FACULTY PROSPECTUS 2010

FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

THE UNIVERSITY OF NAMIBIA
ONGWEDIVA CAMPUS

NOTE

This Faculty Yearbook is valid for 2010 only. Regulations and curricula may be amended without prior notice. General regulations and information appear in the **General Information and Regulations Yearbook**.

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

The information is correct up to 31 October 2010.

The fact that particulars of a specific programme, subject s or modules have been included in this Faculty Yearbook does not necessarily mean that such programme, subject, or module will be offered in 2010 or any subsequent year.

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

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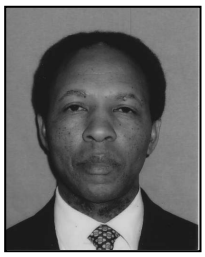
FACULTY PREAMBLE



The Faculty of Engineering and Information Technology at the University of Namibia (UNAM) was founded on 1st January 2008 following the dissolution of the Dept of Engineering and Technology, which had existed under the Faculty of Science since 2000. The Faculty was realized after a Ground Breaking Ceremony conducted by H.E. Dr. Sam Nujoma, Founding Father of the Namibian Nation and Chancellor of the University of Namibia at Ongwediva Town on 17th November 2007. On that occasion, the Chancellor appealed to the Government to allocate funds for the construction of the faculty. The ceremony took place on a 13-hectare plot of land that had been donated to UNAM by Ongwediva Town Council.

In January 2008, the National Planning Commission approved funding for construction of Phase 1 of the new Faculty of Engineering and Information Technology (FOET) in Ongwediva. Construction work began in April 2008 with emphasis on lecture rooms, staff offices, laboratories, IT facilities, student hostels, staff houses and other support facilities. It was the completion of these facilities (Phase IA) that enabled the first batch of students to be admitted in the FOET while Phase IB was ongoing. The climax of it all was the official inauguration of the Faculty Buildings by H.E. Hifikepunye Pohamba, President of the Republic of Namibia, on 17th April 2009. On the same date, the Student Hostels were inaugurated by H.E. Dr. Sam Nujoma, Founding Father of the Namibian Nation and Chancellor of the University of Namibia. The unwavering support of the Faculty of Engineering and IT by their Excellencies is most appreciated.

In 2008 the University Senate approved the administrative structure of the FOET together with several academic programmes of the engineering curriculum offering the Professional B.Sc. (Engineering) degree at Level 8 of the National Qualifications Framework (NQF). The Founding Departments are: Electronics and Telecommunication Engineering; Mechanical and Industrial Engineering; and Mining and Metallurgical Engineering. Academic departments that will be introduced in 2010 include Computer Engineering and Information Technology and Workshops and Industrial Training. Departments of Civil and Environmental Engineering, Electrical and Mechatronics Engineering and Chemical and Biomedical Engineering will follow thereafter.

In this second issue of the Faculty Prospectus, I find great pleasure to welcome students, academic staff and administrative staff of the Faculty of Engineering and Information Technology to the Ongwediva Campus. It is my hope that the students will take maximum advantage of the excellent facilities at the Faculty and be motivated enough to work hard towards their degrees. Facilities like campus wide wireless network, gigabit fast Internet, online lecture notes and assignments, intelligent white boards, high resolution video conferencing, excellent laboratory facilities, 'green' architectural designs, solar technology, on-campus waste management for biogas production, CCTV and finger-print access to buildings are just some of the features that will make students and staff feel very much at home in the Faculty.

Phase I of the Faculty, which was fully funded by the Government of Namibia, is already complete. Phase II due to commence in early 2010 will see the development of two sets of additional buildings. The first set of buildings, which will be funded by the Government of India to the tune of US$ 17 million, including lab equipment, will house the Department of Mining Engineering, Department of Computer Engineering and IT and an Information Resource Centre. This is the single largest external contribution towards the realization of the Faculty so far, and as such, its significance cannot be overemphasized. The second set of buildings, which will be funded by the Government of Namibia, will house the Department of Electronics and Telecommunication Engineering as well as the Department of Electrical Engineering.

I take this opportunity to thank the Government of Namibia, through the Ministry of Education and the National Planning Commission for making this faculty a reality. Special thanks go to Professor Lazarus Hangula, UNAM Vice Chancellor, with whom we worked tirelessly during the past six years to see to it that a fully fledged Faculty of Engineering and IT is realized at UNAM. I must also mention key donors who have provided material and financial support to the FOET, namely: Government of India, Peoples Republic of China, Government of Nigeria, South Africa-Norway Tertiary Education Development (SANTED) programme; Regional Initiative for Science and Education (RISE) programme; Purdue School of Engineering, Indiana University USA; Oulu University Finland; Brandenburg University Germany; DAAD, Ongwediva Town Council, Agricultural Bank of Namibia; Standard Bank Namibia, Old Mutual, Dr. Frans Indongo, Eliakim Namundjebo Family and all others who contributed generously to the ENGIMED fund. Special thanks are also due to all organizations that continue to give bursaries to UNAM engineering students.

Lastly, but not least, I wish to acknowledge the financial contributions from the Ongwediva Business Community, led by His Worship Erastus Uutoni, Major of Ongwediva Town Council and Patron of the Faculty of Engineering and Information Technology, towards supporting needy students of the Faculty with respect to tuition and accommodation fees.

Professor F.P.L. Kavishe
Founding Dean
Faculty of Engineering and Information Technology

January 2010

2010 ACADEMIC YEAR

FIRST SEMESTER

11 January	University opens
21 January	Lecturers resume office duties
18 Jan – 19 February	Registration – Dist Teaching (CES) (Last day for Late Registration: 24 Feb)
28 - 29 January	Registration – Oshakati Campus – Full time senior students
01 - 05 February	Registration – Oshakati, Ogongo & Ongwediva Campuses – All first year students
02 - 18 February	Registration – Main Campus – Full & Part time (Last day for Late Registration: 24 Feb)
17 -18 February	Registration – Ogongo & Ongwediva Campuses – senior students
19 February	Registration – All Post Graduate students (Last day for Late Registration: 24 Feb)
22 February	**Lectures commence for FIRST SEMESTER**
06 April	EASTER BREAK starts
12 April	Lectures resume after Easter Break
11 June	**Lectures end for FIRST SEMESTER**
15 June	First Opportunity Examinations commence (Semester I modules)
02 July	First Opportunity Examinations end (Semester I modules)
02 July	**End of 1st Semester**

SECOND SEMESTER

12 July	**Mid-Year Recess starts**
16 July	**Mid-Year Recess ends**
26 July	**Lectures commence for SECOND SEMESTER**
02 August	Second Opportunity Examinations commence (Postgraduate by Coursework – Final year students)
06 August	Second Opportunity Examinations end (Postgraduate by Coursework – Final year students)
13 September	SPRING BREAK starts
20 September	Lectures resume after Spring Break
05 November	**Lectures end for SECOND SEMESTER**
09 November	First Opportunity Examinations commence (Semester II & Double modules)
26 November	First Opportunity Examinations end (Semester II & Double modules)
26 November	**End of 2nd Semester**
15 December	Academic Year ends & University closes (until 10 January 2011)
10 January 2011	University opens (2011 academic year)
11 January 2011	Second Opportunity Exams commence (Semester I, II & Double modules)
20 January 2011	Lecturers resume office duties
27 January 2011	Last day for appeals (First Opportunity Examinations) (Semester II & Double Modules)
28 January 2011	Second Opportunity Examinations end (Semester I, II & Double modules)

DEADLINES FOR THE 2010 ACADEMIC YEAR

i) GENERAL

Last day for Late Registration (*Late fee payable*) ..... 24 February
Last day for application of exemption(s) ..... 19 February
Last day for application of retention of continuous assessment marks ..... 19 February
Last day for approval of exemption(s) ..... 24 February
Last day for approval of retention of continuous assessment mark ..... 24 February
Last day for approval of module(s) & programme changes 24February
Last day to change Examination Centres at Regional Centres (Semester I modules) 30 April
Last day to submit outstanding documentation ..... 30 July
Last day for appeals (First Opportunity Examinations) (Semester I) ..... 30 July
Last day to change Examination Centres at Regional Centres (Semester II –
(First and Second Opportunity Examinations) ..... 24 September
Last day to apply for enrolment cancellation ..... 01 October
Last day for submission of Theses and Dissertations for examination ..... 19 November

(ii) CANCELLATIONS

First Semester Modules
Last day to cancel Semester I modules ..... 07 May
Second Semester Modules
Last day to cancel Semester II modules ..... 01 October
Double modules
(a double module normally extends over one academic year)
Last day to cancel Double modules ..... 01 October

(iii) FINANCE

First Semester Modules
Last day to cancel with 100% credit ..... 12 March
Last day to cancel with 50% credit ..... 23 April
Last day for payment of Semester I modules ..... 07 June

Second Semester Modules
Last day to cancel with 100% credit ..... 06 August
Last day to cancel with 50% credit ..... 03 Sept
Double modules
(a double module normally extends over one academic year)
Last day to cancel with 100% credit ..... 12 March
Last day to cancel with 50% credit ..... 04 June

A. STRUCTURE AND PERSONNEL OF THE FACULTY

A.1. OFFICE OF THE DEAN

Founding Dean	Professor F. P. L. Kavishe, B.Sc. (Eng) (DSM), MSc, DIC, PhD, (London), R. Eng, C.Eng. (Britain).
Faculty Officer/Administrator	Mrs. Paulina Kashihakumwa
ICT System Administrator	Mr. Gerson Hailundu
Secretary to the Dean	Ms Melinda Christiaan
Admin. Assistant (Projects)	Ms Elizaberth Shigwedha
Staff Development Fellows	Mr. Paulus Tangeni Mulumba, (B.Sc.) UNAM Mr. Abisai M. Shilomboleni, (B.Sc.) UNAM

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

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Namibia

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E-mail: pnshivute@unam.na

Enquiries regarding specific subjects and departments should be addressed to the relevant head of department. (Tel: +264 65 232 4000)

A.2. FOUNDING ACADEMIC DEPARTMENTS

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Acting Head of Dept:	Mr. Epimaque Ruhunga: B.Sc. (Elec Eng), MSc (Elec Eng) (Burundi)
Academic Programs:	Electronics Engineering; Telecommunication Engineering; Electrical Engineering; Computer Engineering

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

Head of Dept:	Dr. Adedayo A. Ogunmokun: B.Sc. (Agr. Eng), (Ife), PhD (Agr. Eng) (Cranfield)
Academic Programs:	Mechanical Engineering; Industrial Engineering; Civil Engineering; Environmental Engineering

DEPARTMENT OF MINING ENGINEERING AND METALLURGICAL ENGINEERING

Head of Dept:	Professor F.P.L. Kavishe: B.Sc. (Mech. Eng), (DSM), MSc, DIC, PhD (Metallurgy), (London)
Understudy:	Ms Bertha Iitana: B.Sc. (Min Eng), MSc (Min Eng), (Wits)
Academic Programs:	Mining Engineering; Metallurgical Engineering.

B. NATURE OF THE B.Sc. (ENGINEERING) CURRICULUM

B.1. INTRODUCTION

In May 2006, the University Senate approved a curriculum for Bachelors degrees in engineering, comprising of four disciplines that included Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering and Mining Engineering. In addition, the Senate recommended to the University Council that a Faculty of Engineering and Information Technology be established at its Northern Campus when funds for capital development are made available by the Government of Namibia. The Senate noted that in October 2005, the then Head of the Department of Engineering and Technology had submitted to the Ministry of Education a proposal for the establishment of the faculty and that the proposal was being studied by the ministry.

On 17th November 2007, H.E. Dr. Sam Nujoma, Chancellor of the University of Namibia (UNAM) and Founding Father of the Namibian Nation conducted a ground-breaking ceremony at the site of the proposed faculty in Ongwediva Town and requested the Ministry of Education and the National Planning Commission to make available funds for the construction of the faculty as a matter of urgency. Following this ceremony, the Faculty of Engineering and Information Technology was formally established and the Vice Chancellor of the University of Namibia, Professor Lazarus Hangula, appointed Professor Frank P. L. Kavishe as its Founding Dean with effect from 1st January 2008.

In 2006 the University Senate directed that all academic curricula of UNAM should be revised during 2007 so as to present learner activity in terms of credits and upgrade the curricula to Level 8 of the National Qualifications Framework (NQF). The engineering curriculum presented to Senate in 2006 had already achieved these objects. However, following consultations with partner universities who intend to assist UNAM to develop its faculty of engineering and IT, it has become necessary to revise the whole curriculum in collaboration with our partners, while introducing new ones in disciplines which were not yet developed. In particular, the University of Oulu in Northern Finland has contributed in the revision and development of the curricula for Mechanical Engineering, Electronics Engineering and Telecommunication Engineering. The University of the Witwatersrand (Wits) in South Africa and the University of Eduardo Mondlane in Mozambique have contributed towards the development of the curricula for Metallurgical Engineering and Computer Engineering. All the degrees are Professional Bachelor Degrees at Level 8 of the NQF.

B.2. 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, Computing, 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, Engineering Mathematics, Engineering Mechanics, Materials Science, Engineering Drawing, Computer Aided Drawing, Computing, Computer Science, Fundamentals of Electrical Engineering and Introductory modules to the various engineering disciplines.

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. These subjects include advanced Engineering Mathematics, Strength of Materials, Electrical Machines and Drives, Statistics for Engineers and Economics for Engineers. Almost all subjects in the Third Year and Fourth Year of Engineering are discipline-specific. In order to provide hands-on experience, all students will be required to undertake Industrial Attachment during the semester breaks of the Second, Third and Fourth Year of Engineering.

B.3. REQUIREMENTS FOR ACCREDITATION

B.3.1 NQF CREDITS

The 8 semesters of the Bachelor of Science degree in Engineering have been structured using the UNAM degree format, while satisfying accreditation requirements of the Namibia Qualifications Authority (NQA), the Engineering Council of Namibia (ECN) and the Engineering Council of South Africa (ECSA) for a total of at least 560 NQF Credits and a minimum specified knowledge area content. The total NQF Credits are mainly accumulated from Levels 5 to 8, and include not more than 40 credits from Level 4.

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.3.2 CONTENT AND KNOWLEDGE AREA

The minimum credits within seven specified knowledge areas in an accredited engineering degree programme that are recommended by ECN and ECSA 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. The actual content per knowledge area in this curriculum is shown in **Appendix 1 to 7** for the various engineering disciplines.

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

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

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

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

C. REGULATIONS AND CURRICULUM FORMAT

The regulations outlined here should be read in conjunction with the **General Information and Regulations** Prospectus of the University of Namibia. The following sections A to D explain the detailed structure of the degree programmes offered by the Faculty.

C.1. DEGREE NAMES AND CODES

The Faculty of Engineering and Information Technology will, in the long run, offer courses that lead to the award of the following degrees plus any others that may be approved by Senate from time to time. Section E shows the programmes currently on offer.

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

C. 2. ADMISSION REQUIREMENTS

C.2.1 GENERAL REQUIREMENTS

To register in the Bachelor of Science (Engineering) course of study, 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. Students doing the UNAM Foundation Programme are eligible for admission into the Pre-engineering Year provided they meet the minimum entry requirements. The Faculty of Engineering and Information Technology may administer an entrance test when places are scarce.

C.2.2 MINIMUM ENTRY INTO PRE-ENGINEERING YEAR (=19BPEN)

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

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

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

C.2.3 MINIMUM ENTRY INTO FIRST YEAR OF ENGINEERING (=19BENG*)*

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

(a) Successful completion of the Pre-engineering Year with passes in the Science and Mathematics modules within one academic year, **or**

(b) A score of **2** or better in Mathematics and Physical Science and a score of **3** or better in English at NSSC-H level (HIGCSE level) or equivalent qualifications. If English was not taken at NSSC-H level, at least a "**C**" symbol in English at NSSC-O level will be required.

Students who have completed the First Year of Science at UNAM with an average pass mark of at least **65%** in Physics, Chemistry, Mathematics and Statistics modules may be admitted to the First Year of Engineering provided they meet the requirements for English specified in B.1.2 above. This criterion will only be applied when there is capacity to admit.

C.3 PROGRESSION

Qualified NSSC-O level candidates must join the Pre-Engineering Year and should normally complete this year successfully within one academic year 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.4. DURATION OF STUDY

The minimum duration for the Bachelor of Science (Engineering) degree programme is (4) years. The B.Sc. (Eng) degree must be completed within six (6) years of full-time study for students who begin at Year 1 of Engineering or seven (7) years for students who begin with Pre-engineering.

C.5. 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) programme. For detailed exemption rules, see the General Information and Regulations Prospectus.

C.6. EXAMINATION REGULATIONS

For detailed examination and promotion rules see the General Information and Regulations Prospectus. A candidate will be eligible to write the examination if he/she has obtained the required **Continuous Assessment Mark of 40%.**

All modules must carry a component of Continuous Assessment. Continuous Assessment will normally consist of **at least 2 written tests plus assignments and/or lab exercises.** University Examinations will normally be administered at the end of the semester. Full modules (16 credits) and three-quarter modules (12 credits) will have 3-hour papers. Although the examination duration for half modules is shown as 2 hours, a Lecturer may administer a 3-hour paper for a half module if it is deemed necessary to have a longer paper for students to demonstrate deeper understanding of the subject matter.

C.7. ACADEMIC ADVANCEMENT RULES

C.7.1 PRE-ENGINEERING TO FIRST YEAR OF ENGINEERING

A student should normally pass all the Science and Mathematics modules within one academic year in order to proceed to the First Year of Engineering. Failed University Core modules can be carried forward to the First Year of Engineering. Outstanding Year 1 students from the B.Sc. (Science) programme who have an average of at least **65% in their first year science and mathematics modules** may be considered for admission into the First Year of Engineering if places are available.

C.7.2 FIRST YEAR TO SECOND YEAR OF ENGINEERING

A student must pass **at least 12 of the prescribed** First Year modules (at least 80% of modules) to be able to register for Second Year modules. If any of the failed modules is a pre-requisite for a Second Year module, then the candidate cannot register for the affected Second Year module until the pre-requisite is passed.

C.7.3 SECOND YEAR TO THIRD YEAR OF ENGINEERING

A student must have passed all prescribed First Year modules. In addition, the student must pass at least 80% of the prescribed Second Year modules to be able to register for Third Year modules. If any of the failed modules is a pre-requisite for a Third Year module, then the candidate cannot register for the affected Third Year module until the pre-requisite is passed.

C.7.4 THIRD YEAR TO FOURTH YEAR OF ENGINEERING

A student **must** have passed all prescribed second year modules. In addition, the student must pass at least 80% of the prescribed **Third Year** modules to be able to register for Fourth Year modules. If any of the failed modules is a pre-requisite for a Fourth Year module, then the candidate cannot register for the affected Fourth Year module until the pre-requisite is passed. Students should note that they cannot register for the Fourth Year Research Project and the Design Project until they have passed **all** Third Year modules.

C.7.5 MINIMUM REQUIREMENTS FOR RE-ADMISSION

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

- At least 71 credits by the end of the first year (at least 40% of total credits in Year 1)
- At least 205 credits by the end of the second year (80% Year 1 plus 40% Year 2)
- At least 362 credits by the end of the third year (or 100% Y1 plus 80% Y2 plus 40% Y3)
- At least 478 credits by the end of the fourth year (or 100% of Y1 and Y2 plus 80% Y3 plus **20%** Y4)

C.7.6 GRADUATION

A student can graduate with a Bachelor of Science in Engineering [B.Sc. (Eng)] degree in a given discipline only if he/she has earned the minimum NQF Credits prescribed in the curriculum.

D. CURRICULUM COMPILATION

The curriculum for the B.Sc. (Eng) degree is made up of the follows components:

PRE-ENGINEERING YEAR (YEAR ZERO) 19BPEN

UNIVERSITY CORE:

ULCE3419 English Communication & Study Skills
ULEA3419 English for Academic Purposes
UCLC3409 Computer Literacy
UCSI3429 Contemporary Social Issues

FACULTY CORE:

All modules specified in the agreed curriculum format

YEAR 1 OF ENGINEERING 19BENG

(Common to all Engineering Disciplines)

FACULTY CORE:

All Year 1 modules specified in the Agreed Curriculum Format

TEGT3509 Workshop Practice

YEAR 2 OF ENGINEERING (= 19BETE; 19BTCE 19BMEE; 19BMNE; 19BCME, 19BCVE; etc)

FACULTY CORE:

TEGT3671 Engineering Mathematics III
TEGT3691 Engineering Mechanics II
TCME3621 Computer Science for Engineers
TEGT3661 Computer Aided Drawing
TEGT3672 Engineering Mathematics IV
SSTS3691 Statistics for Engineers
TEGT3682 Economics for Engineers
TEGT3600 Industrial Attachment I (four weeks in July/August or in January)

DISCIPLINE SPECIFIC MODULES

All modules specified in the Agreed Curriculum Format for a given engineering discipline.

