity equation; ideal flow patterns, streamlines, flow nets; real flow, laminar and turbulent flow, boundary layers and drag). **Flow resistance in pressurised systems:** Dimensional analysis and models. **Advanced flow phenomena:** Variable pressure flows. Vorticity, hydraulic jump, water hammer, extremum principle. **Changing pressurised and open channel flow characteristics**: Pressure impulses and surge tank oscillations. **Flows over free surfaces**: Flow resistance in channels; Flows with uniform regiments. Damper systems. Water surface profile calculations. **Overflow and outflow:** Undisturbed and disturbed flows (back-pressured flows, bridges and culverts). **Theory and practice of numerical modelling of free surface flow**: 1D-modeling (HEC-RAS); examples of 2D-models.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning
The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy
Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presentation)

Quality Assurance Arrangements
The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks
None

Recommended Textbooks

(i) Roberson JA, Cassidy JJ, Chaudry MH. 1998. Solutions Manual Hydraulic Engineering. John Wiley & Sons. ISBN-13: 978-0471244967, ISBN-10: 0471244961
(ii) Nalluri C & Featherstone RE. 2008. Civil Engineering Hydraulics. Blackwell Publishing. ISBN: 978-0-632-05514- 2.
(iii) Finnemore EJ & Franzini JB. 2002. Fluid Mechanics with Engineering Applications. ISBN-13: 978-0-07-243202-2

Software

(i) Hecras 5.0 (U.S. Army Corps of Engineers – Hydrologic Engineering Center)

Issue date: 2020

Next Revision: 2025

Course Title:	**ADVANCED WATER SUPPLY AND WASTEWATER ENGINEERING**

Course Code	**CVE5931**
NQF Level	9
Notional Hours	240
Contact Hours	4 hours lecture plus 2 hours of tutorials or 2 practical sessions per week for one semester
NQF Credits	24
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to equip students with the principles behind water supply and sanitation systems, including systems for clean water distribution and systems for wastewater collection and treatment processes.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Evaluate the impact of water pollutants on public health
2. Identify water resources suitable for drinking purposes
3. Apply appropriate methods to develop a water distribution system under different socio-economic circumstances
4. Use appropriate tools to determine water quality and provide quality assurance of drinking water
5. Discuss the most important techniques for wastewater treatment
6. Plan and use modelling tools to set up an appropriate local and regional sanitation system
7. Evaluate appropriate methods for developing a water distribution system under different socio-economic circumstances
8. Discuss tools that relate water quality aspects
9. Explain the most important techniques for waste water treatment
10. Assess planning and modelling tools for setting up an appropriate regional sanitation system.
11. Design water supply and wastewater facilities.

Course Content:

Introduction: Impact of water pollutants on environment and public health; self-purification of waste in streams; zones of purification; eutrophication. Status and challenges of water supply and sanitation sector. **Water supply:** Urban water cycle, water demand, system analysis of urban and rural water systems, water sources, water quality parameters, legislation, codes, and standards, purification, disinfection, risk management, elevation, adduction, storage, non-revenue water and leakage control, **Design of pipeline networks:** Pipe networks (simple branching circuits, single node reservoir systems, pipe reticulation systems. Permanent pressurized flows.pipeline and hydraulic network systems, pipeline construction, numerical simulation of distribution networks: hydraulics and water quality. **Wastewater:** wastewater system analysis, parameters and processes, wastewater characteristics, wastewater generation, sewage and storm water runoff, drainage systems, rational method, pipelines for foul sewers, open channels, weirs, inverted syphons, culverts. Numerical simulation of sewer and drainage systems. **Wastewater treatment:** wastewater treatment options, mechanical and biological treatment processes, waste stabilization ponds, simulation of biological treatment facilities, sludge treatment. **Operation and management:** development of integrated urban water management plans, ageing and renewal of water systems, management of water companies, regulatory issues.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer’s performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Trifunović (2006): Introduction to urban water distribution. UNESCO-IHE lecture note series
(ii) Butler, Davies (2011): Urban Drainage. Earthscan
(iii) Tchaganoboulos (Metcalf&Eddy 2013): Wastewater engineering

Software

(i) EPANET (U.S. Environmental protection agency)
(ii) SWMM (U.S. Environmental protection agency)
(iii) STOAT (Wrc Water research centre, U.K.)

Issue date: 2020

Next Revision: 2025

Course Title:	SURFACE AND GROUND WATER QUALITY
Course Code	CVE5961
NQF Level	9
Notional Hours	120
Contact Hours	2 hours of lecture + 1 hours of practical work per week for one semester
NQF Credits	12
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	2

This course aims to expose students to the processes and agents that contribute to the quality of surface and ground water with particular reference to Namibia and the available methods of assessing and managing water quality based on existing regulations and national/international water quality standards.

Learning Outcomes: Upon completion of this module, students will be able to:

1. Correlate the key elements of water quality in terms of Water Quality Regulations.
2. Apply national and international Water Quality Standard to ascertain the quality of drinking water.
3. Assess and monitor water quality based on physical, chemical and biological parameters.
4. Designate the various types of water contaminants and how they affect water quality and public health.
5. Discuss parameters that affect the quality of surface water and groundwater and techniques for monitoring quality.
6. Critique the principle involved in groundwater restoration and the impact of hydraulic fracturing on groundwater quality.
7. Conduct a toxicology review of typical substances of concern in Namibian surface and ground water with Case Studies for geogenic, anthropogenic, heavy metal, radioactive and micro-biological contamination.
8. Implement sustainable management practices on the use of surface and ground water resources, specifically in relation to the situation in Namibia.
9. Identify ways and options for water reuse and implementationstrategies.

Course Content:

Water Quality: Parameters for water quality, climate change and its impact on surface and groundwater quality, review of Water Quality (WQ) Regulations. **WQ standards:** World Health Organization drinking water quality standards, Namibian standards, other standards. effluent standards. **WQ Assessment:** Physical, chemical and biological WQ Parameters. Analytic methods for WQ assessment; WQ modeling, WQ Index maps. WQ monitoring and sampling protocols. **Types of water contaminants**: Point source and non-point source contamination, transport processes of contaminants, fate of contaminants, impact of contaminants on water quality and health. **Surface Water:** Surface water quality such as surface run-off, use of surface water, importance of surface water to mankind. **Groundwater:** Groundwater restoration, groundwater quality (especially in arid regions), impact of hydraulic fracturing on groundwater quality. Groundwater salinization, salt water intrusions. Toxicology review of typical substances of concern in Namibian surface and ground water. **Case studies of Namibia**: Fluorides as a geogenic contaminant. Nitrates as an anthropogenic contaminant. Heavy metals as contaminant mobilized by mining. Radon and uranium in groundwater. Micro biological contamination as an indicator for insufficiently protected wells and boreholes. **Management and assessment of surface and ground water**: implementation of sustainable groundwater management plans, source water assessments, urban water management plans, integrated regional water management plans. **Water reuse**: identification of water reuse options, their implementation, advantages and impacts on a sustainable water supply in Namibian municipalities and for agricultural purposes.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, written assignments, lab practicals, group discussions and two days fieldwork.

Assessment Strategy

Examination 50% (1 x 2-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 lab report)

Quality Assurance Arrangements

Internal and external moderation of examination papers and scripts; peer review of course outlines; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination.

Prescribed Textbooks

None

Recommended Textbooks

(i) Monitoring Water Quality. Pollution Assessment, Analysis, and Remediation. Edited by: Satinder Ahuja. ISBN: 978-0-444-59395-5

(ii) Kresic, N., 2009. Groundwater Resources: Sustainability, Management & Restoration. McGraw-Hill Companies Inc. USA.
(iii) Price, M., 2002. Introducing Groundwater. Taylor and Francis Group, London and New York.
(iv) Gupta, S.K. Modern Hydrology & Sustainable Water Development. 2011. Wiley-Blackwell. A John Wiley & Sons, Ltd.