YEAR 3 OF ENGINEERING

FACULTY CORE:

TEGT3742 Entrepreneurship
TEGT3700 Industrial Attachment II (four weeks in July/August or in January)

DISCIPLINE SPECIFIC MODULES:

All modules specified in the Agreed Curriculum Format for a given engineering discipline.

YEAR 4 OF ENGINEERING

FACULTY CORE:

TEGT3821 Society and the Engineer
TEGT3861 Project Management for Engineers
TEGT3800 Industrial Attachment III (four weeks in July/August or in January)

DISCIPLINE SPECIFIC MODULES

All modules specified in the Agreed Curriculum Format 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. ENGINEERING DISCIPLINES TO BE OFFERED

The Bachelor of Science (Engineering) degree will initially comprise the following disciplines:

Mechanical Engineering
Electronics Engineering
Telecommunication Engineering
Mining Engineering
Computer Engineering
Metallurgical Engineering
Civil and Structural Engineering
Electrical Engineering

The following disciplines will be introduced at a latter date when government or donor funding is made available:

Environmental Engineering
Chemical and Process Engineering
Industrial Engineering
Mechatronics Engineering
Biomedical Engineering

E.1. CURRICULUM FORMAT FOR BACHELOR OF SCIENCE (ENGINEERING)

E. 1.2. COURSE CODE STRUCTURE

The code structure employed in this curriculum is as follows:

[TEGT, TMEE, TCME, TETE, TTCE etc] [3] [4 – 8] [full or half] [1 or 2]

T	**First Letter T represents the Faculty of Engineering and Information Technology**
S	**First Letter S represents the Faculty of Science**
EGT, MEE, CME, ETE, MLE, TCE	**Engineering Discipline Letter Code (EGT is for Faculty core modules)**
3	**Bachelors Degree Programme**
4 - 8	**NQF Level**
Full or Half	**Module type, even number for half, odd number for full module, 9 for ¾ module**
1 or 2	**Semester**

E. 1.2. ABBREVIATIONS

L	Lecture
T	Tutorial
PS	Practical Session or Laboratory Session
TEGT	Engineering and Technology course codes
TETE	Electronics Engineering course codes
TTCE	Telecommunication Engineering course codes
TMEE	Mechanical Engineering course codes
TMNE	Mining Engineering course codes
TMLE	Metallurgical Engineering course codes
TCME	Computer Engineering course codes
TCVE	Civil Engineering course codes
SMAT	Mathematics course codes
SSTS	Statistics 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 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.1.1. FORMAT FOR THE PRE-ENGINEERING YEAR (YEAR ZERO)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	English Comm. and Study Skills	ULCE3419	4	16	None
1	Fundamentals of Engineering	TEGT3421	4	8	None
1	Basic Mathematics	SMAT3511	5	16	None
1	Analytic Geometry, Complex Numbers & Matrices	SMAT3531	5	16	None
1	Chemistry 1A	SCHM3411	4	16	None
1	Physics for Physical Sciences I	SPHY3511	5	16	None
Total Credit				**88**	

SEMESTER	MODULE	CODE		CREDIT	PRE &COREQUISITE
2	English for Academic Purposes	ULEA3419	4	16	None
2	Contemporary Social Issues	UCSI3429	4	8	None
2	Pre-Calculus	SMAT3512	5	16	None
2	Introduction to Statistics	SSTS3422	4	8	None
2	Chemistry 1B	SCHM3512	5	16	SCHM3411
2	Physics for Physical Sciences II	SPHY3512	5	16	SPHY3511
2	Computer Literacy	UCLC3409	4	8	None
Total Credit				**88**	

NOTE:

(1) The first year of study (Pre-Engineering Year) is for eligible NSSC-O and NSSC-H candidates, or equivalent qualifications. NSSC-H candidates with a score of 2 or better in Mathematics and Physical Sciences and a score of 3 or better in English shall register directly into the First Year of Engineering.

(2) Students doing the Pre-Engineering year should normally have passed all the Science and Mathematics modules within one academic year in order to proceed to the First Year of Engineering.

(3) Students who do not pass the Pre-Engineering Year may register with the Second Year of B.Sc. (Science) upon satisfying all the Faculty of Science requirements. Alternatively, they may change the discipline altogether.

(4) First year students from the B.Sc. (Science) programme who have an average of at least 65% in their first year science and mathematics modules may be considered for admission into the First Year of Engineering if places are available. Such students must do TEGT3421 Fundamentals of Engineering.

F.1.2. COURSE CONTENT FOR THE PRE-ENGINEERING YEAR (YEAR ZERO)

SEMESTER 1

Module Title:	**ENGLISH COMMUNICATION AND STUDY SKILLS**
Code	ULCE3419
NQF Level	4
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.

Exit 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: January 2009
Next Revision: January 2013

Module Title:	**FUNDAMENTALS OF ENGINEERING**
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ANALYTIC GEOMETRY, COMPLEX NUMBERS & MATRICES**
Code	SMAT3531
NQF level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1x 3 hour paper)
Pre-requisite	None

Contents: Points and lines in a plane: the distance formula, the triangle inequality, parallel and perpendicular lines, circles and tangent lines. Conic sections: ellipse, parabola, hyperbola. Vectors in two and three dimensions: addition of vectors, multiplication by a scalar, magnitude, dot product, cross product. Matrices: addition, multiplication, scalar multiplication and transpose (for up to 3×3 dimension), determinant and inverse (with emphasis on 2 × 2), solutions of systems of linear equations by Cramer's rule (for 2 × 2), and by Gaussian elimination method (for up to 3 × 3 matrices). Complex numbers: operations on complex numbers, the complex conjugate, Argand diagram, modulus-argument form, de Moivre's formula, fundamental theorem of algebra.

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

- calculate the distance between two points in two and three dimensions
- determine whether two lines are parallel or perpendicular
- find the equation of a tangent line to a circle
- find equation of a parabola, hyperbola and ellipse
- add and multiply matrices as well as finding the determinant and the inverse
- solve a system of linear equations
- add and multiply complex numbers
- find the modulus and the principal argument of a complex number

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**CHEMISTRY 1A**
Code	SCHM3411
NQF Level	4
Contact Hours	4L + 1 PS/Week
Credits:	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

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

Exit 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 analyze the periodic relationships among elements
- Explain chemical bonding.
- Predict molecular geometry and hybridization of atomic orbitals.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	ENGLISH FOR ACADEMIC PURPOSES
Code	ULEA3419
NQF level	4
Contact hours	4 Contact hours per week for 14 weeks
Credits	16
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Prerequisites	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.

Exit 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: January 2009
Next Revision: January 2013

Module Title:	CONTEMPORARY SOCIAL ISSUES
Code	UCSI3429
NQF	4
Contact Hours	2 Contact hours per week for 14 weeks
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisite	None

Module Description: The module raises awareness on the need for a personal, national and global ethics. The main objectives of the course is to help students reflect on the social moral issues; to discover themselves in a learner-centered, contextual, religious and life related setting. It also stimulates students for critical thinking and help them to appreciate their values, standards and attitudes. Furthermore it orientates students with regards to the epidemiology of HIV/AIDS; the prevalence of the disease on Namibia, Africa and Internationally. It also informs students on the psycho social and environmental factors that contribute to the spread of the disease, the impact of HIV/AIDS on their individual lives, family and communities at large. The unit further seeks to enhance HIV/AIDS preventive skills among students by means of paradigm shift and behaviour change and also to impart general introductory knowledge on gender, to make students aware, as well as sensitize them towards gender issues and how they affect our society, Sub-Region and continent at large.

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

- Identify social issues affecting the Namibian Society.
- Describe the characteristics of these issues and to design a plan of action;
- Assess the challenges facing the society in a multi-cultural, multi-faith and secular setting;
- Develop respect for humanity, nature and cosmos.
- Describe the physical-medical aspects of HIV/AIDs
- Demonstrate knowledge of the following social factors that can contribute towards the spread of HIV/AIDs; Relationships; Social conditions; Attitudes; Cultural influences; Myths about HIV/AIDs.
- Explain behaviour change towards HIV/AIDS;
- Construct HIV/AIDS prevention strategies, continuum of care and support among students.
- Identify with, and use gender concepts with ease
- Utilize gender-sensitive language and live a life that reflects gender exposure
- Reflect on gender relations between women and men in society, and the impact on society;
- Reduce gender stereotypes in their home and community at large;
- 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.

Issue Date: January 2009
Next Revision: January 2013

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.

Exit Learning Outcomes

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**INTRODUCTION TO STATISTICS**
Code	SSTS3422
NQF Level	4
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.

Exit 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: January 2009
Next Revision: January 2013

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 & 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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**COMPUTER LITERACY**
Code:	**UCLC 3409**
NQF level:	**4**
Contact hours:	**2 lecture periods practical and 1 lecture period / week for 14 weeks**
Credits:	**8**
Module assessment:	**Continuous Assessment 2 Practical Tests 50% and 2 Theory Tests 50%**
Prerequisites:	**University Entry**

Module description: The aim of this module is to equip the students through hands-on experience with the necessary skills to use application software: word processing, spreadsheets, databases, presentations and communications. The objective is to increase student's productivity in both the education and later, the work environment. The module covers the following topics. Introduction to Computers: hardware and software, types and categories of computers, usage of Computer devices and peripherals. Working with the windows operating system: File Management, working with multiple programs, using the recycle bin, using a word processor, formatting a text and documents, spelling check, grammar and thesaurus tools, inserting tables, auto-shapes, clip arts, charts, and mail merge. Spreadsheet: worksheets and workbooks, ranges, formulas and functions, creating graphs, charts, and printing the workbook. Databases: creating tables, relationships, queries, forms and reports. Presentation software: slide layout and master, animations, auto-content wizard and templates. Communication tools, introduction to the Internet, web browser, search engines, downloading and uploading files, creating and sending messages, email etiquette, internet security, and digital signatures.

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

- Distinguish between the functions of various computer components and peripherals
- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Perform practical exercises using MS Word, Excel and PowerPoint.
- Be able to create own email address, communicate with email and use the Internet.

Issue Date: January 2009
Next Revision: January 2013

G. BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

G.1. B.Sc. (MECHANICAL ENGINEERING) 19BMEE

G.2. AIM

The curriculum for the degree of B.Sc. (Mechanical Engineering) 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.3 CURRICULUM STRUCTURE

YEAR 1 OF B.Ss. MECHANICAL ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	16	None
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	8	None
1	*Contemporary Social Issues*	*UCSI3429*	*4*	8	None
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	16	SPHY3511
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	Intro to Mechanical Eng. and Design	TMEE3542	5	8	TEGT3591
2	*Chemistry 1B*	*SCHM3512*	*5*	16	None
2	*English for Academic Purposes*	*ULEA3419*	*4*	16	None
Total Credit				**92**	

NB: Students who have done UCSI3429, ULEA3419, TEGT3421, SPHY3571, SPHY3572 and SCHM3572 will be exempted from taking them in this year.

YEAR 2 OF B.Ss. MECHANICAL ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Engineering Thermodynamics I	TMEE3661	6	8	SCHM3512
1	Engineering Materials	TMEE3621	6	8	TEGT3522
1	Fluid Mechanics	TMEE3611	6	8	TEGT3592
1	Computer Aided Drawing	TEGT3522	6	8	TCME3591 TEGT3591
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
Total Credit				**88**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3572
2	Mechanical Engineering Design I	TMEE3682	6	8	TMEE3542
2	Manufacturing Technology I	TMEE3662	6	8	TEGT3522
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Electrical Machines & Drives	TETE3622	6	8	TEGT3541
2	Solid Mechanics I	TMEE3642	6	8	TEGT3592
2	Strength of Materials	TMEE3622	6	8	TEGT3691
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**80**	

YEAR 3 OF B.Ss. MECHANICAL ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Engineering Thermodynamics II	TMEE3721	7	8	TMEE3661
1	Rigid Body Dynamics	TMEE3711	7	16	TEGT3691 3691
1	Principles of Control Engineering	TMEE3741	7	8	TEGT3671
1	Mechanical Engineering Design II	TMEE3731	7	16	TMEE3682
1	Elements of Machine Automation	TMEE3791	7	12	TETE3622
1	Machine Tools	TMEE3761	7	8	TMEE3662
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
1	Operations Management	TEGT3721	7	8	SSTS3691
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Fundamentals of Mechatronics	TMEE3712	7	16	TMEE3791
2	Solid Mechanics II	TMEE3722	7	8	TMEE3642
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Manufacturing Technology II	TMEE3762	7	8	TMEE3662
2	Fluid Machinery	TMEE3782	7	8	TMEE3611
2	Fracture of Materials	TMLE3742	7	8	TEGT3562, TMEE3622
2	Computer Aided Design	TMEE3732	7	16	TEGT3661
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**76**	

YEAR 4 OF B.Ss. MECHANICAL ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDIT	PRE &COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Mechanical Vibrations	TMEE3811	8	16	TMEE3711
1	Thermal Machines	TMEE3831	8	16	TMEE3721
1	Refrigeration and Air Conditioning	TMEE3891	8	12	TMEE3721
1	Mechanical Engineering Design III	TMEE3881	8	8	TMEE3781
Total Credit				**68**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**CREDIT**	**PRE &COREQUISITE**
2	Research Project	TMEE3839	8	24	All 3rd Year Modules
2	Mechanical Design Project	TMEE3819	8	24	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

G.4 DETAILED COURSE CONTENTS FOR B.Sc. MECHANICAL ENGINEERING

YEAR 1 B.Sc. MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS I**
Code	TEGT3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	None

Content: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING DRAWING
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly – reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Content: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. Electrical machines: transformers, DC motors, generators. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS II**
Code	TEGT3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Content: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. The iron-iron carbide alloy system: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. Properties of materials: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INTRODUCTION TO MECHANICAL ENGINEERING AND DESIGN
Code	TMEE3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TEGT3591 Engineering Drawing

Content: The mechanical engineering profession. Direct stress and strain, stresses in beams. **Mechanical testing**. **Introduction to mechanical engineering sub-divisions:** solid mechanics, thermodynamics, fluid mechanics, machine elements, manufacturing technology. **Connectors**: Bolted and threaded joints, welded joints, riveted joints. **General principles of mechanical design**, standardization, tolerances and fits, design criteria, design rules. Design exercises. Laboratory practicals.

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

- Competently analyse direct and shear stresses and strains
- Describe techniques for mechanical testing of materials
- Distinguish between the various sub-divisions of mechanical engineering
- Select appropriate technologies for joining engineering components
- Describe the design methodology in mechanical engineering and use of standardization
- Translate an idea into an engineering design and present the technical drawings

Issue Date: January 2009
Next Revision: January 2013

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 & 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.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 B.Sc. MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	ENGINEERING MATHEMATICS III
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Thermal stress and strain. Assembly problems. Introduction to statically indeterminate problems.

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

- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Apply Hooke's Law for normal and shear stresses and analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites	TCME3591 Computing Fundamentals

Content: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Problem solving and algorithms using **C++.** Programming in **C++. Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming exercises.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Write a computer program using C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING THERMODYNAMICS I
Code	TMEE3661
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	SCHM3512 Chemistry 1B

Contents: Definitions; system, process, state, property of a system, cycle, pressure, volume, temperature, work, heat. **First law of thermodynamics**: internal energy; non-flow energy equation; energy equation and reversibility. Application of first law to non-flow processes; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. **Application of first law to flow processes;** continuity equation, application to boilers, condensers, turbines, compressors, nozzles, diffusers and throttling devices. **Second law of thermodynamics**: concept of the heat engine; cycle efficiency; Reversibility and irreversibility. Engine efficiency. The Carnot cycle. Absolute temperature scale. Entropy; determination and property diagrams. **Working fluids:** properties of fluids and vapours; thermodynamic properties of steam; properties diagrams. Avogadro's law, the equation of state of a perfect gas, specific heats and non-flow gas processes.

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

- Describe the first law of thermodynamics and its applications to non-flow and flow processes
- Describe the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
- Describe and quantify the properties of working fluids
- Interpret and use thermodynamic property diagrams
- Describe the equation of state of a perfect gas

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING MATERIALS
Code	TMEE3621
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite	TEGT3522 Materials Science

Content: Classification of steels and cast irons: plain carbon, alloy and stainless steels. Grey, nodular and austempered ductile cast irons. **Technical heat treatment of steels**: annealing, normalizing, quench hardening, tempering, hardenability. Other strengthening methods: solid solution hardening, strain hardening, cold working, precipitation-hardening, **Non-ferrous alloys**: copper, aluminium, titanium, nickel and their alloys. **Non-metallic materials:** engineering polymers and plastics, composites, introduction to ceramics.

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

- Distinguish between various classes of steels and cast irons and their uses
- Demonstrate the various techniques used to harden and strengthen metallic materials
- Describe the characteristics and uses of non-ferrous metals and alloys based on aluminium, copper and titanium.
- Describe the characteristics and uses of non-metallic materials such as plastics, composites and ceramics.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FLUID MECHANICS
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	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; elementary analysis of fluid machinery; interaction of pump in system; pipe networks (simple branching circuits, single node reservoir systems, Hardy Cross method for pipe reticulation systems). **Laminar viscous flow**: Differential equations of motion; torsional viscometer; applications (flow with pressure gradient between parallel plate, pipe and channel flows, damper systems).

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	**T**EGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**; TEGT3591** Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Contents: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Contents: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**MECHANICAL ENGINEERING DESIGN I**
Code	TMEE3682
NQF Level	6
Contact Hours	2L + 1T or 1 PS/Week
Credits	8
Assessment:	Continuous 100% (Completed drawings, practical laboratory work)
Pre-requisites	TMEE3542 Introduction to Mechanical Engineering and Design

Content: The design spectrum. Design methodology. Design of parts and machine elements. **Use of Auto-CAD software 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.

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

- Describe the methodology for engineering design
- Describe key features in the design of machine elements
- Use Auto-CAD software in mechanical engineering drawing and design
- Demonstrate basic mechanisms used in machine design
- Describe the fundamentals of different methods of mechanism design, analysis and synthesis

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**MANUFACTURING TECHNOLOGY I**
Code	TMEE3662
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3522 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.

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

- Describe elastic and plastic behaviour of materials and its application to metal forming, forging, extrusion, wire drawing and printing
- Describe the processes of annealing and recrystallization
- Describe the principles of metal cutting
- Describe metal casting processes and basic foundry operations for ferrous and non-ferrous metals
- Describe the various casting defects and how to control them.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ECONOMICS FOR ENGINEERS
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of marketing

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TETE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3541 Fundamentals of Electrical Engineering

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Statics: Properties of three-dimensional force systems. Equilibrium of rigid bodies subjected to two- and three- dimensional force systems. Application of principles of rigid body equilibrium to trusses, frames, and machines. Introduction to the method of virtual work for equilibrium and stability analysis of interconnected systems. **Mechanics of Solids**: Second moment of area. Normal and shear stress and strain. Statically indeterminate problems. Geometric compatibility. Thermal and assembly stresses. Torsion of shafts. Bending of beams. Combined bending and direct stresses. Bending and torsional stresses. Transformation of stresses and strains. Mohr's circle.

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

- Analyse equilibrium of rigid bodies subjected to two and three dimensional force systems
- Describe the principles of rigid body equilibrium to trusses, frames and machines
- Apply the method of virtual work for equilibrium and stability analysis
- Apply properties of areas in solving mechanics problems
- Analyse statically determinate and statically indeterminate problems
- Analyse thermal and assembly stresses and incorporate them in stress analysis
- Analyse stresses and strains under torsion, bending and combined bending and torsion
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3691 Engineering Mechanics II

Content: Analysis of stress and strain, Mohr's circle, Torsion: Torsion of circular sections; Solid non-circular shafts; Thin-walled tubes, Theories of failure. Combined loading. Residual stresses. Bending: Unsymmetrical bending, Inelastic Bending, Residual Stresses. Transverse Shear: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **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.

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

- Apply mathematical and graphical methods (Mohr's circle) to analyse stresses and strains and their applications to torsion, bending, shear and combined loading
- Analyse deflection of beams using integration, discontinuity functions and method of superposition.
- Apply energy methods in stress and strain analysis, deflection and impact loading
- Describe and apply Castigliano's theorem to engineering situations

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 B.Sc. (MECHANICAL ENGINEERING)

SEMESTER 1

Module Title:	ENGINEERING THERMODYNAMICS II
Code	TMEE3721
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3661 Engineering Thermodynamics I

Contents: **Vapour power systems**. Steam calculations. Boiler systems. Introduction to refrigeration and air conditioning systems. **Heat pump systems**. Non reacting gas mixtures and psychometrics. Heat transfer: Thermal conductivity. Steady state one-dimensional conduction. **Forced and natural convection**. Black and grey body thermal radiation. Thermal insulation. Lagging materials. Laboratory work.

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

- Analyse vapour systems and perform calculations on steam, refrigeration and air conditioning
- Analyse and perform calculations on heat pump systems
- Describe the principles of forced and natural convection and perform calculations on the same
- Describe the principles of heat radiation
- Describe the principles of heat insulation and appropriate insulation materials

Issue Date: January 2009
Next Revision: January 2013

Module Title:	RIGID BODY DYNAMICS
Code	TMEE3711
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3691 Engineering Mechanics II

Content: Revision of kinematics and kinetics of a system of particles. **Kinematics of rigid bodies**: Translational motion, rotational motion, absolute Motion. Relative and absolute velocity, instantaneous centre of zero velocity, relative and absolute acceleration. Plane kinematics of a rigid body. **Plane Kinetics of a rigid Body**: Translation, rotation of a rigid body about a fixed axis. General plane motion. Work-Energy and Impulse-Momentum relationships for rigid bodies.

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

- Describe the kinematic principles of rigid bodies and perform calculations on the motion of rigid bodies
- Describe the kinetic principles of rigid bodies and perform calculations on plane kinetics
- Apply the work-energy principle to describe the dynamics of rigid bodies
- Apply the impulse-momentum principle to describe the dynamics of rigid bodies

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PRINCIPLES OF CONTROL ENGINEERING
Code	TMEE3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3671 Engineering Mathematics III

Contents: Basic principles of systems control: Definition of a system, open and closed loop; Methods for system representation and analysis; Mathematical models of control systems: Laplace transform, block diagrams, transfer function, characteristic equations; Applications to simple spring-damper system; Dynamic response of systems: polar and Bode plots; stability analysis: Routh-Hurwitz method, root locus method, pole-zero location on s-plane; Design of closed loop systems: P, PI and PID controllers. Laboratory exercises.

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

- Describe a control system and distinguish between an open loop and a closed loop system
- Apply mathematical modelling with transforms and block diagrams to control systems
- Produce polar and Bode plots for control systems
- Describe the Routh-Hurwitz method and the root locus method
- Design closed loop systems and demonstrate the use of P, PI and PID controllers

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MECHANICAL ENGINEERING DESIGN II
Code	TMEE3731
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TMEE3682 Mechanical Engineering Design I

Content: Analysis, synthesis and design of machine elements and components. Shafts, gears, hydrostatic bearings, springs, clutches, braking systems, bolted joints, riveted joints, welded joints. **Design of assemblies.** Consideration for tolerances, fits and reliability. Dynamic load systems. Power transmission systems. Professional communication techniques. **Tribology**: Contact between rigid bodies. The friction and adhesion of metals. The friction of plastics and some other materials. **Wear;** mechanism of wear, effects of wear on surface quality. **Lubrication**; mechanism of lubrication, significance of lubrication film. **Selecting a lubricant**; greases and lubricating oils. Design exercises.

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

- Design a range of machine elements as applicable to mechanical engineering and present them as drawings and technical reports.
- Apply the knowledge of tolerances, fits dynamic loading and power transmission in the design of assemblies.
- Describe tribological processes that take place due to the interaction of surfaces moving against each other
- Describe the fundamentals of tribology with respect to friction, wear and lubrication
- Apply tribological considerations in the design and maintenance of machines

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ELEMENTS OF MACHINE AUTOMATION
Code	TMEE3791
NQF Level	7
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	TETE3622 Electrical Machines and Drives

Content: **Measurement theory and analysis:** The General measurement system: Measuring pressure, force and torque. Measuring position and orientation. Static characteristics of measurement system elements. Propagation of errors and accuracy of measurement systems in steady state. Dynamic characteristics of measurement system elements. Transferring and processing sensor signals and protecting signals from noise. Using sensors in feedback circuits. **Sensing elements in measurement systems:** Transducers and Sensors: performance, terminology. Systems measuring displacement, position, proximity, velocity, force, fluid pressure, fluid flow, liquid level, temperature and light. Thermocouples, ultrasonic measuring devices, optical measuring instruments. Selection and positioning of sensors. **Mechanical and electrical drives and actuators**: Pneumatic and hydraulic actuation systems, regulating valves, cylinders, motors. Mechanical Actuation Systems: Elementary kinematic chains; gear trains; belt and chain drives. Electrical Actuation Systems: Relays, solid state switches, solenoids, the permanent magnet DC motor, mechanical aspects of electric motors. Design of simple actuation systems. **Signal conditioning:** Amplification, filtering, sampling. A/D, D/A conversion. Pulse width modulation.

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

- Describe the principles behind various techniques for measuring physical quantities
- Describe the various sensors used in measurement systems
- Describe various mechanical and electrical drives and actuators used in machine automation
- Describe the principles of signal conditioning

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MACHINE TOOLS
Code	TMEE3761
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3662 Manufacturing Technology I

Contents: **Principal methods of metal cutting**. Types of machine tools. Basic operations of the Lathe, shaping machine, milling machine, drilling machine. Metal cutting. **Design features of cutting tools**. Economics of cutting. Calculations of feeds, cutting speeds and other parameters. Conventional and unconventional machining. **Computer numerical controlled (CNC) machines**. Automation in machine tools.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

Module Title:	OPERATIONS MANAGEMENT
Code	TEGT3721
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

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

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

- Describe the various techniques of operation management
- Demonstrate knowledge of quality assurance and reliability measures in engineering projects
- Describe the key features of Total Quality Management

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	FUNDAMENTALS OF MECHATRONICS
Code	TMEE3712
NQF Level	7
Contact Hours	4L + 1T or 1PS/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisite	TMEE3791 Elements of Machine Automation

Contents: Modelling of mechatronical systems. Modelling of kinematic and dynamic mechanisms. Calculation of set value. **Sensors in back feed systems**. Regulating units which are adapted to servo-systems. Intelligent devices. Hydraulic servo-systems. **Digital control in regulating units**. Distributed control. **Lab design exercises.**

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

- Apply knowledge of mechanisms, electronics and computer technology to model mechatronical systems
- Describe the principles of hydraulic servo systems
- Describe the application of digital control in mechatronical systems
- Design simple mechatronical systems or machines

Issue Date: January 2009
Next Revision: January 2013

Module Title:	SOLID MECHANICS II
Code	TMEE3722
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3642 Solid Mechanics I

Content: Mechanics of composite bodies: Materials; Manufacturing methods; Micromechanics; Macro-mechanics of a lamina; Failure criteria; Laminate analysis; Design of composite structures. **Stress analysis of asymmetric solids:** Thick-walled and compound cylinders; Rotating discs and cylinders; Autofrettage.

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

- Analyse composite bodies using the principles of engineering mechanics
- Describe design features of composite structures
- Analyse stresses in asymmetric solids including cylinders and rotating discs

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MANUFACTURING TECHNOLOGY II
Code	TMEE3762
NQF Level	7
Contact Hours	2L + 1Tor 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3662 Manufacturing Technology I

Content: Welding Processes: Manual and automated systems. Welding of mild steels, stainless steels and aluminium alloys. Robotics in welding. Weld defects and how to avoid them. Brazing. **Advanced cutting techniques**. Use of water jet, compressed air, ultrasound; Electro erosion; Cutting by penetration with a wire. Electro-chemical dissolution treatment. **Powder metallurgy**, composite materials treatment. Surface engineering. **Processing and foaming of plastics and rubber**. Extrusion; Injection moulding; blow moulding, foaming processes. Rapid prototyping.

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

- Describe the principles of various welding processes used in engineering and associated welding parameters
- Describe the principles of non-conventional cutting techniques used in engineering
- Apply the knowledge of powder metallurgy to composite materials and to surface engineering
- Describe the various techniques used in the processing and forming of plastics and rubber

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FLUID MACHINERY
Code	TMEE3782
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3611 Fluid Mechanics

Content: Momentum principles applied to fluids. Jet propulsion. Design of fluid machinery: **Centrifugal and axial flow machines**, pipe-machine characteristics, cavitation, water hammer. Inclined and tilting hydrodynamic thrust bearings, journal bearings. Hydrostatic thrust bearings. Nozzles. **Power hydraulics**. Turbulent flow. Supersonic flow. Pressure and temperature measurements.

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

- Describe the principles used in the design of jet engines and general fluid machinery
- Describe the principles and characteristics of centrifugal and axial flow machines
- Describe the principles and characteristics of power hydraulics

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FRACTURE OF MATERIALS
Code	TMLE3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3522 Materials Science; TMEE3622 Strength of Materials

Content: **Fracture**: Micro-mechanisms of brittle fracture and ductile failure. **Fracture Mechanics**: Linear-elastic fracture mechanics, Elastic-plastic fracture mechanics. **Fracture toughness**: Stress intensification, plane strain fracture toughness K_{IC}, measurement of fracture toughness. R-curves and their applications in determining fracture toughness. **Fatigue**: Cyclic loading, low cycle fatigue, micro-mechanisms of fatigue, Paris law. **Creep and stress relaxation**: Creep curve, creep behaviour, modelling creep with viscoelastic behaviour. Creep resistant alloys. Introduction to failure analysis.

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

- Distinguish between the various fracture mechanisms in engineering materials
- Describe the principles of linear elastic fracture mechanics
- Demonstrate knowledge of fracture toughness and its relevance in materials selection
- Describe the key features of material failure by fatigue and failure by creep
- Carry out simple failure analysis based on mechanisms and mechanics of fracture

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DESIGN
Code	TMEE3732
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3661 Computer Aided Drawing

Content: Three dimensional automated modelling: automated computer graphics, types of modelling, solid modelling and its limitations. **Computer aided design:** design constraints and requirements, flow models and analysis, conceptual design, evaluation of design, engineering analysis. **Fundamentals of finite element method**: introduction to concepts, fundamentals of linear elasticity, principles of finite elements, types of elements, nodes, mesh refinement, interpolation polynomial functions, iso-parametric representations, general expression for stiffness matrix, computer implementation of finite elements. **Computer aided analysis**: finite element software, interactive mesh generation, static stress analysis, dynamic response analysis, linear and non-linear structural 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.

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

- Describe various techniques of 3-D automated modelling
- Demonstrate an understanding of the principles of computer aided design
- Describe the key parameters used in the finite element method
- Apply the principles of finite element method to analyze an engineering problem
- Demonstrate an understanding of the main features of computer integrated manufacturing

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3600 Industrial Attachment I

Description: 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 B.Sc. MECHANICAL ENGINEERING

SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title	**PROJECT MANAGEMENT FOR ENGINEERS**
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

Module Description:

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**MECHANICAL VIBRATIONS**
Code	TMEE3811
NQF Level	8
Contact Hours	4L + 2T or 1PS/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TMEE3711 Rigid Body Dynamics

Content: Fundamentals of vibrations: Basic Concepts and definitions. Vibration Analysis, Harmonic Motion. **Single degree-of-freedom systems:** Equation of motion, Lagrange's equation, free vibration of undamped and damped systems; logarithmic decrement, other forms of damping. **Forced vibration**: Equation of motion, response to harmonic excitation, resonance, rotating unbalanced, base motion excitation, response to general non-periodic excitation, impulse response function. **Design for vibration control:** Vibration isolation, critical speeds of rotating shafts; practical isolation design. **Multiple degree-of-freedom systems:** Equations of motion; Lagrange's equations, free vibration, natural frequencies and mode shapes, forced vibration, response to harmonic excitations and normal-mode approach. **Continuous systems:** Transverse vibration of a taut (tight) string, longitudinal vibration of a bar, torsional vibration of a shaft. Lateral vibration of a beam: free vibration; natural frequencies and mode shapes; forced vibration; normal mode analysis. Discretization of continuous systems. Approximate (Ritz) method. **Vibration absorption**. Balancing of rotating machines.

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

- Describe the fundamentals of vibration analysis
- Distinguish between the various forms of vibration
- Describe methods used to control vibration in practice including balancing techniques
- Describe techniques used in vibration absorption

Issue Date: January 2009
Next Revision: January 2013

Module Title:	THERMAL MACHINES
Code	TMEE3831
NQF Level	8
Contact Hours	**3**L + 2T or 1PS/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TMEE3721 Thermodynamics II

Content: Vapour power cycles. Analysis of aavailable energy. Heat pump cycles. Gas power cycles. **Internal combustion engines**. Principles and applications. **Principles of steam and gas turbines**. Energy analysis in the steam cycle in steam and gas turbines. Vapour flow in turbine blades and turbine phases. Turbine losses. Turbine performance. Multi-phase turbines. Thermal calculations of the gas turbine scheme. Load regulation system. Control and safety. **Power plants**.

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

- Describe and analyse vapour power cycles
- Describe the principles and characteristics of internal combustion engines
- Describe the principles and characteristics of steam turbines
- Describe the principles and characteristics of gas turbines
- Perform thermal calculations on thermal machines
- Describe the general design principle of power plants

Issue Date: January 2009
Next Revision: January 2013

Module Title:	REFRIGERATION AND AIR-CONDITIONING
Code	TMEE3891
NQF Level	8
Contact Hours	**3**L + 2T or 1PS/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TMEE3721 Thermodynamics II

Content: Review of thermodynamics. Analysis of the main cycles. **Refrigeration**: Basic components, refrigeration agents. Refrigeration systems and their applications. Calculations on refrigeration machines. **Air-conditioning**: Basic components, air-conditioning systems and applications. Air-conditioning calculations. Fault diagnosis and maintenance. Environmental problems, alternative refrigerants. **Refrigeration & air-conditioning units:** Domestic and industrial scale units. Exercises with refrigeration and air-conditioning laboratory equipment.

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

- Describe the principle of refrigeration and the roles played by the various refrigeration components
- Describe the principles of air conditioning and the roles played by the various air conditioning components
- Perform calculations involving refrigeration and air conditioning
- Demonstrate knowledge of the various factors that are used to select or determine an appropriate air conditioning system.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MECHANICAL ENGINEERING DESIGN III
Code	TMEE3881
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3781 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.

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

- Demonstrate knowledge of design features appropriate to a manufacturing undertaking
- Describe the principles of operation of the various equipment and machines used in handling bulk engineering materials
- Demonstrate the roles of ergonomics, innovation and product development in industrial design engineering
- Demonstrate an in-depth knowledge of design methodology and the entire design process

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3700 Industrial Attachment II

Description: During Industrial Attachment III, students will work under company supervision at the level of Engineer 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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TMEE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MECHANICAL DESIGN PROJECT
Code	TMEE3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

H. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRONICS ENGINEERING

H.1. B.Sc. (ELECTRONICS ENGINEERING) 19BETE

H.2 AIM

The curriculum for the degree of B.Sc. (Electronics Engineering) aims at producing Graduate Engineers with knowledge, skills and abilities in electronics engineering, and who can competently work in the design and evolution of electronic hardware, electronics production systems, information and communication technologies and service industries.

H.3 CURRICULUM STRUCTURE:

YEAR 1 OF B. Sc. ELECTRONIC ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	*8*	*None*
1	*Contemporary Social issues*	*UCSI3429*	*4*	*8*	*None*
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physical for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	Fundamentals of Electronics	TETE3542	5	8	TEGT3541
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				**92**	

NB: Students who have done UCSI3429, ULEA3419, TEGT3421, SPHY3571, SPHY3572 and SCHM3572 will be exempted from taking them in this year.

YEAR 2 OF B. Sc. ELECTRONIC ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Principles of Electronics Design	TETE3621	6	8	TETE3542
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
1	Computer Organisation and Assembly Language	TCME3641	6	8	TCME3591
1	Applied Electromagnetics	TETE3681	6	8	SPHY3512
1	Computer Aided Drawing	TEGT3522	6	8	TCME3591 TEGT3591
Total Credit				**80**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3672 TEGT3672
2	Electric Circuit Theory	TETE3612	6	16	TETE3542 TEGT3671
2	Signals and Systems	TETE3692	6	12	TEGT3572 TEGT3671
2	Introduction to Telecommunication Engineering	TETE3682	6	8	TETE3542
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Analogue Filters	TETE3642	6	8	TETE3621
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**84**	

YEAR 3 OF B. Sc. ELECTRONIC ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Basics of Analogue and Digital Communication	TETE3751	7	16	TETE3672 TETE3692
1	Basics of Radio Engineering	TETE3781	7	8	TETE3681
1	Programmable Electronics Design	TETE3741	7	8	TETE3542 TETE3621
1	Power Electronics	TETE3791	7	12	TETE3612 TETE3642
1	Computer Aided Circuit Design	TETE3721	7	8	TETE3612 TETE3621
1	Electronics Design I	TETE3711	7	16	TETE3621
1	Electronic Materials	TETE3761	7	8	TEGT3522 TEGT3541
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Digital Filters	TETE3722	7	8	TETE3692 TEGT3672
2	Introduction to Microelectronics & Micromechanics	TETE3742	7	8	TETE3761
2	Electronics Measurement Techniques	TETE3732	7	16	TETE3621
2	Electronics Design II	TETE3792	7	12	TETE3711
2	Computer Networks	TCME3722	7	8	TCME3621
2	Embedded Systems	TETE3782	7	8	TETE3621 TCME3692
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Principles of Semiconductor Devices	TETE3762	7	8	TETE3761
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**80**	

YEAR 4 OF B. Sc. ELECTRONIC ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Control Engineering	TETE3851	8	16	TEGT3671
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Electronic System Design	TETE3811	8	16	TETE3782 TETE3792
1	Advanced Digital Techniques	TETE3891	8	12	TETE3741
1	Optoelectronics	TETE3841	8	8	TETE3762
1	Measuring and Testing Techniques	TETE3821	8	8	TETE3732
Total Credit				**76**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**CREDITS**	**PRE &COREQUISITE**
2	Research Project	TETE3839	8	24	All 3rd Year modules
2	Embedded System Design Project	TETE3819	8	24	All 3rd Year modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

H.4 DETAILED COURSE CONTENTS FOR B.Sc. ELECTRONICS ENGINEERING

YEAR 1 B.Sc. (ELECTRONICS ENGINEERING)

SEMESTER 1

Module Title	ENGINEERING MATHEMATICS I
Code	TEGT 3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENGINEERING DRAWING
Code	TEGT 3591
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Module Description: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Circuit laws : Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. Time and frequency response, phasor calculation, Electrical machines: transformer, motors, generators. Basics of circuit simulation. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGT 3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Module Description: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; **Equilibrium phase diagrams**: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **The iron-iron carbide alloy system**: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Properties of materials**: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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 & Solubilty Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; Ph and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	FUNDAMENTALS OF ELECTRONICS
Code	TETE 3542
NQF Level	5
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TEGT 3541 Fundamentals of Electrical Engineering

Module Description: Analogue electronics : Introduction to semi-conductor theory, Electronic components: Inductor, capacitors, resistors, diodes, transistors, thyristors/triacs, IC's. **Simple electronic circuits**: Clamping circuits, rectifying circuits, simple amplifier (single stage RC). **Digital Technique**: Logic operation of integrated circuits. Boolean algebra, number systems, codes and parity, analysis and synthesis of combinatorial logic, latches and flip-flops, analysis and synthesis of sequential logic, MSI building blocks of sequential logic, design principles of digital systems, physical properties of digital circuits.

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

- Distinguish between passive and active devices, and between power supplies & signals.
- Describe, construct and test wave rectifier circuits using diodes
- Recognize terminology of basic electronic devices and apply DC laws to electronic circuit calculations.
- Practice circuit construction/assembling and use multi-meters and oscilloscope and RLC meters to perform electronic measurement and do basics trouble-shooting.
- Identify and apply electronic devices and their schematic symbols in a circuit.
- Analyse & describe the operation of p-n semiconductor diodes transistors and Op-Amps.
- Use the binary number system to carry out basic arithmetic operations, and implement digital circuits
- Use Boolean algebra and related techniques to simplify logical expressions, analyze simple combinational logic circuits, with logic gates, simple sequential logic circuits and standard flip-flops.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT 3592
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	SPHY3511 Physics for physical Sciences I

Module Description: Statics*:* Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. Analysis of forces in a truss: Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces, buoyancy. Distributed forces: centroids and center of gravity; Pappu's second moment. **Friction**: Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. Analysis of frames and machines. **Virtual work**.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 B.Sc. (ELECTRONICS ENGINEERING)

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3691
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Thermal stress and strain. Assembly problems. Introduction to statically indeterminate problems.

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

- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Apply Hooke's Law for normal and shear stresses and analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites	TCME3591 Computing Fundamentals

Contents: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Introduction to problem solving and algorithms with C++. **Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming project.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	PRINCIPLES OF ELECTRONICS DESIGN
Code	TETE 3621
NQF Level	6
Contact Hours	2L + 1P/S /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TETE3542 Fundamentals of Electronics

Module Description: Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modelling and analysing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA –conversion and principles of VLSI-technology.