Issue date: 2020

Next Revision: 2025

Course Title	**STATISTICS AND RESEARCH METHODS**
Course Code	**EGT5981**
NQF Level	9
Notional Hours	180
Contact hours	3 hours lecture plus 2 hours tutorial or 2 computer-based practicals per week for one semester
NQF Credits	18
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 & 2
This course aims to equip students with the advanced skills needed to identify and to conduct reliable advanced research and statistical analysis as required in scientific research and industrial practice.	
Learning Outcomes: Upon completion of this course, students should be able to: 1. Define the responsibilities of a researcher, including scientific ethics, and data and code management requirements. 2. Formulate appropriate research questions/hypothesis and select appropriate research designs;3. 4. Apply concepts of probability, random variables, statistical inference, hypothesis testing and regression in engineering. 5. Manipulate data and use statistic software to perform statistical analysis and probability calculations 6. Develop and write scientific research proposals	

Course Content

The course has three sections. The first section focused on **research methods**. This section will provide students with an advanced knowledge and skills to initiate, structure and conduct excellent, publishable research. It will advance research concepts covered at an undergraduate level, such as research design, research methodology and research validation. Both qualitative and quantitative research methods will be covered at an advanced level. Concepts such as problem identification, formulation of appropriate research questions/ hypothesis, conducting related literature search and evaluation, development of a research plan, research design, data analysis, disseminate the results and development of a research proposal will be covered at an advanced level. This section will concluded with **Research ethics**: different citation methods and styles, importance of referencing and research ethic codes.

The second section will focus on **experimental methods and statistics**. **Statistical Data Analysis:** Introduction to statistical experimental design, ANOVA analysis, error or residue analysis, simple and multiple linear regression analysis, maximum flow theory, probability theory, discrete and continuous probability distribution, reliability and decision analysis. Use of Statistical Software**:** Use of statistical software such as SPSS, R, Mini Tab, etc.

The last section is **Research Proposal Writing:** Students apply what they have learn to write Research Proposals for research work in their fields of interest under the supervision of an academic member of staff and present the Research Proposal for assessment.

Contribution to Assessment of Exit Programme Outcome:

(3) Research capability at work or towards PhD studies

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions. Each topic covered in the lectures will be followed by exercises analyzing real data in practical computing classes using statistical software.

Assessment Strategy

Continuous Assessment **100%**, involving at least 2 Tests **25%**; Assignments **20%**; Research Proposal and Proposal Presentation **50%.**

Quality Assurance Arrangements

Research proposal and statistics components are moderated internally. Students complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(vii) Thiel, D. (2014). An introductory note for instructors. In *Research Methods for Engineers*. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139542326.002

(viii) Peter RN, Coffin M, Copeland KAF. (2003). Introductory Statistics for Engineering Experimentation. Academic Press, Technology &Engineering

(ix) Jeff Wu C.F, Michael S. Hamada. (2011). Experiments: Planning, Analysis, and Optimization. John Wiley & Sons. Edition 2, illustrated. ISBN 1118211537, 9781118211533 & Sons

First Issue 2020

Next Revision: 2025

Course Title	**ACADEMIC WRITING FOR POST GRADUATE STUDIES**
Course Code	UAE5819
NQF Level	8
Notional Hours	56 contact hours
Contact hours	4 hours per week for one semester
NQF Credits	0 (course is required but does not contribute any credits)
Pre-requisites	None
Compulsory/Elective	Compulsory
Semester Offered	1 &2
This course aims to equip students with further knowledge of academic writing skills.	
Learning Outcomes: Upon completion of this course, students should be able to: 1. Access various academic sources 2. Analyse a text critically 3. Use a process approach when research writing 4. Write an academic text utilizing proper rhetoric and style 5. Format a written academic text in APA (American Psychological Association) style	

Course Content

This course is a post-graduate course designed to empower students with skills and knowledge to access and critique academic sources and to synthesize information from these sources to assist them in the substantiation and development of their own claim when writing an academic paper in their respective fields of specialization. Additionally, this course will empower students when with the capacity to undertake the challenges of academic writing by exposing them to the different rhetorical and stylistic elements typical of academic texts. Finally, students will be introduced to the American Psychological Association (APA) witting style and will be equipped with the necessary skills to format an academic paper in APA style.

Contribution to Assessment of Exit Programme Outcome:

(5) Engagement in independent scholarly works through publications or conference presentations

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, group work and class discussions.