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

- Describe the basic operation and structures of diodes, transistors and operational amplifiers.
- Bias a BJT, FET or MOSFET device to achieve a desired quiescent operating point.
- Describe the concepts of analogue electronic design techniques and internal structure of digital circuits
- Apply the principles of AD/DA –conversion and principles of VLSI-technology.

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER ORGANISATION AND ASSEMBLY LANGUAGE
Code	TCME3641
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TCME3591 Computing Fundamentals

Content: Computer organization, description of the basic computer functions, representation of information, computer memory hierarchy and its implementation, input/output operations, use of assembly language programming, basic instruction sets, arithmetic and logical operations, addressing modes and macro definition, assembly language programming assignment.

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

- Describe computer organization and identify various computer functions
- Demonstrate an understanding of the operation of digital computer
- Describe computer memory organization and its implementation
- Use of assembly language programming, basic instruction sets, arithmetic and logical operations,
- Addressing modes and macro definition.
- Solve an engineering problems using assembly language programming

Issue Date: January 2009
Next Revision: January 2013

Module Title	APPLIED ELECTROMAGNETICS
Code	TETE3681
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisites	SPHY3512 Physics II

Module Description: This course examines concepts of electromagnetism, electrostatic fields, Coulomb's Law, Gauss's Law, magnetostatic fields, Ampere's Law, electromagnetic induction, Faraday's Law, transformer, Maxwell equations and time-varying fields, wave equations, wave propagation, dipole antenna, polarization, energy flow, and applications.

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

- Demonstrate an understanding of theories and applications of electromagnetic fields and waves
- Demonstrate an understanding of the physical meaning and significance of Maxwell's equations;
- Describe electromagnetic and time varying I fields and waves, and their implications in modern communication systems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Module Description: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Module Description: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	**ELECTRIC CIRCUIT THEORY**
Code	TETE 3612
NQF Level	6
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TEGT3542 Fundamentals of Electronics
Co-requisite:	TEGT3671 Engineering Mathematics III

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

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

- Use principles and methods of analysis and modelling of electric circuits in the steady state.
- Apply Network theorems to the analysis of networks.
- Use of Laplace transformation and bode plots in circuit analysis
- Apply the concepts of frequency response, resonance, and network functions, two port networks including hybrid parameters.

Issue Date: January 2009
Next Revision: January 2013

Module Title	**SIGNALS AND SYSTEMS**
Code	TETE3692
NQF Level	6
Contact Hours	3L + 1T/Week or 1PS/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite:	TEGT3572 Engineering Mathematics II
Co –requisite	TEGT3671 Engineering mathematics III

Module Description: An introductory course covering the principles of signals and systems. The course combines lectures, Matlab simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing.

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

- Demonstrate the basic understanding of continuous time and discrete-time signals and systems, and the various methods and approaches used to analyze signals and systems
- Develop knowledge and have a sufficient experience in utilizing MatLab to simulate and solve problems relating to signals and systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	INTRODUCTION TO TELECOMMUNICATION ENGINEERING
Code	TTCE 3682
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3542 Fundamentals of Electronics

Module Description: Terminology, basics of communication networks, key concepts and technologies required in Wireless Communication systems R&D. Fixed line network technology

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

- Demonstrate an understanding of the basic concepts of telecommunications
- Describe wireless network systems and its application.
- Demonstrate an understanding of the wireless technology network system

Issue Date: January 2009
Next Revision: January 2013

Module Title	ECONOMICS FOR ENGINEERS
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of budgeting

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ANALOGUE FILTERS
Code	TETE3642
NQF Level	6
Contact Hours	2L + 1P/S /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	TETE3621 Principles of Electronics Design

Module Description: Prototype filters (Butterworth, Chebychev, Bessel etc.), frequency transforms and impedance conversions. Implementations using lumped and distributed circuits. Active filters. Sensitivity analysis and optimizing the dynamic range of filter stages.

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

- Demonstrate an understanding of basic concepts for designing active and analogue filters
- Apply computer tools for computer aided filter design and analysis
- Apply the concepts of the complex frequency, time domain, Laplace transform, scaling, and frequency transformation for filter design.

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Module Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 B.Sc. ELECTRONICS ENGINEERING

SEMESTER 1

Module Title	BASICS OF ANALOGUE AND DIGITAL COMMUNICATION
Code	TETE3751
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites	TETE3692 Signals and Systems, TEGT3672 Engineering Mathematics IV

Module Description: **Analogue Communication**: Basic blocks of a communication system, linear and angle modulations, phase-lock loop and its applications, analogue and digital pulse modulations, multiplexing methods, comparison of modulation methods without interference. SNR performance analysis of various continuous-wave and pulse modulations and their comparison, influence of a single-tone interference and phase-error, threshold effect, methods to improve system performance. **Digital communication:** Basic blocks of a digital transmission system, baseband digital transmission, digital continuous-wave modulations (ASK, MPSK, MFSK), correlation and matched filter receivers, receiver structures and their bit error probability performance with AWGN channel, effect of band-limiting and multipath propagation, basics of information theory, discrete channel models, entropies, source coding, channel capacity, basics of error-correction coding methods

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

- Describe the concepts of analogue and digital transmission systems different digital and analogue modulation techniques and how to analyse them.
- Demonstrate an understanding of basic principles of analogue amplitude, phase and frequency modulation methods, their implementation methods, and to compare their performance under the influence of noise and single-tone interference.
- Describe basics of digital transmission systems that are based on amplitude, phase and frequency modulation of a discrete-valued symbol sequence, the influence of transmission channel on system performance,
- Describe the basics of information and coding theory and the fundamentals of error control coding
- Apply MATLAB or other software for signal analysis and modelling

Issue Date: January 2009
Next Revision: January 2013

Module Title	BASICS OF RADIO ENGINEERING
Code	TETE3781
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TETE3681 Applied Electromagnetics

Module Description: Electromagnetic waves. Maxwell equations. Radiowave reflection and refraction. Boundary conditions. Transmission lines and impedance matching using Schmith's chart. Description of microwave circuits using scattering matrix. Review of passive and active microwave components. Basic antenna parameters. Radiowave propagation phenomena. Applications of radio engineering

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

- Demonstrate an understanding of radio signal propagation theory.
- Describe the basic concepts of radio engineering.
- Demonstrate an understanding of basic antenna parameters .radiowave propagation phenomena and applications of radio engineering.
- Describe the microwaves circuits using scattering matrix

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PROGRAMMABLE ELECTRONICS DESIGN
Code	TETE3741
NQF Level	7
Contact Hours	2L + 1PS//Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3542 Fundamentals of Electronics, TETE3621 Principles of Electronics Design

Module Description: Implementation of digital systems by means of FPGA/CPLD platforms and microcontrollers. Configuration of a simple digital device to an FPGA/CPLD circuit and microcontroller

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

- Demonstrate and implement digital systems by means of FPGA/CPLD platforms and microcontrollers.
- Configure a simple digital device to an FPGA/CPLD circuit and microcontroller.
- Describe the function and operation of an electronics circuit analysis program
- Demonstrate an understanding of the concept of small programmable system architecture, its operation, and techniques for programming using assembly language and higher level languages.
- Have an insight into the systematic design of micro-controller and microprocessor-based programmable electronic systems.

Issue Date: January 2009
Next Revision: January 2013

Module Title	POWER ELECTRONICS
Code	TETE3791
NQF Level	7
Contact Hours	**3**L + 1PS /Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3612 Electric Circuit Theory; TETE3642 Analogue Filters

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module	COMPUTER AIDED CIRCUIT DESIGN
Code	TETE 3721
NQF Level	7
Contact Hours	4L + 1P/S /Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3612 Electric Circuit Theory; TETE3621 Principles of Electronics Design

Module Description: Circuit simulators ,Solving network equations, Principles of AC, DC, transient analyses and steady-state simulation methods, Simulation of noise and distortion, Worst-case and statistical analysis and optimization. Physical design and design verification.

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

- Use CAD software in Electronic design, Electronic simulation and Drafting
- Demonstrate an understanding of the concept of computer-aided circuit analysis based on the network circuit theory
- Describe the function and demonstrate the use of computer Aided circuit analysis software (eg. PCSpice, Microcap, Electronic Workbench etc..)
- Demonstrate an understanding of the operation, limitations and application areas of various types of front-end and back-end CAD tools used for analogue and mixed signal design.
- Use the techniques, skills and modern engineering tools necessary for design and simulation of circuit

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONICS DESIGN I
Code	TETE 3711
NQF Level	7
Contact Hours	4L + 1PS/week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3hour paper)
Pre-requisite	TETE3621 Principles of Electronics Design

Module Description: Frequency response of transistor amplifier, differential amplifier, feedback, stability and nonidealities of feedback amplifier, comparator, output stages and power amplifiers, application of operational amplifier, oscillators, tuned amplifiers and ECL-logic. Modelling of BJT, MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

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

- Using both basic circuit theorems as well as more advanced circuit analysis methods
- Model bipolar transistors, MOS transistors and use them to describe the operation of logic gates and amplifiers.
- understand the concepts of analogue circuit blocks and their application and use in the design of electronic equipment
- Use of basic skills for the design of integrated building blocks and advanced analogue electronic circuits
- Apply Analogue electronic concepts including frequency response, real world applications of operational amplifiers, power amplifiers, oscillators, and turned amplifiers..
- Use Demonstrate the knowledge and practical skills to analyse and design electronic circuits computer based software for electronics circuits design and simulation

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONIC MATERIALS
Code	TETE3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2hour paper)
Pre-requisites	TEGT3522 Materials Science; TEGT3541 Fundamental of Electrical Engineering

Module Description: Electrical materials and their application, Study of materials for IC fabrication including Si, compound semiconductors and advanced Si on insulator structures Study of the basic principles of dielectrics with reference to the use of insulating materials in electronic devices and capacitors Introduction to liquid crystals with reference to their usage in electronic displays An introduction to magnetic materials for information storage, material for optoelectronics devices and transducers.

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

- Competently describe the properties, uses and characteristics of materials used in the electronics industry
- Demonstrate knowledge of the principles and physical behaviour of magnetic materials used in storage devices
- Demonstrate a clear understand of materials used in semiconductors devices
- Demonstrate an understanding of the basic principles of Integrated Circuit (IC) fabrication

Issue Date: March 2009
Next Revision: March 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	DIGITAL FILTERS
Code	TETE3722
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3692 Signals and Systems, TEGT3672 Engineering Mathematics IV

Module Description: 1. Introduction, Discrete transforms, Convolution and correlation, Digital filter design, FIR filters, IIR filters, Decimation, interpolation and multirate, Filter banks, Adaptive filters, Signal processors. Applications**.**

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

- Demonstrate an understanding of FIR and IIR digital filters and their design, analysis
- Demonstrate an understanding of the basic knowledge of digital signal processing and its applications
- Design filter using CAD software e.g Matlab software etc..

Issue Date: January 2009
Next Revision: January 2013

Module Title	INTRODUCTION TO MICROELECTRONICS AND MICROMECHANICS
Code	TETE 3742
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	TETE3761 Electronic Materials

Module Description: Different fabrication methods of IC circuits: materials, methods, devices and circuit technologies of monolithic techniques. Thick film hybrid techniques. Fabrication of micromechanical structures. Applications, examples.

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

- Demonstrate knowledge of the fundamentals of microelectronics and micromechanics
- Apply different methods used for the fabrication of integrated (IC) circuits and structures of micromechanics.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONICS MEASUREMENT TECHNIQUES
Code	TETE3732
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TETE3621 Principles of Electronics Design

Module Description: Calibration, measurement amplifiers, interconnections of sensors and amplifiers, spectrum analysers and correlation measurements, noise and interference, grounding, CMR and processing of measurement results.

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

- Demonstrate an understanding of the measurement systems. Instrumentation concept, signal conditioning and processing
- Demonstrate an understanding of the design and operation of analogue and digital measuring instruments
- Demonstrate a deeper un understanding of the field of electronic measurement techniques,
- Provide solutions to interference problems, simple interface and the principles of the processing of measurement results.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONICS DESIGN II
Code	TETE3792
NQF Level	7
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite	TETE3711 Electronics Design I

Module Description: Design and construction of an electronic device or a part of a device according to the given specification. The task can be part of an industrial research or a product design project. Experienced designers are used as instructors. The task can be carried out by one person or by a team of two persons. This design task is executed under supervision in the workstation class and the whole IC design flow and the IC design software are studied.

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

- Design, assembly and test an electronic device according to given specifications.
- Apply methods and tools used in the design process to analyse and test an electronic circuit system
- Apply standard integrated circuit chips to a given design and be able to work on projects within a group.

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER NETWORKS
Code	TCME3722
NQF Level	7
Contact Hours	2L + 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3621 Computer Science for Engineers

Module Description: Physical layer, data link layer, medium access control sublayer, network layer, transport layer, application layer, multimedia, QoS, network management, network security.

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

- Have a comprehensive description on computer networks, from underlying physical layer up to application layer and today's most popular network applications.
- Identify and use internetworking, broadband, electrical interface, and data transmission concepts

Issue Date: January 2009
Next Revision: January 2013

Module Title	EMBEDDED SYSTEMS
Code	TETE3782
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3621 Principles of Electronics Design; TCME3692 Object Oriented Programming

Module Description: The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing

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

- Demonstrate an understanding of the basic knowledge about the design and implementation of embedded systems and its components.
- Have a basic knowledge about the hardware programming with an Atmel AVR series microcontroller.
- Use and programme a microprocessor or microcontroller
- Demonstrate an understanding of design life cycle of the embedded systems, and a basic tool set for embedded systems development.
- Apply components and tools: IAR Embedded Workbench, Orcad 9.2, AVR Studio, ATICE50,JTAG-ICE
- Demonstrate hands-on program development using a microcontroller.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	PRINCIPLES OF SEMICONDUCTOR DEVICES
Code	TETE3762
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisites:	TETE 3761 Electronic Materials

Module Description: p-n metal/semiconductor and hetero-junctions. Diodes, bipolar transistors, JFET, MESFET, HEMT, MOS structure, CCD, MOSFET, lasers, switching devices.

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

- understand of the semiconductor bonding and energy band models
- Demonstrate an understanding of the principles of operation and properties of semiconductor devices used in electronic circuits.
- Aapply standard device models to explain/calculate critical internal parameters and standard characteristics of the BJT, JFET, MESFET, HEMT, MOS structure, CCD, MOSFET, lasers, switching devices.

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 B.Sc. ELECTRONICS ENGINEERING

SEMESTER 1

Module Title	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

Module Description: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **Labour laws**. Trade Union laws. HIV/AIDS education and its impact on the workforce. **Intellectual property rights.**

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title	**CONTROL ENGINEERING**
Code	TETE3851
NQF Level	8
Contact Hours	4L + 1PSWeek
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3671 Engineering Mathematics III

Module Description: Controllability and observability, state estimation and parameter identification. Design and analysis of feedback control system design using frequency-domain and state-space methods. Introduction to optimal control. Design of analogue and digital feedback control systems, review of functions and state variable models for continuous-time and discrete-time systems, sampling, relationship between poles locations and time response, frequency domain design, root locus design, continuous-time and discrete-time compensation techniques, state variable feedback and pole positioning design.

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

- Describe classical and modern control system with analysis techniques, controllability and observability
- Design and analyse feedback control systems using frequency-domain and state-space methods
- Design analogue and digital feedback control systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	**PROJECT MANAGEMENT FOR ENGINEERS**
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONIC SYSTEM DESIGN
Code	TETE 3811
NQF Level	8
Contact Hours	4L + 1PS /Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3792 Electronics Design II, TETE3782 Embedded Systems

Module Description: Electronic product design process, patents, test design and EMC/LVD standards, Characteristics of ASIC technology and design, Characteristics of high-speed digital design. Reliability engineering. Documentation.

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

- Design, in a structured way, the logic of digital and analogue circuits.
- Apply advanced methods & techniques to design larger electronic entities such as equipment and systems.
- Demonstrate knowledge of the characteristics of ASIC technology and design
- Demonstrate knowledge of major engineering problems associated with building high speed digital systems and how they are solved.
- Use a range of software tools which synthesize digital systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	ADVANCED DIGITAL TECHNIQUES
Code	TETE3891
NQF Level	8
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite:	TETE3741 Programmable Electronics Design

Module Description: Digital Systems, Functional Principle of Synchronous Logic, Basic Architecture of a Synchronous Logic Circuit, Design of Combinatorial Logic, Design of Sequential Logic Semiconductor Memories, Design of Arithmetic Logic, Design of Clocking System, Architectural Design of a Logic Circuit, Design of Control Blocks of a Logic Circuit, Interconnections between Digital Systems, A/D and D/A converters.

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

- Design, in a structured way, the logic of digital systems.
- Demonstrate an understanding of synchronous machines and their implementation
- Demonstrate an understanding of the basic architectures of synchronous logic circuits and structural blocks
- Design, analyse and implement combinatorial and sequential logic systems using digital CAD software tools

Issue Date: January 2009
Next Revision: January 2013

Module Title	OPTOELECTRONICS
Code	TETE3841
NQF Level	8
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3762 Principles of Semiconductor Theory.

Module Description: Geometrical and physical optics, optical instruments ,optical fibers and their properties, sources of radiation (the radiation of black body, LED- and laser structures), photo detectors (photo conductive detector, light multiplier, PIN and AMP diodes, position sensitive detectors), light source modulation, preamplifiers and their bandwidth/stability/noise analysis, the signal analysis methods used in optoelectronics. Lasers and their applications in communications, industries, computers, mines, medicine, and agriculture.

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

- Describe the concepts of geometrical and physics optics
- Demonstrate the working of the amplifiers, detectors, modulators, transmitters and receiver ,
- Describe the theory and properties of optical fibers and their usage in various applications.
- Apply and analyze fiber optics & optoelectronic devices and their applications in a hands-on environment
- Use applications of optics and laser instruments

Issue Date: March 2009
Next Revision: March 2013

Module Title	MEASURING AND TESTING TECHNIQUES
Code	TETE3821
NQF Level	8
Contact Hours	2L + 1P/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3732 Electronics Measurement Techniques

Module Description: Quality and reliability, controlling the manufacturing process using test results, automatic test equipment, test strategies, design for testability, boundary-scan, built-in self-test.

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

- Competently use testing methods and testing equipment for the electronics industry
- Use test results to control safety and reliability in manufacturing processes

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3700 Industrial Attachment II

Module Description: During Industrial Attachment III, students will work under company supervision at the level of Engineer Trainee and will undertake at least 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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	RESEARCH PROJECT
Code	TETE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date: January 2009
Next Revision: January 2013

Module Title	EMBEDDED SYSTEM DESIGN PROJECT
Code	TETE 3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

I. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN TELECOMMUNICATION ENGINEERING

I.1. B.Sc. (TELECOMMUNICATION ENGINEERING) 19BTCE

I.2 AIM

The curriculum for the degree of B.Sc. (Telecommunication Engineering) aims at producing Graduate Engineers with knowledge, skills and abilities in telecommunication engineering, and who can competently work in telecommunication systems design and applications, Microwave Communication, Satellite Communications, Television/Radio Broadcast, Telephone/Mobile Communications, Wireless Networking and related service industries.

I.3 CURRICULUM STRUCTURE

YEAR 1 B.Sc. TELECOMMUNICATION ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	MAT3531
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	*8*	*None*
1	*Contemporary Social issues*	*UCSI3429*	*4*	*8*	*None*
Total Credit				***84***	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	Fundamentals of Electronics	TETE3542	5	8	TEGT3541
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				**92**	

YEAR 2 B.Sc. TELECOMMUNICATION ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Principles of Electronics Design	TETE3621	6	8	TETE3542 TEGT3541
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
1	Computer Organisation and Assembly Language	TCME3641	6	8	TCME3591
1	Applied Electromagnetics	TETE3681	6	8	SPHY3512
1	Computer Aided Drawing	TEGT3522	6	8	TCME3591 TEGT3591
Total Credit				80	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3672 3572
2	Electric Circuit Theory	TETE3612	6	16	TETE3532 TEGT3671
2	Signals and Systems	TETE3692	6	12	TEGT3572 TEGT3671
2	Introduction to Telecommunication Engineering	TETE3682	6	8	TETE3542
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Analogue Filters	TETE3642	6	8	TETE3621
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509

Total Credit				**84**	

YEAR 3 OF B.Sc. (TELECOMMUNICATIONS ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Basics of Analogue and Digital Communications	TETE3751	7	16	TEGT3672 TETE3692
1	Basics of Radio Engineering	TETE3781	7	8	TETE3681
1	Telecommunication Engineering Laboratory	TTCE3761	7	8	TTCE3682
1	Communication Networks I	TTCE3791	7	12	TCME3621
1	Computer Aided Circuit Design	TETE3721	7	8	TETE3612 TETE3621
1	Wireless Communications	TTCE3751	7	16	TTCE3682
1	Electronic Materials	TETE3761	7	8	TEGT3522 TEGT3541
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Digital Filters	TETE3722	7	8	TETE3692 TEGT3672
2	Radio Communication Channels	TTCE3722	7	8	TETE3681 TETE3682
2	Radio Engineering I	TTCE3742	7	8	TETE3681 TETE3781
2	Mobile Telecommunication Systems	TTCE3732	7	16	TETE3781 TETE3751
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Computer Networks	TCME3722	7	8	TCME3621
2	Embedded systems	TETE3782	7	8	TETE3621 TCME3692
2	Statistical Signal Processing	TTCE3792	7	12	SSTS3691 TETE3692
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**80**	

YEAR 4 OF B.Sc. (TELECOMMUNICATION ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Society and Engineer	TEGT3821	8	8	TEGT3421
1	Communication Networks II	TTCE3811	8	16	TTCE3791
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Signal Processing	TTCE3891	8	12	TETE3692 TTCE3792
1	Radio Engineering II	TTCE3831	8	16	TTCE3742
1	Information Theory	TTCE3861	8	8	TETE3751
1	Telecommunication Simulation	TTCE3841	8	8	TETE3721 TETE3751
Total Credit				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Research Project	TTCE3830	8	24	All 3rd Year modules
2	Telecommunication Design Project	TTCE3810	8	24	All 3rd Year modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

I.4 DETAILED COURSE CONTENTS FOR B.Sc. TELECOMMUNICATION ENGINEERING

YEAR 1 OF B.Sc. (TELECOMMUNICATION ENGINEERING)

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGT 3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	None

Module Description: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	**ENGINEERING DRAWING**
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Module Description: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Circuit laws : Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. time and frequency response, phasor calculation, Electrical machines: transformer, motors, generators. Basics of circuit simulation. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	3L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGT 3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Module Description: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; **Equilibrium phase diagrams**: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **The iron-iron carbide alloy system**: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Properties of materials**: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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 & 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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	FUNDAMENTALS OF ELECTRONICS
Code	TETE 3542
NQF Level	5
Contact Hours	**2**L + 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TEGT 3541 Fundamentals of Electrical Engineering

Module Description: Analogue electronics : Introduction to semi-conductor theory, Electronic components: Inductor, capacitors, resistors, diodes, transistors, thyristors/triacs, IC's. **Simple electronic circuits**: Clamping circuits, rectifying circuits, simple amplifier (single stage RC). **Digital Technique**: Logic operation of integrated circuits. Boolean algebra, number systems, codes and parity, analysis and synthesis of combinatorial logic, latches and flip-flops, analysis and synthesis of sequential logic, MSI building blocks of sequential logic, design principles of digital systems, physical properties of digital circuits.

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

- Distinguish between passive and active devices, and between power supplies & signals.
- Describe, construct and test wave rectifier circuits using diodes
- Recognize terminology of basic electronic devices and apply DC laws to electronic circuit calculations.
- Practice circuit construction/assembling and use multi-meters and oscilloscope and RLC meters to perform electronic measurement and do basics trouble-shooting.
- Identify and apply electronic devices and their schematic symbols in a circuit.
- Analyse & describe the operation of p-n semiconductor diodes transistors and Op-Amps.
- Use the binary number system to carry out basic arithmetic operations, and implement digital circuits
- Use Boolean algebra and related techniques to simplify logical expressions, analyze simple combinational logic circuits, with logic gates, simple sequential logic circuits and standard flip-flops.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT 3592
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	SPHY3511 Physics for physical Sciences I

Module Description: Statics*:* Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. Analysis of forces in a truss: Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces, buoyancy. Distributed forces: centroids and center of gravity; Pappu's second moment. **Friction**: Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. Analysis of frames and machines. **Virtual work**.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 B.Sc. TELECOMMUNICATION ENGINEERING

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3691
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Thermal stress and strain. Assembly problems. Introduction to statically indeterminate problems.

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

- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Apply Hooke's Law for normal and shear stresses and analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites	TCME 3511 Computing Fundamentals

Contents: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Introduction to problem solving and algorithms with C++. **Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming project.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	PRINCIPLES OF ELECTRONICS DESIGN
Code	TETE 3621
NQF Level	6
Contact Hours	2L + 1P/S /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TEGT3541 Fundamentals of Electrical Engineering, TETE3542 Fundamentals of Electronics

Module Description: Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modelling and analysing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA –conversion and principles of VLSI-technology.

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

- Describe the basic operation and structures of diodes, transistors and operational amplifiers.
- Bias a BJT, FET or MOSFET device to achieve a desired quiescent operating point.
- Demonstrate an understanding of the concepts of analogue electronic design techniques and internal structure of digital circuits
- Apply the principles of AD/DA –conversion and principles of VLSI-technology.

Issue Date: January 2009
Next Revision: January 2013

Module Title	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Module Description: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER ORGANISATION AND ASSEMBLY LANGUAGE
Code	TCME3641
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TCME3591 Computing Fundamentals

Content: Computer organization, description of the basic computer functions, representation of information, computer memory hierarchy and its implementation, input/output operations, use of assembly language programming, basic instruction sets, arithmetic and logical operations, addressing modes and macro definition, assembly language programming assignment.

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

- Describe computer organization and identify various computer functions
- Demonstrate an understanding of the operation of digital computer
- Describe computer memory organization and its implementation
- Use of assembly language programming, basic instruction sets, arithmetic and logical operations,
- Addressing modes and macro definition.
- Solve an engineering problems using assembly language programming

Issue Date: January 2009
Next Revision: January 2013

Module Title	APPLIED ELECTROMAGNETICS
Code	TETE3681
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisites	SPHY3512 Physics II

Module Description: This course examines concepts of electromagnetism, electrostatic fields, Coulomb's Law, Gauss's Law, magnetostatic fields, Ampere's Law, electromagnetic induction, Faraday's Law, transformer Maxwell equations and time-varying fields, wave equations, wave propagation, dipole antenna, polarization, energy flow, and applications.

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

- Demonstrate an understanding of theories and applications of electromagnetic fields and waves
- Demonstrate an understanding of the physical meaning and significance of Maxwell's equations;
- Describe electromagnetic and time varying I fields and waves, and their implications in modern communication systems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Module Description: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	**ELECTRIC CIRCUIT THEORY**
Code	TETE 3612
NQF Level	6
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TEGT3532 Fundamental of Electrical Engineering, TEGT 3572 Engineering Mathematics II
Co-requisite:	TEGT 3671 Engineering Mathematics III

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

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

- Use principles and methods of analysis and modelling of electric circuits in the steady state.
- Apply Network theorems to the analysis of networks.
- Use of Laplace transformation and bode plots in circuit analysis
- Apply the concepts of frequency response, resonance, and network functions, two port networks including hybrid parameters.

Issue Date: January 2009
Next Revision: January 2013

Module Title	**SIGNALS AND SYSTEMS**
Code	TETE3692
NQF Level	6
Contact Hours	3L + 2T/Week or 1PS/week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite:	TEGT 3572 Engineering Mathematics II
Co -requisite	TEGT3671 Engineering mathematics III

Module Description: An introductory course covering the principles of signals and systems. The course combines lectures, Matlab simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing.

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

- Demonstrate the basic understanding of continuous time and discrete-time signals and systems, and the various methods and approaches used to analyze signals and systems
- Develop knowledge and have a sufficient experience in utilizing MatLab to simulate and solve problems relating to signals and systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	INTRODUCTION TO TELECOMMUNICATION ENGINEERING
Code	TTCE 3682
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3542 Fundamentals of Electronics

Module Description: Terminology, basics of communication networks, key concepts and technologies required in Wireless Communication systems R&D. Fixed line network technology

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

- Demonstrate an understanding of the basic concepts of telecommunications
- Describe wireless network systems and its application.
- Demonstrate an understanding of the wireless technology network system

Issue Date: January 2009
Next Revision: January 2013

Module Title	ECONOMICS FOR ENGINEERS
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of marketing

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009

Next Revision: January 2013

Module Title	ANALOGUE FILTERS
Code	TETE3642
NQF Level	6
Contact Hours	2L + 1P/S /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	TETE3621 Principles of Electronics Design

Module Description: Prototype filters (Butterworth, Chebychev, Bessel etc.), frequency transforms and impedance conversions. Implementations using lumped and distributed circuits. Active filters. Sensitivity analysis and optimizing the dynamic range of filter stages.

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

- Demonstrate an understanding of basic concepts for designing active and analogue filters
- Apply computer tools for computer aided filter design and analysis
- Apply the concepts of the complex frequency, time domain, Laplace transform, scaling, and frequency transformation for filter design.

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Module Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 B.Sc. TELECOMMUNICATION ENGINEERING

SEMESTER 1

Module Title	BASICS OF ANALOGUE AND DIGITAL COMMUNICATIONS
Code	TETE3751
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3692 Signals and Systems; TEGT3672 Engineering Mathematics IV

Module Description: **Analogue Communications**: Basic blocks of a communication system, linear and angle modulations, phase-lock loop and its applications, analogue and digital pulse modulations, multiplexing methods, comparison of modulation methods without interference. SNR performance analysis of various continuous-wave and pulse modulations and their comparison, influence of a single-tone interference and phase-error, threshold effect, methods to improve system performance. **Digital communications:** Basic blocks of a digital transmission system, baseband digital transmission, digital continuous-wave modulations (ASK, MPSK, MFSK), correlation and matched filter receivers, receiver structures and their bit error probability performance with AWGN channel, effect of band-limiting and multipath propagation, basics of information theory, discrete channel models, entropies, source coding, channel capacity, basics of error-correction coding methods

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

- Describe the concepts of analogue and digital transmission systems different digital and analogue modulation techniques and how to analyse them.
- Demonstrate an understanding of basic principles of analogue amplitude, phase and frequency modulation methods, their implementation methods, and to compare their performance under the influence of noise and single-tone interference.
- Describe basics of digital transmission systems that are based on amplitude, phase and frequency modulation of a discrete-valued symbol sequence, the influence of transmission channel on system performance,
- Demonstrate an understanding of the basics of information and coding theory and the fundamentals of error control coding .
- Apply MATLAB or other software for signal analysis and modelling

Issue Date: January 2009
Next Revision: January 2013

Module Title	BASICS OF RADIO ENGINEERING
Code	TETE3781
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3681 Applied Electromagnetics

Module Description: Basics of electromagnetic radiation. Characteristics of electromagnetic waves. Maxwell equations. Radiowave reflection and refraction. Boundary conditions. Transmission lines and impedance matching using Schmith's chart. Description of microwave circuits using scattering matrix. Review of passive and active microwave components. Basic antenna parameters. Radiowave propagation phenomena. Applications to radio engineering.

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

- Demonstrate an understanding of radio signal propagation theory
- Demonstrate an understanding of basic antenna parameters .radiowave propagation phenomena and applications of radio engineering.
- Describe the microwaves circuits using scattering matrix

Issue Date: January 2009
Next Revision: January 2013

Module Title	TELECOMMUNICATION ENGINEERING LABORATORY
Code	TTCE3761
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TTCE3682 Introduction to Telecommunication Engineering

Module Description: Radio interface and spectrum. Measurements of radio system components. Performance measurements of digital modulation.

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

- Demonstrate an understanding of measurements in radio communication system, operational principles and performance
- Describe the concept of digital modulation
- Apply instruments used in telecommunications

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMMUNICATION NETWORKS I
Code	TTCE3791
NQF Level	7
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TCME3621 Computer Science for Engineers

Module Description: Data link control, circuit switching, packet switching, local area networks, Frame Relay, asynchronous transfer mode, local area networking architectures and techniques, wireless data networks, communications architecture and protocols, ad hoc and sensor networks.

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

- Demonstrate an understanding of different communication networks and protocols.
- Demonstrate an understanding of the fundamentals of the structure of digital data transmission systems.
- Demonstrate an understanding of current networks: Network infrastructure, architecture, circuit switched, packet switched, ATM, internet, wireless networks.

Issue Date: January 2009
Next Revision: January 2013

Module	COMPUTER AIDED CIRCUIT DESIGN
Code	TETE3721
NQF Level	7
Contact Hours	4L + 1P/S /Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3612 Electric Circuit Theory; TETE3621 Principles of Electronics Design

Module Description: Circuit simulators, Solving network equations, Principles of AC, DC, transient analyses and steady-state simulation methods, Simulation of noise and distortion, Worst-case and statistical analysis and optimization. Physical design and design verification.

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

- Use CAD software in Electronic design, Electronic simulation and Drafting
- Demonstrate an understanding of the concept of computer-aided circuit analysis based on the network circuit theory
- Describe the function and demonstrate the use of computer Aided circuit analysis software (eg. PCSpice, Microcap, Electronic Workbench etc..)
- Demonstrate an understanding of the operation, limitations and application areas of various types of front-end and back-end CAD tools used for analogue and mixed signal design.
- Use the techniques, skills and modern engineering tools necessary for design and simulation of circuit

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WIRELESS COMMUNICATIONS
Code	TTCE3751
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TTCE3682 Introduction to Telecommunication Engineering

Module Description: Wideband radio channels, multiple access techniques, spread spectrum and CDMA techniques, basics of multicarrier and UWB techniques, positioning, most common standards. Broadband channels and their modelling, spread spectrum techniques and modems in civil and military systems, design of OFDM systems, data transmission and positioning with UWB techniques

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

- Demonstrate an understanding of the principles behind the design of broadband wireless communication systems and technologies.
- Demonstrate an understanding of the basics of radio transmission and reception in different frequency bands and different physical environments
- Demonstrate an understanding of radio signal propagation and properties of wireless communication systems.
- Characterize TDMA,FDMA and CDMA

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONIC MATERIALS
Code	TETE3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2hour paper)
Prerequisites:	TEGT3522 Materials Science; TEGT3541 Fundamental of Electrical Engineering

Module Description: Electrical materials and their application, Study of materials for IC fabrication including Si, compound semiconductors and advanced Si on insulator structures Study of the basic principles of dielectrics with reference to the use of insulating materials in electronic devices and capacitors Introduction to liquid crystals with reference to their usage in electronic displays An introduction to magnetic materials for information storage, material for optoelectronics devices and transducers.

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

- Competently describe the properties, uses and characteristics of materials used in the electronics industry
- Demonstrate knowledge of the principles and physical behaviour of magnetic materials used in storage devices
- Demonstrate a clear understand of materials used in semiconductors devices
- Demonstrate an understanding of the basic principles of Integrated Circuit (IC) fabrication

Issue Date: March 2009
Next Revision: March 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	DIGITAL FILTERS
Code	TETE3722
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2hour paper)
Pre-requisites	TETE3692 Signals and Systems; TEGT3672 Engineering Mathematics IV

Module Description: Introduction, Discrete transforms, Convolution and correlation, Digital filter design, FIR filters, IIR filters, Decimation, interpolation and multirate, Filter banks, Adaptive filters, Signal processors. Applications**.**

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

- Demonstrate an understanding of FIR and IIR digital filters and their design
- Demonstrate basic knowledge of digital signal processing and its applications
- Design filters using suitable Computer Aided Design software

Issue Date: January 2009
Next Revision: January 2013

Module Title:	RADIO COMMUNICATION CHANNELS
Code	TTCE3722
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3681 Applied Electromagnetics; TTCE3682 Introduction to Telecommunication Engineering

Module Description: Different mechanisms of radiowave propagation: absorption, scattering, reflection, refraction and diffraction. Importance of radiowave propagation in the design of cellular communication systems. Effects of antennas on the radio channel. Principles of propagation modelling. Radiowave propagation phenomena over fixed terrestrial radio links and over fixed or mobile satellite links. Radio channel modelling for cellular systems. Multipath propagation and its effects on narrowband and wideband radio channels. Radiowave propagation inside or into buildings. Mitigation methods of propagation phenomena. Simulation of wideband radio channels.

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

- Demonstrate an understanding of the properties of different communication channels and how channels can be modelled
- Demonstrate an understanding of the new trends in mobile/wireless communication networks.
- Demonstrate an understanding of the concepts the basics of radiowave propagation over terrestrial and satellite channels.
- Demonstrate an understanding of the composition and importance of the propagation models and apply them in practice. Apply CAD tools for simulation of wideband radio channels
- Describe the Principles of propagation modelling, Radiowave propagation phenomena over fixed terrestrial radio links and over fixed or mobile satellite links.

Issue Date: January 2009
Next Revision: January 2013

Module Title	RADIO ENGINEERING I
Code	TTCE3742
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisite	TETE3681 Applied Electromagnetics
Co-requisite	TETE3781 Basics of Radio Engineering

Module Description: Definitions of noise terms, impedance matching using discrete components, microstrip matching networks, RF transistor amplifier design, active and passive mixers, oscillators, digital PLL, automatic gain control (AGC), power amplifier design.

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

- Demonstrate an understanding of the theory and techniques of designing radio frequency circuits used in radio transceivers.
- Apply RF transistors, mixers ,oscillators ,digital PLL in the designing process

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MOBILE TELECOMMUNICATION SYSTEMS
Code	TTCE3732
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TETE3751 Basics of Analogue and Digital Communications; TETE3781 Basics of Radio Engineering

Module Description: Concept of mobile communications system. Co-channel and adjacent channel interference and methods to reduce interference, Analysis of radio communications systems, Definition of radio network dimensioning and performance. Basics of radio network planning Control of radio resources. Examples of radio networks and the spectral efficiency of different networks. Basics of GSM- and UMTS-networks and development scenarios of mobile communication systems in 10 to 20 years time span.

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

- Demonstrate an understanding of the concept of mobile communication systems dimensioning and performance.
- Demonstrate an understanding of the current and development of mobile communication system and standards
- Demonstrate an understanding of the structure, functionality and dimensioning of communications systems.
- Analyse and evaluate radio communications systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER NETWORKS
Code	TCME3722
NQF Level	7
Contact Hours	2L + 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3621 Computer Science for Engineers

Module Description: Physical layer, data link layer, medium access control sublayer, network layer, transport layer, application layer, multimedia, QoS, network management, network security.

Exit Learning Outcomes:

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

- Have a comprehensive description on computer networks, from underlying physical layer up to application layer and today's most popular network applications.
- Identify and use internetworking, broadband, electrical interface, and data transmission concepts

Issue Date: January 2009
Next Revision: January 2013

Module Title	EMBEDDED SYSTEMS
Code	TETE3782
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3621 Principles of Electronics Design; TCME3692 Object Oriented Programming

Module Description: The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing.

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

- Demonstrate an understanding of the basic knowledge about the design and implementation of embedded systems and its components.
- Have a basic knowledge about the hardware programming with an Atmel AVR series microcontroller.
- Use and programme a microprocessor or microcontroller
- Demonstrate an understanding of design life cycle of the embedded systems, and a basic tool set for embedded systems development.
- Apply components and tools: IAR Embedded Workbench, Orcad 9.2, AVR Studio, ATICE50,JTAG-ICE
- Demonstrate hands-on program development using a microcontroller.

Issue Date: January 2009
Next Revision: January 2013

Module Title	STATISTICAL SIGNAL PROCESSING
Code	TTCE3792
NQF Level	7
Contact Hours	3L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites:	SSTS3691 Statistics for Engineers; TETE3692 Signals and Systems

Module Description: Introduction, Modelling of estimation problems, Least Squares estimation, BLUE-estimation, Signal detection, ML estimation, MS estimation, MAP estimation, Kalman Filter.

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

- Demonstrate knowledge of statistical signal processing, estimation theory and its applications
- Demonstrate an understanding of the statistical nature of communication and signal processing

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3600 Industrial Attachment I

Module Description: 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 OF B.Sc. (TELECOMMUNICATION ENGINEERING)

SEMESTER 1

Module Title	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

Module Description: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **Labour laws**. Trade Union laws. HIV/AIDS education and its impact on the workforce. **Intellectual property rights.**

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title	**COMMUNICATION NETWORKS II**
Code	TTCE3811
NQF Level	8
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TTCE3791 Communication Networks I

Module Description: Introduction to concepts in queuing theory, birth-death process, queueing systems and their measures of effectiveness, Little's result, blocking in queuing systems, open and closed (Jackson) queuing networks, advanced routing in data networks, multiple access techniques, network information theory, Cognitive networks.

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

- Demonstrate an understanding of the fundamental principles of modern data communications and networks
- Design, build, maintain and manage network and communication systems
- Apply principles of queuing theory to practical communication systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	**PROJECT MANAGEMENT FOR ENGINEERS**
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	SIGNAL PROCESSING
Code	TTCE3891
NQF Level	8
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3692 Signals and Systems; TTCE3792 Statistical Signal Processing

Module Description: Communication Signal Processing applies statistical signal processing methodology for communication receiver baseband algorithm design. Particular emphasis is on detector and equalizer design problems relevant in the baseband processing of Wireless Communication receivers. Algorithms and computation solutions based on matrix algorithms and adaptive filters are covered. Both linear and nonlinear equalizers are considered. Optimal linear filters and in particular Wiener filters are reviewed and their adaptive implementations are introduced. Least-mean square (LMS) and recursive least squares (RLS) algorithms are derived and their properties are analyzed. Spectrum estimation and array processing problems are introduced, and their relationship to adaptive filtering is illustrated.