Assessment Strategy

Continuous Assessment: 100% (critical reading assignment, annotated bibliography, term paper

Quality Assurance Arrangements

Internal and external moderation of test papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments and tests

First Issue 2020

Next Revision: **2025**

Course Title:	**INTEGRATED WATER RESOURCES MANAGEMENT**
Code	**CVW5999**
NQF Level	9
Notional Hours	180
Contact Hours	3 hours of lecture + 2 hours of tutorial/seminar per week for one semester
NQF Credits	18
Prerequisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims is to present the principles, techniques and tools used in Integrated Water Resources Management (IWRM) including Environmental Impact Assessment (EIA) and employing Geographic Information Systems (GIS).

Learning Outcomes: Upon completion of this course, students should be able to:

1. Discuss critically water resources management concepts and principles
2. Identify management functions and decision-making processes in water resourcesmanagement
3. Interpret and analyze regional issues and regional projects on IWRM in Namibia
4. Evaluate measures and sensitivity analysis of IWRM tools on water related issues
5. Present existing procedures for water resources management and suggest improvements
6. Interpret risk management strategy in IWRM including mitigation measures
7. Contrast GIS and RS concepts, techniques and their application to real world situations
8. Relate to and practice the technical language of GIS and RS
9. Assemble and categorize requisite spatial data and format for water resource management.
10. Measure and evaluate environmental impacts of interaction between humans and the environment
11. Discuss planning tools and modeling approaches for environmental impact assessment (EIA) of water projects and their legal implications.

Course Content

Climate change and water resources: Impact of climate change and challenges. Case study Namibia. **International approaches and worldwide examples of IWRM.** Management of water resources: Catchment management, wetlands management, water conservation, implementation strategies and management techniques. Adoption of the principles of IWRM and the impact on water resources of different stakeholders - examples from Africa, Asia and South America. Development and use of river, lake, wetlands, and other water assets. **National and trans-boundary strategies:** Policies, goals, institutional arrangements for IWRM. Review of implemented guidelines and directives, e.g. European Water Framework Directive. **Data acquisition and processing:** Acquisition of data for water quantities and quality. Overview of important advanced state-of-the-art measurement techniques for IWRM. Pre- and post-processing of in-situ data. Data validation. Transformation of algorithms into training and practice-oriented water data processing systems. **Management approaches for IWRM:** Global research, data sources and international initiatives regarding water. Evaluation of annual water budget. Water abstraction, licensing, consultation procedures. **Risk identification and assessment:** Water conservation and capacity building for water conservation. **GIS principles:** Characteristic of and modeling spatial data; projections and coordinate systems; data sources, entry and editing; GPS; visualization and cartographic design. **Applied GIS:** Map algebra, local and neighborhood operations, zonal and proximity operations, and data query. **Principles of Remote Sensing**: Properties of electromagnetic, wavelength regions and their applications; sensors and satellites; image acquisition; image resolutions: spectral, spatial, temporal and radiometric; image preprocessing and display. **Applied Remote Sensing**: Digital image processing, land cover and land use classifications, change detection, rainfall estimate, and water quality assessment. **Integrated Remote Sensing and GIS**: Assembling and assessing requisite data for the application of terrain and hydrological modeling. Assess, interpret and synthesize results obtained from practicals. **Use of GIS and Remote Sensing software** such as ArcGIS, ENVI, ILWIS and QGIS; ideally latest versions. **Environmental Impact Assessment (EIA)**: Data and indicators; Analysis of cause – effect interrelations; avoidance, minimization and compensation; risk management; models; goal concepts; evaluation and decision support; planning methodologies; checklists, matrices, networks; EIA process – screening, scoping, environmental baseline; key elements of Environmental Impact Statement (EIS); Public participation in planning and decision-making; monitoring and auditing; Critically review an Environmental Impact Statement (EIS) for completeness and adequacy.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(4) Application of specialized computer software in analysing engineering problems and systems
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, practicals, written assignments, group discussions and two days fieldwork.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminar presenation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation form towards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Lenton R. and Muller M. (Eds.) (2009). Integrated Water Resources Management in Practice: Better Water Management for Development. Taylor and Francis. ISBN 978-1-84407-649-9 (Hardback), ISBN 978-1-84407-650-5 (Paperback)