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

- Apply statistical signal processing methodology for communication receiver baseband algorithm design
- Demonstrate an understanding of the theory of linear and adaptive filter equalizers ,spectrum estimation
- Apply mathematical tools and computation methods for signal processing
- Demonstrate an understanding of Least-mean square (LMS) and recursive least squares (RLS) algorithms and its applications in signal processing

Issue Date: January 2009
Next Revision: January 2013

Module Title	RADIO ENGINEERING II
Code	TTCE3831
NQF Level	8
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TTCE3742 Radio Engineering I

Module Description: This course is a continuation of Radio Engineering I and covers radio transceiver as a system. Restricting effects, nonlinear properties. Performance criteria, Design of RF and IF parts. A/D, interface, Frequency synthesizer, Transceiver design examples.

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

- Demonstrate an understanding of basics for radio transceiver design in system level
- Know the functional blocks interconnection and its sets requirements
- Demonstrate an understanding of the performance criteria in designing of RF and IF parts. A/D, interface, Frequency synthesizer and Transceiver .

Issue Date: January 2009
Next Revision: January 2013

Module Title	INFORMATION THEORY
Code	TTCE3861
NQF Level	8
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites:	TETE3751 Basics of Analogue and Digital Communications

Module Description: Basic concepts, data compression, basics of source coding, channel capacity, capacity of a Gaussian channel, maximum entropy method, rate distortion theory.

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

- Describe the concept of information theory and its applications in modern communications engineering
- Demonstrate an understanding of source coding, channel capacity and rate distortion theory

Issue Date: January 2009
Next Revision: January 2013

Module Title	TELECOMMUNICATION SIMULATION
Code	TTCE3841
NQF Level	8
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3751 Basics of Analogue and Digital Communications TETE3721 Computer Aided Circuit Design

Module Description: Simulation methods, modeling communication systems with simulations, confidence limits of simulation, generation of noise and random numbers, modeling of fading channels. A simple baseband simulation example covering the above topics is discussed.
Some common simulation packages for simulation of communication and RF systems are briefly introduced.

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

- Demonstrate an understanding of the principles and techniques of communication systems simulation and its limitations
- Apply CAD software tools for design simulation and modelling of communications and RF systems
- Analyze and design telecommunication network using modelling simulations tools.

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3700 Industrial Attachment II

Module Description: During Industrial Attachment III, students will work under company supervision at the level of Engineer Trainee and will undertake at least 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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	RESEARCH PROJECT
Code	TTCE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date: January 2009
Next Revision: January 2013

Module Title	TELECOMMUNICATION DESIGN PROJECT
Code	TETE 3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

J. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN METALLURGICAL ENGINEERING

J.1. B.Sc. (METALLURIGAL ENGINEERING) 19BMLE

J.2. AIM

The curriculum for B.Sc. (Metallurgical Engineering) degree aims at producing Graduate Engineers with knowledge, skills and abilities in Physical Metallurgy or Extraction Metallurgy.

J.3 CURRICULUM STRUCTURE

YEAR 1 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	Physics *for Physical Sciences* I	SPHY3511	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	Fundamentals of Engineering	TEGT3421	*4*	*8*	*None*
1	Contemporary Social Issues	UCSI3429	*4*	*8*	*None*
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	Properties of Materials	TMLE3542	5	8	None
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				**92**	

YEAR 2 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Chemistry for Metallurgists	TMLE3621	6	8	SCHM3572
1	Process Engineering for Metallurgists I	TMLE3641	6	8	SCHM3572
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
1	Engineering Thermodynamics I	TMEE3661	6	8	SCHM3512
1	Computer Aided Drawing	TEGT3661	6	8	TCME3591 TEGT3591
Total Credit				**80**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**CREDITS**	**PRE & COREQUISITE**
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3672 3572
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Materials Processing	TMLE3662	6	8	TMLE3542 TEGT3562
2	Process Eng. for Metallurgists II	TMLE3692	6	12	TMLE3641
2	Computer Science for Metallurgists	TMLE3642	6	8	TCME3621
2	Electrical Machines & Drives	TETE3622	6	8	TEGT3541
2	Introduction to Mineralogy	TMLE3622	6	8	TEGT3421
2	Strength of Materials	TMEE3622	6	8	TEGT3691
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**80**	

YEAR 3 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Metallurgical Thermodynamics I	TMLE3711	7	16	TMEE3661
1	Process and Materials Design	TMLE3731	7	16	TMLE3692
1	Solidification, Heat Treatment and Microstructure	TMLE3791	7	12	TEGT3522
1	Pyrometallurgy	TMLE3771	7	16	TMLE3692
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
1	Non Destructive Testing of Materials	TMLE3741	7	8	TMEE3521
1	Rate Processes I	TMLE3761	7	8	MET3621
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Metallurgical Thermodynamics II	TMLE3712	7	16	TMLE3711
2	Rate Processes II	TMLE3732	7	16	TMLE3761
2	Crystal Structure and Analysis	TMLE3752	7	16	TMLE3791
2	Environmental Process Engineering	TMLE3792	7	12	TMLE3731
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Fracture of Materials	TMLE3742	7	8	TEGT3522 TMEE3622
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**80**	

YEAR 4 OF B.Sc. (METALLURGICAL ENGINEERING) - EXTRACTIVE METALLURGY OPTION

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Management for Process Engineers	TMLE3821	8	8	TEGT3642
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Corrosion and Wear	TMLE3841	8	8	TMLE3712
1	Physical Chemistry of Iron and Steel Manufacturing	TMLE3861	8	8	TMLE3712
1	Engineering Failure Analysis	TMLE3881	8	8	TMLE3742
1	Particulate Systems	TMLX3891	8	12	TMLE3662
1	Hydrometallurgy	TMLX3821	8	8	TMLE3712
1	Process Control	TMLX3841	8	8	TMLE3731
Total Credit				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	
2	Metallurgical Design Project	TMLE3819	8	24	All 3rd Year Modules
2	Research Project	TMLE3839	8	24	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

YEAR 4 OF B.Sc. (METALLURGICAL ENGINEERING) - PHYSICAL METALLURGY OPTION

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Management for Process Engineers	TMLE3821	8	8	TEGT3642
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Corrosion and Wear	TMLE3841	8	8	TMLE3791
1	Physical Chemistry of Iron and Steel Manufacturing	TMLE3861	8	8	TMLE3712
1	Engineering Failure Analysis	TMLE3881	8	8	TMLE3522
1	Carbon Engineering	TMLP3861	8	8	TMLE3771
1	Forming and Welding Processes	TMLP3891	8	12	TMLE3791
1	Structure and Property of Materials	TMLP3881	8	8	TMLE3712
Total Credit				**76**	

SEMESTER	MODULE	CODE	8	CREDITS	
2	Metallurgical Design Project	TMLE3819	8	24	All 3rd Year Modules
2	Metallurgical Research Project	TMLE3839	8	24	All 3rd Year Modules
2	TEGT3800 Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

J.4 DETAILED COURSE CONTENTS FOR B.Sc. METALLURGICAL ENGINEERING

YEAR 1 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS I**
Code	TEGT3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	None

Content: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly – reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Content: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. Electrical machines: transformers, DC motors, generators. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	3L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS II
Code	TEGT3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Content: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. The iron-iron carbide alloy system: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. Properties of materials: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PROPERTIES OF MATERIALS
Code	TMLE3542
NQF Level	5
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Content: Review of Quantum mechanics: the basic principles required to understand the physical properties of materials (wave-particles duality, quantisation, Pauli exclusion principle, Fermi-Dirac statistic and band structure of materials). **Electrical Properties:** the conductivity of metals, semi-conductors and insulators on the basis of the band structure of materials. Doping of semiconductors and applications. **Magnetic properties:** ferromagnetic, paramagnetic and diamagnetic materials and their electronic structure. Domain structure, magnetisation and applications. **Thermal properties:** thermal expansion, thermal conductivity, heat capacity. Electron and phonon conduction. Optical properties: absorption, optical fibres, lasers. **Mechanical Properties and applications to metallurgy:** Tensile, hardness, bending, impact and torsion tests, plane strain, fracture toughness and creep.

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

- Describe the origin of physical properties of materials
- Describe the origin of electrical properties
- Describe the mechanisms of semi-conducting materials
- Describe the origin of magnetic properties
- Demonstrate knowledge of different mechanical properties and be able to measure them
- Describe the importance of measured properties on the selection of materials

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CHEMISTRY 1A
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 & 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.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**CHEMISTRY FOR METALLURGISTS**
Code	TMLE3621
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	SCHM3572 Chemistry

Content: Gases; Equations of State, Intermolecular forces, liquids and solids; Properties of solutions; Additional aspects of aqueous equilibria; Chemical thermodynamics; Electrochemistry; Metals and Metallurgy.

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

- Demonstrate an understanding of the science of liquids and solids
- Demonstrate an understanding of the concepts of thermodynamics and chemical equilibrium
- Demonstrate an understanding of the fundamentals of Metallurgy

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**PROCESS ENGINEERING FOR METALLURGISTS I**
Code	TMLE3641
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	SCHM3572 Chemistry

Content: Dimensions, units and conversion factors used in metallurgical engineering. Stoichiometry, sampling and measurements statistics. Material balances, thermochemistry, energy balances.

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

- Manipulate and convert between different systems of units
- Demonstrate an understanding of stoichiometry
- Demonstrate an understanding of the necessity of sampling procedures and statistical evaluation
- Demonstrate an understanding of material balances
- Demonstrate an understanding ofing and calculation of energy balances

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Thermal stress and strain. Assembly problems. Introduction to statically indeterminate problems.

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

- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Apply Hooke's Law for normal and shear stresses and analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites	TCME3591 Computing Fundamentals

Content: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Problem solving and algorithms using **C++.** Programming in **C++. Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming exercises.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Write a computer program using C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Contents: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING THERMODYNAMICS I
Code	TMEE3661
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	SCHM3572 Chemistry

Contents: Definitions; system, process, state, property of a system, cycle, pressure, volume, temperature, work, heat. **First law of thermodynamics**: internal energy; non-flow energy equation; energy equation and reversibility. Application of first law to non-flow processes; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. **Application of first law to flow processes;** continuity equation, application to boilers, condensers, turbines, compressors, nozzles, diffusers and throttling devices. **Second law of thermodynamics**: concept of the heat engine; cycle efficiency; Reversibility and irreversibility. Engine efficiency. The Carnot cycle. Absolute temperature scale. Entropy; determination and property diagrams. **Working fluids:** properties of fluids and vapours; thermodynamic properties of steam; properties diagrams. Avogadro's law, the equation of state of a perfect gas, specific heats and non-flow gas processes.

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

- Describe the first law of thermodynamics and its applications to non-flow and flow processes
- Describe the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
- Describe and quantify the properties of working fluids
- Interpret and use thermodynamic property diagrams
- Describe the equation of state of a perfect gas

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Contents: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ECONOMICS FOR ENGINEERS**
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principle of budgeting
- Demonstrate an understanding of the principle of marketing

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**MATERIALS PROCESSING**
Code	TMLE3662
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite	TEGT3562 Materials Science; TMLE3542 Properties of Materials

Content: Particulates processing. Powder production and processing. Near-net-shape processing. Hard metals, porous products. Isostatic pressing. Machining of materials. Processes and characteristics.

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

- Knowledge of particulate materials, manufacturing methods
- Knowledge of particulate processing by mechanical and thermo means
- Knowledge of assessment and measurement of product properties
- An understanding of the interplay of the variables contributing to the properties
- Familiarisation with the common methods of metal machining
- An understanding of cutting tools and feedstock properties, and tool wear

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PROCESS ENGINEERING FOR METALLURGISTS II
Code	TMLE3692
NQF Level	6
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TMLE3641 Process Engineering for Metallurgists I

Content: Introduction to minerals engineering; proportion of mined material physical processing – sizing and size reduction, agglomeration and solid liquid separation and mineral beneficiation processes. Selected process flowsheets.

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

- Demonstrate an understanding of communition processes and their selection
- Demonstrate an understanding of agglomeration and separation processes
- Demonstrate an understanding of flowsheets and their selection

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER SCIENCE FOR METALLURGISTS
Code	TMLE3642
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TCME3621 Computer Science for Engineers

Description of Module: Use of the chosen high level language to perform calculations in areas relevant to process engineering. The emphasis is on doing the calculations and not on producing professional programming code for others to use.

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

- Demonstration and application of the selected high level language to perform relevant engineering calculations
- Demonstration of the limitations of the calculating technique

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TETE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3541 Fundamentals of Electrical Engineering

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INTRODUCTION TO MINERALOGY
Code	TMLE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TEGT 3421 Fundamentals of Engineering

Content: Ore genesis and mineral identification. Application of microscopy, image analysis, XRD, modal analysis and mineralogical textures to characterise ores and minerals.

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

- Demonstrate an understanding of the origin and placement of important ores
- Demonstrate an understanding of the analytical methods used to analyse mineral and to apply them
- Apply the analytical methods to analyse minerals and ores
- Demonstrate an understanding of the limitations of the analytical techniques
- Be able to identify common minerals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TEGT3691 Engineering Mechanics II

Content: Analysis of stress and strain, Mohr's circle, Torsion: Torsion of circular sections; Solid non-circular shafts; Thin-walled tubes, Theories of failure. Combined loading. Residual stresses. Bending: Unsymmetrical bending, Inelastic Bending, Residual Stresses. Transverse Shear: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **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.

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

- Apply mathematical and graphical methods (Mohr's circle) to analyse stresses and strains and their applications to torsion, bending, shear and combined loading
- Analyse deflection of beams using integration, discontinuity functions and method of superposition.
- Apply energy methods in stress and strain analysis, deflection and impact loading
- Describe and apply Castigliano's theorem to engineering situations

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER 1

Module Title:	**METALLURGICAL THERMODYNAMICS I**
Code	TMLE3711
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMEE3661 Engineering Thermodynamics 1

Content: First law of thermodynamics: internal energy, work and heat. Constant volume and constant pressure processes. Isothermal and adiabatic process paths. Enthalpy and heat capacity. Enthalpies of formation and enthalpies of reactions. **Second law of thermodynamics:** entropy, reversibility and irreversibility, equilibrium. Combination of first and second laws. Free energy and equilibrium constant. Reactions involving gases and pure condensed phases. The Ellingham diagram. **Solution thermodynamics:** Partial, relative partial and excess partial molar quantities, Chemical potential. Integral, relative integral and excess integral molar properties: Gibbs-Duhem equation. Behaviour of solutions, simple solution types; Raoult's and Henry's laws. Activity and activity coefficients. Dilute solutions, alternate reference and standard states. Interaction parameters. Reactions involving gases and components in solution.

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

- Describe the concepts of thermodynamic variables, such as enthalpy, entropy, heat capacity…
- Calculate enthalpies of formation, and of reactions
- Evaluate the feasibility of potential reactions from thermodynamic data
- Demonstrate an understanding of Raoult's and Henry's laws
- Demonstrate an understanding of the concepts of partial, and excess molar quantities

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**PROCESS AND MATERIALS DESIGN**
Code	TMLE3731
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMLE3692 Process Engineering for Metallurgists 2

Content: Formal lectures on design related topics of a general nature such as costing, specification, alternatives and brainstorming as well as lectures tailored to the design task at hand. Design tasks to be completed by students working in groups. Verbal presentations by students at various stages of the design. Feedback by students on presentations and brainstorming. Present final design both verbally and on paper in a competent manner. Familiarisation with aspects of professional conduct and of occupational health and safety act.

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

- Demonstrate the importance of costing of metallurgical processes
- Demonstrate the implications and application of the occupational health and safety act
- Design a plant for a specific metallurgical operation
- Present the design to an engineering audience

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**SOLIDIFICATION, HEAT TREATMENT AND MICROSTRUCTURE**
Code	TMLE3791
NQF Level	7
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TEGT3522 Materials Science

Content: The solidification process. Development of a microstructure. Modification of microstructure. The cast structure. Segregation. Single crystals. The development of microstructure during solidification. Binary phase diagrams. The Fe-C system. Heat treatment of steel. Isothermal transformations. Diffusion. Surface engineering. Recovery, recrystallisation and grain growth. Precipitation hardening. Alloy steels.

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

- Demonstrate an understanding of the origins and development of microstructures
- Demonstrate an understanding of the manipulation of microstructure by thermo and thermo-mechanical methods
- Demonstrate an understanding of the relationship between microstructure and properties
- Specify processes for the generation of particular properties

Location: This course is currently conducted at the Windhoek VTC / School of Chemical and Metallurgical Engineering, University of the Witwatersrand.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PYROMETALLURGY
Code	TMLE3771
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMLE3692 Process Engineering for Metallurgists 2

Description of Module: This unit applies the fundamental knowledge of physical chemistry to various high temperature unit processes encountered in the production of metals and alloys. The unit processes are reduction smelting, sulphide smelting, converting, refining and fused salt electrolysis. Many examples such as the production of copper, zinc, aluminium, tin, lead, magnesium, and ferroalloys are given with reference to their unit operations. Specialist knowledge with respect to source of metals; pre-treatment processes such as roasting, calcination, sintering, pelletising, etc. are covered. Impact of pyrometallurgy on society and environment is also emphasised. When all the above is synthesised by the students they will be able to apply the information to engineering problem solving, data analysis and simple process design.

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

- Demonstrate an understanding of the use of high temperature methods in the processing of metals and alloys
- Select appropriate processes for specific operations
- Demonstrate an understanding of the chemistry, kinetics and thermodynamics of high temperature processes

Issue Date: January 2009
Next Revision: January 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

Module Title:	NON DESTRUCTIVE TESTING OF MATERIALS
Code	TMLE3741
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMEE3521 Materials Science

Contents: **Theory and application** of Non Destructive Testing (NDT) methods such as the Liquid Penetrant Method, Magnetic Particles, Ultrasonic Flaw Detectors, X-ray Radiography, Gamma (γ) ray Radiography, Eddy Current Testing and other electrical methods in **testing, flaw detection and integrity checking of engineering materials**. Laboratory exercises on some of these methods. National and International Standards on NDT methods.

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

- Describe the various techniques of non-destructive testing applicable to engineering materials and engineering components and structures
- Demonstrate practical knowledge of some non-destructive testing techniques in a laboratory environment.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	RATE PROCESSES I
Code	TMLE3761
NQF Level	7
Contact Hours	2L + 1T /Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TMLE3621 Chemistry for Metallurgists

Content: Principles of heat, mass and momentum transport and their mathematical expressions. Principles of chemical kinetics, homogeneous and heterogeneous systems. Topo-chemical reactions. Reactions with diffuse phase boundaries.

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

- Demonstrate an understanding of the principles of mass and momentum transfer
- Calculate temperature gradients and reaction times, based on available data
- Calculate concentration gradients and rates of mass transfer

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	METALLURGICAL THERMODYNAMICS II
Code	TMLE3712
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMLE3711 Metallurgical Thermodynamics I

Content: Phase equilibria: Phase rule and equilibrium diagrams. Free energy composition relationship. Unary, binary and ternary phase diagrams. Equilibrium path of crystallisation. Various types of invariant reactions.

Electrochemistry: The relationship between chemical and electrical driving forces, the electromotive force (emf). Nature of electrolytes, transference numbers and mobilities. Thermodynamics of electrolytes. The effect of concentration on emf. Formation cells, concentration cells and transference. Electrode potentials. The electrochemical series. The Pourbaix diagram. Chemistry of aqueous solutions. Fused salt electrolysis.

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

- Describe and apply the phase rule
- Interpret and apply phase diagrams
- Demonstrate an understanding of the relationship between chemical and electrical driving forces
- Describe and apply Pourbaix diagrams
- Apply thermodynamics to solve relevant engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	RATE PROCESSES II
Code	TMLE3732
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMLE3641 Process Engineering for Metallurgists 1
Co-requisites	TMLE3761 Rate Process I

Content: Treatment of heat, mass and momentum transfer problems in metallurgical engineering by interaction of chemical kinetics and transport processes. Solid-solid, solid-liquid, solid-gas, liquid-liquid, liquid-gas and solid-liquid-gas reaction systems.

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

- Demonstrate an understanding of the relationships between thermodynamics and kinetics
- Apply principles of heat and mass transfer to metallurgical processes
- Demonstrate an understanding of the different types of interface reactions

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CRYSTAL STRUCTURE AND ANALYSIS
Code	TMLE3752
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMLE3791 Solidification, Heat Treatment and Microstructure

Content: Crystal structures: Application of crystallography, point groups and space groups to understand the structures of different phases and the reciprocal lattice. Use of stereographic projections to analyse deformation in cubic materials. Relation of defects in crystals, and texture to the properties of metals. **Analytical techniques:** Evaluation and application of optical microscopy, X-ray diffraction, scanning and transmission electron microscopy, including EDS, to analyse and characterise microstructure. Description of techniques to analyse textures. Introduction to Mossbauer spectroscopy. Application and understanding of these techniques to materials characterisation together with specialist techniques. **Application of computer software in analysing and characterising microstructure and texture.**

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

- Demonstrate an understanding of different basic crystal structures
- Demonstrate an understanding of the representation of crystals
- Relate crystal structure to properties
- Apply stereographic projections to derive active slip systems
- Describe and apply different analytical techniques to identify crystal structures
- Demonstrate an understanding of the limitations of the analytical techniques
- Apply computer software in the analysis and characterization of microstructures.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENVIRONMENTAL PROCESS ENGINEERING
Code	TMLE3792
NQF Level	7
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	TMLE3731 Process and Material Design

Description of Module: By the end of the unit, students will be expected to have obtained a basic knowledge of air and water quality objectives in Southern Africa, including an introduction to the health, safety and risk aspects, based on current codes of practice and legislation. They will master basic strategies for the treatment of natural water and wastewaters and industrial air pollution. They will be able to apply these strategies to the modelling, analysis, design and optimisation of several types of pollution control equipment, e.g. ESP's, sand filters, incinerators, anaerobic digesters etc, with a view to promoting sustainable development by South African chemical and metallurgical industries.

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

- Demonstrate an understanding of air and water quality objectives
- Demonstrate an understanding of the health and safety issues, and relevant legislation
- Demonstrate an understanding of the impact of industrial processes on the environment
- Demonstrate an understanding of the different techniques that can be used
- Apply the relevant equipment and methods
- Demonstrate an understanding of the concept of sustainability

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3600 Industrial Attachment I

Description: 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 OF B.Sc. (METALLURGICAL ENGINEERING)

SEMESTER 1

Module Title:	SOCIETY AND THE ENGINEER
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MANAGEMENT FOR PROCESS ENGINEERS
Code	TMLE3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TMLE3642 Economics for Engineers

Content: Organisational behaviour: organisational culture, change management, work performance levels and managing diversity in organisations. **Financial management:** the origin of financial information, introduction to and analysis of financial statements, financial decision making and risk management. **Operations management from a process engineering perspective:** TQM and time-based competition. **Economics:** Micro and Macro Economics, Markets and Confidence.

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

- Appreciate the fundamental importance in any operation
- Appreciate the fundamental importance of people and interpersonal skills in any operation
- Demonstrate an understanding of and apply relevant principles of management
- Demonstrate an understanding of the origin of financial information, and be able to analyse such information

Issue Date: January 2009
Next Revision: January 2013

Module Title	PROJECT MANAGEMENT FOR ENGINEERS
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CORROSION AND WEAR
Code	TMLE3841
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TMLE3712 Metallurgical Thermodynamics II

Content: Understanding and use of general corrosion theory, including electrochemistry, thermodynamics and kinetics. Identification of different corrosion forms and passivity, and a knowledge of the fundamental mechanisms involved in each case, as well as application of corrosion principles in the understanding of the corrosion situations. Experience in various corrosion testing methods. Design against corrosion by using cathodic and anodic protection, material selection, application design, environmental control and surface treatments. Understanding tribological principles: friction, wear and wear mechanisms and lubrication. Application of various aspects of surface engineering such as surface modifications and surface coatings.

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

- Identify the common corrosion processes
- Demonstrate an understanding of the principles of electrochemistry and corrosion
- Recommend processes to reduce or avoid corrosion
- Identify the different wear mechanisms
- Demonstrate an understanding of the interplay between abrasive and wear in specific environments
- Recommend processes to reduce wear

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PHYSICAL CHEMISTRY OF IRON AND STEEL MANUFACTURING
Code	TMLE3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TMLE3712 Metallurgical Thermodynamics II

Content: Conventional blast furnace ironmaking; modelling of blast furnace; alternative ironmaking methods: direct reduction; oxygen steelmaking: top, bottom-blown and mixed processes; electric steelmaking; secondary steelmaking and refining and stainless steel: AOD process. Scrap metal operations. Metal recycling operations. Impact on society and the environment.

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

- Demonstrate an understanding of the principles of blast furnace operations
- Demonstrate an understanding of the principles of steel converter operations
- Carry out basic calculations relating to the conversion of pig iron to steel
- Apply thermodynamic and chemical principles to steel manufacture
- Demonstrate an understanding of alternative routes for steelmaking

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING FAILURE ANALYSIS
Code	TMLE3881
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMLE3742 Fracture of Materials

Content: This unit is about engineering problem-solving through application of fundamental and specialist knowledge leading to engineering design, synthesis and manufacture as well as to experimentation, investigation, data analysis and engineering methods: **Failure analysis:** Importance of analysing failure, causes of failure, typical failure analysis case studies, non-destructive inspection. **Fatigue failure:** Designing against fatigue, fatigue mechanisms in metals and nonmetallic materials, fractographic features of fatigue, introduction to the problems of welded structures, importance of design detailing. **Fracture:** Factors that influence fracture, ductile-to-brittle transition, fractographic features associated with brittle fracture, microstructural effects on toughness. Role of stress concentrations. Energy approach to fracture. Stress intensity factors. Crack tip plasticity. Yielding fracture mechanics.

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

- Identify the probable mode of failure from visual inspection of failed components
- Evaluate the mechanical properties of materials and relate them to failure modes
- Demonstrate an understanding of the application of NDT methods to evaluate structural integrity
- Recommend appropriate materials and structural details to avoid specific types of failures

Issue Date: January 2009
Next Revision: January 2013

OPTION 1 – EXTRACTIVE METALLURGY

Module Title:	PARTICULATE SYSTEMS
Code	TMLX3891
NQF Level	8
Contact Hours	**3**L + 2T or 1PS/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TMLE3662 Materials Processing

Content: Characterisation of particulate populations: quantitative description of particle size, nominal diameters, types of distributions for particle populations as a function of their physical properties (size, grade, relative density, extent of liberation. Influence of various forces (fluid drag, gravity, magnetic, electrostatic) on motion and fracture of particles, particle/particle effects. Application of the above to formulation on models for comminution, flotation, gravity separation, electrostatic and magnetic separation of particles. Application of the above in design of process requirements and in design of experimental programmes. Laboratory work illustrating value and limitations of experimental work aimed at obtaining design parameters. Reporting on laboratory investigations.

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

- Demonstrate an understanding of the nature and behaviour of particulate materials
- Apply appropriate methods to size particulate materials
- Demonstrate an understanding of the influence of different forces on the movement and fracture of particles
- Apply appropriate methods to separate value from gangue minerals, such gold from quartzite
- Design experimental programmes to evaluate important parameters n minerals dressing
- Report on the techniques, results and limitations of the different available processes
- Design specific operations for the processing ore body

Issue Date: January 2009
Next Revision: January 2013

Module Title:	HYDROMETALLURGY
Code	TMLX3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMLE3712 Metallurgical Thermodynamics II

Content: Behaviour of metal ions in solution (complex formation, equilibria, E_h vs pH diagram) and electrochemical kinetics are used to develop models for leaching, precipitation and electrowinning. Carrier phase separations (adsorption, resin ion exchange, solvent extraction) are modelled for multistage operation. Models are used for analysis and design of full scale hydrometallurgical operations.

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

- Demonstrate an understanding of the effect of different parameters on metal ions in solution
- Design specific processes for the treatment of particular pulps
- Model different phase separation mechanisms for multistage operations
- Analyse full-scale hydrometallugical operations

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**PROCESS CONTROL**
Code	TMLX3841
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMLE3731 Process and Materials Design

Content: Control objectives (stability, optimisation and safety) and methodology for control system design. Industry-wide conventions and terminology for effective multidisciplinary communication. Mathematical modelling of processes. Block diagrams. Stability criteria, feedback controller design for Single Input Single Output (SISO) systems. Extensions to multivariable systems. Cascade, feed-forward model-based and other specialised control systems. Digital simulation of dynamic systems.

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

- Demonstrate an understanding of the objectives of process control in a given system
- Demonstrate an understanding of industrial conventions of process control
- Recommend appropriate instrumentation to effect process control
- Model different processes, and undertake simulations under different conditions
- Demonstrate an understanding of specialised control systems

Issue Date: January 2009
Next Revision: January 2013

OPTION 2 – PHYSICAL METALLURGY

Module Title:	**CARBON ENGINEERING**
Code	TMLP3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMLE3771 Pyrometallurgy

Content: Allotropy in Carbon: graphite structure and properties, diamond structure and properties. **Coal and Coke:** characteristics, uses, availability, international market trends. **Carbon fibres**: manufacture, characteristics, properties and uses. Carbon fibres for composite applications. **Carbon nanotubes**: science behind carbon nanotubes, manufacture, characteristics, properties and uses.

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

- Distinguish between graphite and diamond from their structure and characteristics
- Describe characteristics and uses of carbon fibres with emphasis on composite reinforcement
- Describe characteristics and uses of carbon nanotubes with emphasis on industrial applications

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**FORMING AND WELDING PROCESSES**
Code	TMLP3891
NQF Level	8
Contact Hours	3L + 1P/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TMLE3791 Solidification, Heat Treatment and Microstructure

Content: Casting as a forming process; gating and feeding systems. Metal fluidity. **Continuous casting**. Design of castings. Casting defects. Important casting processes. **Lab exercises** on casting simple components. **Mechanical forming of materials**; hot and cold forming. Formability. Wire drawing. Extrusion. Rolling. Deep drawing. Forging. Defects in wrought metals. **Welding processes**; control and practical applications. Pool interactions. Residual stresses. **Weld metallurgy**. Weld defects. Designing against failure of welds.

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

- Demonstrate familiarity to the common welding processes
- Specify welding processes for specific operations
- Demonstrate an understanding of the metallurgical effects of welding on different alloys
- Demonstrate familiarity with the common casting and mechanical forming processes
- Demonstrate appreciation for the mechanical properties of castings
- Demonstrate an understanding of the interplay between hot and cold processes and product processes
- Specify mechanical forming processes and heat treatments to generate specific properties

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STRUCTURE AND PROPERTIES OF ENGINEERING MATERIALS
Code	TMLP3881
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMLE3712 Metallurgical Thermodynamics II

Content: Dislocation theory: Effect of dislocations on mechanical properties. Relationship of dislocations, stacking faults, grain boundaries and second phase particles on strengthening. Effect of different types of interface. **Phase Transformations:** Role of diffusion, nucleation and growth on solid state transformations. Mechanisms and kinetics of phase transformations (especially in steels). **Strengthening Mechanisms in Alloys:** Alloying additions (especially for steels). Improvement of mechanical properties by work-hardening, solid solution strengthening, dispersion strengthening and grain size. Effects of metastable precipitates (especially in aluminium-based alloys). Phase proportions and morphology (especially for titanium-based alloys). **Composites:** Application of general principles and mechanisms of strengthening of composites to design the structure and processing, taking fracture mechanisms into account. Relation of matrix and fibre/particle properties to manufacturing techniques and optimisation of the processing. Typical failure mechanisms. Optimisation of process and properties of hard metals through understanding the microstructure. **Ceramics:** Processing considerations. Effect of purity and grain size. Examples of different ceramics and their failure mechanisms. **Polymers:** Application of knowledge of structures, types (elastomers, thermoplastics and thermosets), components (fillers, plasticisers), shaping methods, and failure mechanisms to understand and utilise materials.

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

- Demonstrate an understanding of the effect of dislocation in strengthening of materials
- Demonstrate an understanding of the effect of phase transformations in the strengthening of materials, especially in steels, aluminium alloys
- Demonstrate an understanding of the effects of microstructural morphology (such as grain size and particle distribution) on properties
- Demonstrate an understanding of how composites function and calculate mechanical properties for composites
- Demonstrate an understanding of the effect of processing on the properties of ceramics and recommend processing routes for specified ceramics
- Demonstrate an understanding of the available strengthening mechanisms in polymers and their different failure modes

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3700 Industrial Attachment II

Description: During Industrial Attachment III, students will work under company supervision at the level of Engineer 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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TMLE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Design an experimental matrix to undertake a specific investigation
- Demonstrate the ability to investigate a project in a scientific manner
- Use specific relevant equipment to measure specific properties
- Demonstrate abilities to present the results of an investigational project verbally and in a written report
- Demonstrate the ability to carry out scientific experiments and evaluate the results

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**METALLURGICAL DESIGN PROJECT**
Code	TMLE3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Recommend appropriate designs for specific metallurgical operations
- Undertake the full design of a metallurgical process
- Undertake costing and evaluate environmental suitability of the design
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings

Issue Date: January 2009
Next Revision: January 2013

K. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

K.1. B.Sc. (COMPUTER ENGINEERING) 19BCME

K.2. AIM

The curriculum for B.Sc. (Computer Engineering) aims at producing Graduate Engineers with knowledge, skills and abilities in Computer Engineering and Information Technology.

K.3 CURRICULUM STRUCTURE

YEAR 1 OF B.Sc. (C0MPUTER ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	*8*	*None*
1	*Contemporary Social Issues*	*UCSI3429*	*4*	*8*	*None*
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	Fundamentals of Electronics	TETE3542	5	8	TEGT3541
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				**92**	

YEAR 2 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Principles of Electronics Design	TETE3621	6	8	TETE3542
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
1	Computer Organisation and Assembly Language	TCME3641	6	8	TCME3591
1	Computer Aided Drawing	TEGT3522	6	8	TCME3591 TEGT3591
Total Credit				**72**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3572
2	Electric Circuit Theory	TETE3612	6	16	TETE3542 TEGT3572
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Digital Logic and Digital System Design	TCME3632	6	16	TETE3621 TEGT3691
2	Data Structures and Algorithms	TCME3622	6	8	TCME3621
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**80**	

YEAR 3 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Electronic Circuit I	TCME3781	7	8	TETE3542 TETE3612
1	Computer Aided Circuit Design	TETE3721	7	8	TETE3612 TEGT3661 TETE3621
1	System Software Design	TCME3751	7	16	TCME3641
1	Advanced Object Oriented Programming	TCME3791	7	12	TCME3692
1	Microprocessor Systems	TCME3721	7	8	TCME3621
1	Software Engineering I	TCME3741	7	8	TCME3692 TCME3621
1	Electronic Materials	TETE3761	7	8	TEGT3522 TEGT3541
1	Database Systems	TCME3761	7	8	TCME3692
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Electronic Circuit II	TCME3782	7	8	TCME3781
2	Embedded Systems	TETE3782	7	8	TETE3621 TCME3692
2	Computer Design and Architecture	TCME3772	7	16	TCME3632
2	UNIX System Software	TCME3762	7	8	TCME3751
2	Software Engineering II	TCME3742	7	8	TCME3741
2	Computer Networks	TCME3722	7	8	TCME3621
2	Operating Systems	TCME3792	7	12	TCME3621 TCME3641
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**80**	

YEAR 4 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Computer Network Management Systems	TCME3811	8	16	TCME3722 TETE3782
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Compiler Construction	TCME3821	8	8	TCME3641
1	Digital Image Processing	TCME3841	8	8	TCME3622
1	Artificial Intelligence	TCME3861	8	8	TCME3622
1	Computer System Performance	TCME3881	8	8	TCME3782 TCME3622
1	Control Theory	TCME3851	8	16	TEGT3671
Total Credit				**80**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Design Project	TCME3819	8	24	All 3rd Year Modules
2	Research Project	TCME3839	8	24	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

K.4 DETAILED COURSE CONTENTS FOR B.Sc. COMPUTER ENGINEERING

YEAR 1 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS I**
Code	TEGT3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	**ENGINEERING DRAWING**
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Module Description: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Circuit laws : Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. time and frequency response, phasor calculation, Electrical machines: transformer, motors, generators. Basics of circuit simulation. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGT3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Module Description: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

Exit Learning Outcomes

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; **Equilibrium phase diagrams**: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. **The iron-iron carbide alloy system**: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. **Properties of materials**: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. **Effects of environment on materials**: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Module Description: Statics*:* Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. Analysis of forces in a truss: Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces, buoyancy. Distributed forces: centroids and center of gravity; Pappu's second moment. **Friction**: Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. Analysis of frames and machines. **Virtual work**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	FUNDAMENTALS OF ELECTRONICS
Code	TETE 3542
NQF Level	5
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TEGT 3541 Fundamentals of Electrical Engineering

Module Description: Analogue electronics : Introduction to semi-conductor theory, Electronic components: Inductor, capacitors, resistors, diodes, transistors, thyristors/triacs, IC's. **Simple electronic circuits**: Clamping circuits, rectifying circuits, simple amplifier (single stage RC). **Digital Technique**: Logic operation of integrated circuits. Boolean algebra, number systems, codes and parity, analysis and synthesis of combinatorial logic, latches and flip-flops, analysis and synthesis of sequential logic, MSI building blocks of sequential logic, design principles of digital systems, physical properties of digital circuits.

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

- Distinguish between passive and active devices, and between power supplies & signals.
- Describe, construct and test wave rectifier circuits using diodes
- Recognize terminology of basic electronic devices and apply DC laws to electronic circuit calculations.
- Practice circuit construction/assembling and use multi-meters and oscilloscope and RLC meters to perform electronic measurement and do basics trouble-shooting.
- Identify and apply electronic devices and their schematic symbols in a circuit.
- Analyse & describe the operation of p-n semiconductor diodes transistors and Op-Amps.
- Use the binary number system to carry out basic arithmetic operations, and implement digital circuits
- Use Boolean algebra and related techniques to simplify logical expressions, analyze simple combinational logic circuits, with logic gates, simple sequential logic circuits and standard flip-flops.

Issue Date: January 2009
Next Revision: January 2013

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 & 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.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENGINEERING MECHANICS II**
Code	TEGT3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Thermal stress and strain. Assembly problems. Introduction to statically indeterminate problems.

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

- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Apply Hooke's Law for normal and shear stresses and analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites	TCME3591 Computing Fundamentals

Contents: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Introduction to problem solving and algorithms with C++. **Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming project.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	PRINCIPLES OF ELECTRONICS DESIGN
Code	TETE3621
NQF Level	6
Contact Hours	2L + 1P/S /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3542 Fundamentals of Electronics

Module Description: Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modelling and analysing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA –conversion and principles of VLSI-technology.

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

- Describe the basic operation and structures of diodes, transistors and operational amplifiers.
- Bias a BJT, FET or MOSFET device to achieve a desired quiescent operating point.
- Describe the concepts of analogue electronic design techniques and internal structure of digital circuits
- Apply the principles of AD/DA –conversion and principles of VLSI-technology.

Issue Date: January 2009
Next Revision: January 2013

Module Title	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Module Description: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER ORGANISATION AND ASSEMBLY LANGUAGE
Code	TCME3641
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TCME3591 Computing Fundamentals

Content: Computer organization, description of the basic computer functions, representation of information, computer memory hierarchy and its implementation, input/output operations, use of assembly language programming, basic instruction sets, arithmetic and logical operations, addressing modes and macro definition, assembly language programming assignment.

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

- Describe computer organization and identify various computer functions
- Demonstrate an understanding of the operation of digital computer
- Describe computer memory organization and its implementation
- Use of assembly language programming, basic instruction sets, arithmetic and logical operations,
- Addressing modes and macro definition.
- Solve an engineering problems using assembly language programming

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS IV
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Module Description: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRIC CIRCUIT THEORY
Code	TETE3612
NQF Level	6
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TETE3542 Fundamentals of Electronics
Co-requisite:	TEGT3671 Engineering Mathematics III

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

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

- Use principles and methods of analysis and modelling of electric circuits in the steady state.
- Apply Network theorems to the analysis of networks.
- Use of Laplace transformation and bode plots in circuit analysis
- Apply the concepts of frequency response, resonance, and network functions, two port networks including hybrid parameters.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ECONOMICS FOR ENGINEERS
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of marketing

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	DIGITAL LOGIC AND DIGITAL SYSTEM DESIGN
Code	TCME3632
NQF Level	6
Contact Hours	4L + 1PS/Week
Credits	16
Module Assessment:	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TEGT3671 Engineering Mathematics III, TETE3621 Principles of Electronics Design

Module Description: Synthesis of state machines including design, applications and implementation. Register transfer languages and ASM chart design methodologies. PLA, ROM-CENTERED, and FPGA implementations. Specific applications to controllers and interface devices will be discussed. An FPGA based laboratory experience is included. **Fundamental theory and design methods for digital systems**. Topics include logic components, Boolean algebra, combinational circuit analysis and design, synchronous and asynchronous sequential circuit analysis and design, state diagrams, state minimization and assignment, basic computer organization and design. This course also teaches the use of software tools for design, minimization, simulation, and schematic capture of digital systems. The digital systems that are designed will be implemented using MSI, LSI, and field programmable gate arrays. A hands-on laboratory is included in which students work in teams.