(ii) Martinez-Santos, P., Aldaya, M.M., Llamas R. (Eds.) (2014). Integrated Water Resource Management in the 21st Century: Revisiting the Paradigm. CRC Press. ISBN 978-1-138-00143-5 (Hardback), ISBN 978-1-315-79409-9 (eBook PDF)

(iii) Bolstand, P (2016). GIS Fundamentals: A First Text on Geographic Information Systems, 5th edition. XanEdu Publishing, Michigan.http://paulbolstad.net/gisbook.html

(iv) U.S. EPA (2012): Assessment methodology for the environmental impact of water resources projects ISBN-13: 978-1249422136

(v) Meire, P., Coenen, M., Lombardo, C., Robba, M., Sacile, R. (Eds.) (2008). Integrated water management: practical experiences and case studies. Springer. ISBN 978-1-4020-6552-1

(vi) Ruppel & Ruppel-Schlichting (2016): Environmental Law and Policy in Namibia http://www.environment-namibia.net/

Journals

(i) Environmental Impact Assessment Review(Elsevier)

(ii) Impact Assessment and Project Appraisal (International Association for Impact Assessment IAIA)

Issue date: 2020

Next Revision: 2025

Course Title:	**ADVANCED HYDRO-ENGINEERING**
Code	**CVW5912**
NQF Level	9
Notional Hours	240
Contact Hours	4-hours lecture plus 2- hours of tutorial/practical per week for one semester
NQF Credits	24
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to provide in-depth knowledge of the design of hydraulic structures and machinery including costal engineering problems, e.g. tidal and wave motion dynamics, coastal protection structures and harbour design.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Design specific hydraulic structures and hydraulic machinery
2. Construct different types of hydropower plants including pump-storage-plants and determine the mean annual usable energy capacity
3. Determine hydraulic pressure transients in pipelines and dimension surge tanks
4. Design ducts and pipes with all factory equipment, e.g. inlets, screens, valves, outlets etc.
5. Apply design criteria for spillways and stilling basins
6. Link river hydraulics and design of hydraulic structures
7. Quantify dam safety procedures
8. Develop river bank erosion protection
9. Apply culvert and bridge hydraulics
10. Evaluate the mean sea level and the process of storm surge genesis
11. Apply wave theories and wave prediction, refraction and diffraction prediction
12. Design adequate coastal protection structures.

Course Content

Patterns and design of hydraulic structures: Weirs, earth fill dams/rock fill dams, seepage control concepts and monitoring, failure mechanisms; gravity concrete dams, concrete arch dams, buttress dams, control gates, screens, inlets, pipelines and channels, outlets, spillways, stilling basins, surge tanks. **Hydropower plants:** Determining design parameters; design of hydropower plants (micro, mini and large) including pump-storage-plants; determination of mean annual energy capacity at a hydropower plant site with specific hydrological and topographic boundary conditions. **Application of specific design criteria:** River hydraulics and design of hydraulic structures, river bank protection measures, culvert and bridge hydraulics. **Coastal Engineering: Water levels and bathymetry:** Development of the mean sea level (MSL) and extreme storm surges, especially in Namibia. Influence of climate change. **Tidal system dynamics:** Basic understanding of the genesis of tides and waves (wave theory). **Time series analysis:** Working with time series, e.g. water levels, wind data, extreme value statistics and their applications to coastal engineering. **Coastal protection structures and harbour design**: Design of typical coastal protection structures, such as dikes, revetments, groints, caissons for harbour design and other protection and harbour facility design approaches.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(2) Design and synthesis of engineering structures and systems
(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments, 1 lab report and 1seminar presentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation formtowards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbooks

(i) Tanchev L. 2014. Dams and Appurtenant Hydraulic Structures. CRC Press Balkema. ISBN 978-1-138-00006-3
(ii) Chanson H. 2002. The Hydraulics of Stepped Chutes and Spillways. Swets & Zeitlinger. ISBN 90 5809 352 2
(iii) Shore Protection Manual, US Army Coastal Engineering Research Center. ISBN: 0-89499-176-0

Issue date: 2020

Next Revision: 2025

Course Title:	**HYDROLOGY AND HYDROGEOLOGY**
Code	**CVW5989**
NQF Level	9
Notional Hours	180
Contact Hours	3-hours Lecture + - hours tutorial/practical per week for one semester
NQF Credits	18
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	1

This course aims to expose students holistically to the hydrological cycle, its components, processes and the quantification thereof using advanced methods with focus on groundwater recharge, the interaction of surface water and groundwater.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Identify and quantify hydrological processes and their contribution to water balance using advanced methods
2. Quantify evapotranspiration and precipitation at various scales
3. Evaluate and estimate groundwater recharge
4. Perform streamflow and hydrograph analyses
5. Conduct separation techniques and tracer studies
6. Compose water sample analyses with reference to hydrochemical processes
7. Discuss procedures involved in the containment of waste disposal, monitoring of waste, landfills and sewage and determine the vulnerability of aquifers.
8. Construct and interpret various surface and groundwater models.

Course Content

Hydrological processes and water balance: precipitation, evaporation, surface run-off, interception, infiltration, groundwater flow, storage, discharge, precipitation regionalization; evapotranspiration quantification methods. **Streamflow and hydrograph analyses:** streamflow analysis; hydrograph analysis; baseflow separation techniques; tracer studies including isotopic studies; forward and inverse techniques; geology of aquifers; aquifer parameter estimation based on hydrographs; hydrograph response to pumping; artificial (managed) groundwater recharge**. Groundwater recharge:** direct, indirect, localized groundwater recharge; interaction surface water – groundwater; groundwater recharge in different climates; soil water balance modeling; chloride mass balance method, lysimeters, application of isotope techniques. **Hydrochemistry:** Thermodynamic principles applied to hydrochemistry, dissolution & precipitation reactions, redox reactions, cation exchange,the carbonate system, open and closed systems, silicate weathering. **Waste/Aquifer vulnerability:** land fill disposals; containments of waste disposals; geomembranes, combined liners; monitoring of waste/landfills; monitoring of sewage; contamination sources; saltwater intrusion; vulnerability of aquifers: concept and background. **Mini Project**: students conceive, design, synthesize and implement a mini project, individually or in a group.

Contribution to Assessment of Exit Programme Outcomes

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools
(4) Application of specialized computer software in analysing engineering problems and systems

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: lectures, laboratory exercises, seminars, assignments

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 seminarpresentation)

Quality Assurance Arrangements

The examination will be moderated internally and externally. Students will be expected to complete an evaluation formtowards the end of the semester and evaluate the course and the lecturer's performance.

Prescribed Textbooks

None

Recommended Textbook

N/A

Issue date: 2020

Next Revision: 2025

Course Title:	**DROUGHT AND FLOOD RISK MANAGEMENT**
Code	**CVW5992**
Notional Hours	180
Contact Hours	3-hours lecture plus - hours tutorial per week for one semester , plus 3 days fieldtrip
NQF Credits	18
Pre-requisite	None
Compulsory/Elective	Compulsory
Semester Offered	2

This course aims to provide in-depth knowledge of hydraulic and hydrological modelling and strategies for drought management, water harvesting and flood risk management.

Learning Outcomes: Upon completion of this course, students will be able to:

1. Apply advanced concepts of modelling hydrological extremes and interpretation of the modelling results.
2. Develop appropriate regional strategies of drought protection and mitigation strategies and measures.
3. Discuss the flood risk management cycle and its component as well as appropriate information to describe the flood risk of a region.
4. Explain and select structural and non-structural measures for flood protection.
5. Prepare a flood risk management plan for a chosen region.

Course Content

Hydrological and hydraulic modelling: statistical modelling: application of extreme-value-analysis, precipitation-runoff modelling: applicable software applications, precipitation-runoff-model, data interpretation, traffic management systems, Application of flood hazard mapping. **Groundwater engineering**: distribution and movement of water through geological formations (soils, sediments and rocks); modelling of fluid flow in porous media using analytical, numerical and statistical approaches; hydrogeological investigations; concept designs and construction of wells and well fields. **Drought:** types of droughts, meteorological and hydrological description; consequences of droughts; strategies for drought protection and mitigation. **Water harvesting**: strategies of water harvesting, rainwater harvesting, floodwater harvesting, engineering structures, typical examples. **Flood risk management:** types and origins of floods; flood damages; flood risk management strategy; flood forecast; flood risk maps and flood hazard maps; emergency management; flood precaution; structural and non-structural measures; typical examples. Field trips to drought and//or flooded regions and to flood control structures.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools

(2) Design and synthesis of engineering structures and systems

(4) Application of specialized computer software in analysing engineering problems and systems

(6) Multidisciplinary working ability through interaction with other engineers, planners, environmentalists, economists etc

Methods of Facilitation of Learning

The course will be facilitated through the following learning activities: Lectures, tutorials, written assignments, practicalsessions, group work, class discussions and three days fieldwork.

Assessment Strategy

Examination 50% (1 x 3-hours paper); **Continuous 50%** (at least 2 two written tests, 2 assignments and 1 field trip report)

Quality Assurance Arrangements

Internal and external moderation of examination papers and scripts; peer review of course outlines and teaching; students' evaluation, regular review of course content, and effective and efficient supervision and monitoring of assignments, tests and examination.

Prescribed Textbooks

None

Recommended Textbook

(i) The United Nations World Water Development Report 4 (2012). Managing Water under Uncertainty and Risk. United Nations Educational, Scientific and Cultural Organization. UNESCO Publishing. ISBN 978-92-3-104235-5, ISBN 978-92-3-001045-4 (e-book) Jensen, JR (2015). Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition Pearson Education, Illinois

Issue date: 2020

Next Revision: **2025**

Course Title	**THESIS**
Course Code	EGT5990
NQF Level	9
Notional Hours	1080
Contact hours	4 hours per week average for consultation with supervisorsAbout 20 hours per week of student individual work
NQF Credits	120
Pre-requisite **Co-requisite**	EGT5980 None
Compulsory/Elective	Compulsory
Semester Offered	Final Year Semester 1 and 2

The course aims to make the students demonstrate the ability to carry out fundamental research on a well-structured proposal and to present results and conclusions backed by available literature and appropriate scientific theories for an industrial based project.

Learning Outcomes: Upon completion of this course, students should be able to:

1. Identify, assess and solve open-ended hydraulic engineering problems creatively and innovatively
2. Apply knowledge of mathematics, basic science and transport engineering sciences from first principles to solve water engineering problems
3. Design components, systems and processes while dealing with constraints, assessing financial and social costs and benefits, and taking other impacts into account in
4. Plan and conduct investigations and experiments
5. Analyse and interpret data and derive information from data
6. Exercise limited transportation engineering judgement
7. Use modern transport engineering methods, skills and tools to assess their outputs
8. Communicate effectively in writing and orally with supervisors, peers and subordinates
9. Recognise the impact of transportation engineering activity on society and the environment
10. Be aware of the importance of engaging in lifelong learning and holding lifelong learning as a professional value
11. Recognise the need to act professionally and ethically within their own area of competence

Course Content

Development of Thesis Document. Identify authentic research problem, formulate objectives and develop appropriate research questions or hypothesis. Identify and critically analyse and synthesise relevant literatures. Design appropriate research methods including design of experiments using appropriate statistical methods. Present data in a systematic, and well structures approach using different data presentation tools. Perform relevant statistical analysis in a manner that supports or explain the data presented or responds to the hypothesis presented. Discuss results in a way that convert data to information and draw appropriate conclusions and recommendation. Convert thesis into journal papers.

Contribution to Assessment of Exit Programme Outcome:

(1) Advanced engineering problem solving ability through critical analysis and use of appropriate engineering tools.

(3) Research capability at work or towards PhD studies.

(5) Engagement in independent scholarly works through publications or conference presentations.

Methods of Facilitation of Learning

The course will be facilitated through a well-structured research and thesis writing under the supervision of at least one senior academic member of staff.

Assessment Strategy

Continuous Assessment (100%). The thesis will be evaluated by one Internal Examiner and one External Examiner.Qualifications of Examiners will be as per UNAM Post Graduate Studies Committee guidelines.

Quality Assurance Arrangements

Internal and external examination of thesis as per procedures of the Post Graduate Studies Committee (PGSC)

First Issue 2020

Next Revision: 2025