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

- Synthesise state machines as well as design, apply and implement them.
- Use register transfer languages and ASM chart design methodologies.
- Implement PLA, ROM-CENTERED, and FPGA concepts.
- Use logic components, Boolean algebra, combinational circuit analysis in basic Computer Organisation and Design
- Analyse and design synchronous and asynchronous sequential circuits
- Use software tools for design, minimization, simulation, and schematic capture of digital systems.
- Use MSI, LSI, and field programmable gate arrays in the implementation of the design of a digital system.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Module Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER 1

Module Title	**ELECTRONICS CIRCUIT I**
Code	TCME3781
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3542 Fundamentals of Electronics; TETE3612 Electric Circuit Theory

Module Description: The basic building blocks used in electronic engineering are studied. Diodes, bipolar transistors, and MOS transistors are modelled and then used to describe the operation of logic gates and amplifiers. Emphasis is placed on the operation and applications of standard integrated circuit chips.

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

- Apply the basic building blocks used in electronic engineering to Computer Engineering.
- Model Diodes, bipolar transistors, and MOS transistors and use them to describe the operation of logic gates and amplifiers.
- Apply standard integrated circuit chips.

Issue Date: January 2009
Next Revision: January 2013

Module	**COMPUTER AIDED CIRCUIT DESIGN**
Code	TETE3721
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	TETE3612 Electric Circuit Theory
Pre-requisites	TEGT3661 Computer Aided Drawing; TETE3621 Principle of Electronics Design;

Module Description: Circuit simulators, Solving network equations, Principles of AC, DC, transient analyses and steady-state simulation methods, Simulation of noise and distortion, Worst-case and statistical analysis and optimization. Physical design and design verification.

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

- Use CAD software in Electronic design, Electronic simulation and Drafting
- Demonstrate an understanding of the concept of computer-aided circuit analysis based on the network circuit theory
- Describe the function and demonstrate the use of computer Aided circuit analysis software (eg. PCSpice, Microcap, Electronic Workbench etc).
- Demonstrate an understanding of the operation, limitations and application areas of various types of front-end and back-end CAD tools used for analogue and mixed signal design.
- Use the techniques, skills and modern engineering tools necessary for design and simulation of circuit

Issue Date: January 2009
Next Revision: January 2013

Module Title	**SYSTEM SOFTWARE DESIGN**
Code	TCME3751
NQF Level	7
Contact Hours	4L + 1PS /Week
Credits	16
Module Assessment:	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TCME3641 Computer Organization and Assembly Language

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ADVANCED OBJECT ORIENTED PROGRAMMING
Code	TCME3791
NQF Level	7
Contact Hours	**3**L + 1PS/Week
Credits	12
Module Assessment:	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-Requisite	TCME3692 Object Oriented Programming

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	MICROPROCESSOR SYSTEMS
Code	TCME3721
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment:	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TCME3621 Computer Science for Engineers

Module Description: Processor organization: general-purpose and application-specific processors, datapath and control implementation, pipelining concepts. Memory organization: static and dynamic semiconductor memory, optical and magnetic memory, memory hierarchy and caches. I/O organization: physical and logic interfaces, interrupts and interrupt services routines, direct memory access (DMA), device drivers. Buses and protocols: bus signalling and arbitration, examples of modern buses, communications protocol concepts. Computer networking: network topologies, protocol stack, examples of modern networks.

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

- Describe Processor organization including general-purpose and application-specific processors, datapath and control implementation, pipelining concepts.
- Plan and implement Memory organization including static and dynamic semiconductor memory, optical and magnetic memory, memory hierarchy and caches.
- Plan and perform I/O organization including physical and logic interfaces, interrupts and interrupt services routines, direct memory access (DMA), device drivers.
- Implement protocols and effectively use bus signalling and arbitration; use examples of modern buses, and communications protocol concepts.
- Identify and Implement network topologies and protocol stack; use examples of modern networks.

Issue Date: January 2009
Next Revision: January 2013

Module Title	SOFTWARE ENGINEERING I
Code	TCME3741
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	TCME3692 Object Oriented Programming
Pre-requisites	TCME3621 Computer Science for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONIC MATERIALS
Code	TETE3761
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2hour paper)
Prerequisites:	TEGT3522 Materials Science TEGT3541 Fundamental of Electrical Engineering

Module Description: Electrical materials and their application, Study of materials for IC fabrication including Si, compound semiconductors and advanced Si on insulator structures Study of the basic principles of dielectrics with reference to the use of insulating materials in electronic devices and capacitors Introduction to liquid crystals with reference to their usage in electronic displays An introduction to magnetic materials for information storage, material for optoelectronics devices and trasducers.

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

- Competently describe the properties, uses and characteristics of materials used in the electronics industry
- Demonstrate knowledge of the principles and physical behaviour of magnetic materials used in storage devices
- Demonstrate a clear understanding of materials used in semiconductors devices
- Demonstrate an understanding of the basic principles of Integrated Circuit (IC) fabrication

Issue Date: March 2009
Next Revision: March 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	**ELECTRONIC CIRCUITS II**
Code	TCME3782
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment:	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisites	TCME3781 Electronic Circuit I

Module Description: This course is a continuation of Electronics I. Analogue and digital circuits are discussed. Analogue topics include frequency response, real world applications of operational amplifiers, power amplifiers, filters, oscillators, and A/D and D/A converters. Digital electronic building blocks are discussed, including flip-flops, counters, coding and decoding circuits, and memory.

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

- Apply Analogue electronic concepts including frequency response, real world applications of operational amplifiers, power amplifiers, filters, oscillators, and A/D and D/A converters.
- Apply Digital electronic building blocks, including flip-flops, counters, coding and decoding circuits, and memory.
- Design and analyse analogue and digital circuits.

Issue Date: January 2009
Next Revision: January 2013

Module Title	**EMBEDDED SYSTEMS**
Code	TETE3782
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3621 Principles of Electronics Design; TCME3692 Object Oriented Programming

Module Description: The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing.

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

- Demonstrate an understanding of the basic knowledge about the design and implementation of embedded systems and its components.
- Have a basic knowledge about the hardware programming with an Atmel AVR series microcontroller.
- Use and programme a microprocessor or microcontroller
- Demonstrate an understanding of design life cycle of the embedded systems, and a basic tool set for embedded systems development.
- Apply components and tools: IAR Embedded Workbench, Orcad 9.2, AVR Studio, ATICE50,JTAG-ICE
- Demonstrate hands-on program development using a microcontroller.

Issue Date: January 2009
Next Revision: January 2013

Module Title	**COMPUTER DESIGN AND ARCHITECTURE**
Code	TCME3772
NQF Level	7
Contact Hours	4L + 1PS /Week
Credits	16
Module Assessment:	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TCME3632 Digital Logic and Digital System Design

Module Description: A review of fundamental theory and design methods for digital systems. Machine architecture-machine performance relationships, computer classifications, and computer description languages. Consideration of alternative machine architectures. Software influences on computer design.

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

- Identify Machine architecture - machine performance relationships
- Evaluate computer classifications, and computer description languages.
- Examine alternative machine architectures and Software influences on computer design.

Issue Date: January 2009
Next Revision: January 2013

Module Title	UNIX SYSTEM SOFTWARE
Code	TCME3762
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment:	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisites	TCME3751 System Software Design

Module Description: Fundamentals of the UNIX operating system. Students apply the skills using the UNIX operating system. Topics covered include X-windows, several basic UNIX commands, compilers and debugging tools, scripting tools, the use of system libraries, and the creation of system libraries.

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

- Identify fundamentals of the UNIX operating system.
- Apply skills using the UNIX operating system including X-windows, basic UNIX commands, compilers and debugging tools and scripting tools
- Demonstrate ability to use system libraries and to create system libraries.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER NETWORKS
Code	TCME3722
NQF Level	7
Contact Hours	2L + 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3621 Computer Science for Engineers

Module Description: Physical layer, data link layer, medium access control sublayer, network layer, transport layer, application layer, multimedia, QoS, network management, network security.

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

- Have a comprehensive description on computer networks, from underlying physical layer up to application layer and today's most popular network applications.
- Identify and use internetworking, broadband, electrical interface, and data transmission concepts

Issue Date: January 2009
Next Revision: January 2013

Module Title	OPERATING SYSTEMS
Code	TCME3792
NQF Level	7
Contact Hours	**3**L + 1PS /Week
Credits	12
Module Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TCME3621 Computer Science for Engineers; TCME3641 Computer Organization and Assembly language

Module Description: Operating system design and implementation using the specifics of current operating systems. The course covers file, process, memory and Input/Output management; multitasking, synchronization, and deadlocks; scheduling and inter-process communication. Projects include team system's programming assignments to investigate the kernel interface, files, processes, and inter-process communication for a current operating system.

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

- Design and Implement Operating systems using the specifics of current operating systems.
- Identify file, process, memory and Input/Output management; multitasking, synchronization, and deadlocks; scheduling and inter-process communication.
- Use team system's programming assignments to investigate the kernel interface, files, processes, and inter-process communication for a current operating system.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 OF B.Sc. (COMPUTER ENGINEERING)

SEMESTER 1

Module Title	SOCIETY AND THE ENGINEER
Code	TEGT3821
NQF Level	8
Contact Hours	2L /Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2hour paper)
Pre-requisites	TEGT3421 Fundamentals of Engineering

Module Description: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **Labour laws**. Trade Union laws. HIV/AIDS education and its impact on the workforce. **Intellectual property rights.**

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

- Demonstrate an understanding of Professional ethics, including Registration of Engineers, Societies for Professional Engineers, Engineer-society relationship and the engineer and the environment.
- Apply Engineering Professional practice and uphold standards.
- Apply Safety and health regulations at the work place, including Safety and health legislation.
- Apply Labour laws including Trade Union laws, HIV/AIDS education and its impact on the workforce.
- Demonstrate knowledge about compliance of Intellectual property rights.

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER NETWORK MANAGEMENT SYSTEMS
Code	TCME3811
NQF Level	8
Contact Hours	4L + 1PS/Week
Credits	16
Module Assessment:	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisite	TETE3782 Embedded Systems
Pre-requisite	TCME3722 Computer Networks

Module Description: Introduction to current networking methodologies. Backbone design, layered architecture, protocols, local and wide area networks, internetworking, broadband, electrical interface, and data transmission. Simulation projects are included. Topics include: network management systems and architectures; network management protocols and standards; management of information bases. Examples are drawn primarily from the Internet (e.g., SNMP).

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

- Identify current networking methodologies.
- Use Backbone design, layered architecture, and protocols in local and wide area networks.
- Identify and use internetworking, broadband, electrical interface, and data transmission concepts.
- Apply management principles to network systems and architectures
- Apply network management protocols and standards including management of information bases.

Issue Date: January 2009
Next Revision: January 2013

Module Title	PROJECT MANAGEMENT FOR ENGINEERS
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPILER CONSTRUCTION
Code	TCME3821
NQF Level	8
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment:	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TCME3641 Computer Organisation and Assembly Language

Module Description: Syntax analysis and semantic processing for a block-structured language. Compilation vs. interpretation; lexical analysis based on finite automata; syntax-directed translation; symbol tables; run-time storage allocation; error detection and recovery; code generation and optimization. Students are required to write a compiler.

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

- Analyse Syntax and perform semantic processing for a block-structured language.
- Compare Compilation vs. Interpretation including lexical analysis based on finite automata; syntax-directed translation; symbol tables; run-time storage allocation; error detection and recovery; code generation and optimization.
- Design and write a compiler.

Issue Date: January 2009
Next Revision: January 2013

Module Title	DIGITAL IMAGE PROCESSING
Code	TCME3841
NQF Level	8
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment:	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3622 Data Structures and Algorithms

Module Description: Techniques of digital image processing are introduced. Topics include basic colour, image perception and transformation, image enhancement and compression, and image analysis, and computer vision, human vision models, 2-D sampling and quantization, image transforms, image enhancements, colour image processing, image restoration, image and video compression, image segmentation by thresholding and region analysis, texture analysis, boundary descriptions, morphological methods, image processing system architecture.

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

- Describe digital image processing techniques.
- Demonstrate basic colour, image perception and transformation, image enhancement and image analysis, computer vision, human vision models, 2-D sampling and quantization, image transforms, image enhancements, colour image processing and image restoration.
- Apply image and video compression techniques including image segmentation by thresholding and region analysis, texture analysis, boundary descriptions, morphological methods and image processing system architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ARTIFICIAL INTELLIGENCE
Code	TCME3861
NQF Level	8
Contact Hours	2L + 1PS /Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3622 Data Structures and Algorithms

Module Description: Philosophy of artificial intelligence. AI programs and languages, representations and descriptions, exploiting constraints. Rule-based and heuristic systems. Applications to engineering. Study of intelligent machines and machine learning. Includes problem solving and heuristic search, natural language understanding, game playing, database and expert systems. Artificial Intelligence projects will be implemented using an AI language such as LISP, Prolog, C++ or Ada.

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

- Identify the philosophy of artificial intelligence.
- Apply AI programs and languages, representations and descriptions, exploiting constraints, and Rule-based and heuristic systems to engineering.
- Implement intelligent machines and machine learning including problem solving and heuristic search, natural language understanding, game playing, database and expert systems.
- Use an AI language such as LISP, Prolog, C++ or Ada.

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER SYSTEMS PERFORMANCE
Code	TCME3881
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Module Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TCME3782 Embedded Systems, TCME3622 Data Structure and Algorithms

Module Description: Development of broad working knowledge of probability, petri net, Asynchronization parallelism: Structure & communication & problems of MIMD System, Synchronous Parallelism: Structure & communication &problems of SIMD System, computer systems simulation, and empirical analysis techniques as applied to computer systems modelling. This course is oriented toward a practical application of theory and concepts to computer systems hardware and software performance.

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

- Apply principles Asynchronous Parallelism and Synchronous Parallelism, computer systems simulation, and empirical analysis techniques as applied to computer systems modelling.
- Apply the theory and concepts to computer systems hardware and software performance.

Issue Date: January 2009
Next Revision: January 2013

Module Title	CONTROL THEORY
Code	TCME3851
NQF Level	8
Contact Hours	4L + 2T/Week
Credits	16
Module Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TEGT3671 Engineering Mathematics III

Module Description: Classical control of single-input single-output systems. Both time domain and frequency domain analysis and design techniques are presented. Subjects included are signal flowgraphs, control devices, electrical motors, root-locus, Bodé plots, stability, Routh-Hurwitz criterion, Nyquist stability, phase lead/lag controllers and PID controllers.
Introduces control of discrete systems, modern control theory, and nonlinear control. Concepts of discrete systems, state variables, observability, controllability, phase plane and describing functions method are surveyed.

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

- Control single-input single-output systems.
- Use both time domain and frequency domain analysis and design techniques in Control environment.
- Evaluate control of discrete systems, modern control theory, and nonlinear control.
- Apply the concepts of discrete systems, state variables, observability, controllability and phase plane to describing functions method.

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	DESIGN PROJECT
Code	TCME3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

Module Title	RESEARCH PROJECT
Code	TCME3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date: January 2009
Next Revision: January 2013

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

L.1. B.Sc. (MINING ENGINEERING) 19BMNE

L.2 AIM

The curriculum for the degree of B.Sc. (Mining Engineering) aims at producing Graduate Engineers with knowledge, skills and abilities in all aspects of mining engineering.

L.3 CURRICULUM STRUCTURE

YEAR 1 OF B.Sc. (MINING ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics* for Physical Sciences *I*	*SPHY3511*	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	*8*	*None*
1	*Contemporary Social Issues*	*UCSI3429*	*4*	*8*	*None*
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics* for Physical Sciences *II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	Introduction to Mining Engineering	TMNE3542	5	8	TEGT3591
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				**92**	

YEAR 2 OF B.Sc. (MINING ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Engineering Thermodynamics I	TMEE3661	6	8	SCHM3572
1	Engineering Materials	TMEE3621	6	8	TEGT3522
1	Fluid Mechanics	TMEE3611	6	16	TEGT3592
1	Computer Aided Drawing	TEGT3661	6	8	TCME3591 TEGT3591
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
Total Credit				**96**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3572
2	Structural Geology	TMNE3622	6	8	TMNE3621
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Electrical Machines & Drives	TETE3622	6	8	TEGT3541
2	Solid Mechanics I	TMEE3642	6	8	TEGT3592
2	Excavation Engineering	TMNE3612	6	16	TMNE3542
2	Strength of Materials	TMEE3622	6	8	TEGT3691
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**76**	

YEAR 3 OF B.Sc. (MINING ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Mining Methods	TMNE3791	7	12	TMNE3621
1	Technical Valuation	TMNE3721	7	8	SSTS3691
1	Mine Transportation Machinery	TMNE3731	7	16	TMNE3542
1	Computer Applications in Mining	TMNE3701	7	8	TEGT3661 TCME3621
1	Ore Body Modelling	TMNE3741	7	8	TCME3621 TMNE3622
1	Mine Graphics and Design	TMNE3761	7	8	TEGT3661
1	Mine Management Principles	TMNE3781	7	8	TEGT3682
1	Surveying for Engineers	TCVE3741	7	8	TEGT3571
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
Total Credit				**84**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Geo-technical Engineering	TCVE3742	7	8	TMNE3621
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Underground Mining	TMNE3712	7	16	TMNE3791
2	Mine Ventilation and Climate Control	TMNE3762	7	8	TMEE3661
2	Ore Dressing and Extractive Metallurgy	TMNE3792	7	12	TMEE3621 TMEE3661
2	Computerized Mine Design	TMNE3742	7	8	TMNE3761 TMNE3741
2	Rock Mechanics	TMNE3722	7	8	TMEE3642 TMNE3622
2	Hydrogeology	TMNE3782	7	8	TMNE3622 TEGT3612
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**80**	

YEAR 4 OF B.Sc. (MINING ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Health, Safety and Mining Environment	TMNE3821	8	8	TMNE3762
1	Coal Mining	TMNE3841	8	8	TMNE3712
1	Surface Mining	TMNE3861	8	8	TMNE3791
1	Rock Engineering	TMNE3881	8	8	TMNE3722
1	Financial Valuation	TMNE3891	8	12	TEGT3682
1	Mine Surveying	TMNE3801	8	16	TCVE3741
Total Credit				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Research Project	TMNE3839	8	24	All 3rd Year Modules
2	Mining Design Project	TMNE3819	8	24	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

L.4. DETAILED COURSE CONTENTS FOR B.Sc. MINING ENGINEERING

YEAR 1 OF B.Sc. MINING ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS I**
Code	TEGT3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	None

Content: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly – reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Content: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. Electrical machines: transformers, DC motors, generators. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS II
Code	TEGT3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Content: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. The iron-iron carbide alloy system: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. Properties of materials: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INTRODUCTION TO MINING ENGINEERING
Code	TMNE3542
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TEGT3591 Engineering Drawing

Content: Minerals and mineral ores. Mineral deposits. The economic significance of the Namibian Mining Industry. **Structure of the Namibian Mining Industry**. Drilling equipment, tunneling, and explosives. Shallow and deep mining. Blasting and loading equipment. **Rock transportation systems and their applications**. Diamond and Gold mining technologies and methods. Extraction and refining of Gold, Copper mining and refining methods; lead mining and processing methods. **Introduction to mine safety**, mine ventilation, strata control. Environmental considerations. Mine visits.

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

- Demonstrate knowledge of the Namibian mining industry and Namibian mineral deposits
- Describe various mining methods and mining equipment
- Describe various mine transportation methods
- Describe methods of extraction and refining of common base metals
- Demonstrate knowledge of mine safety and mine environmental issues

Issue Date: January 2009
Next Revision: January 2013

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 & 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.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 OF B.Sc. (MINING ENGINEERING)

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**INTRODUCTION TO ENGINEERING GEOLOGY**
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Mohr's circle. Thermal stress and strain. Assembly problems. Torsion of circular sections. Combined loading. Introduction to statically indeterminate problems.

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

- Competently express motion of a body in terms of position, velocity and acceleration
- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Analyse stresses and strains in two & three dimensions with cases for plane stress and plane strain
- Apply Hooke's Law for normal and shear stresses
- Analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING THERMODYNAMICS I
Code	TMEE3661
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	SCHM3512 Chemistry 1B

Contents: Definitions; system, process, state, property of a system, cycle, pressure, volume, temperature, work, heat. **First law of thermodynamics**: internal energy; non-flow energy equation; energy equation and reversibility. Application of first law to non-flow processes; constant volume, constant pressure, polytrophic, adiabatic and isothermal processes. **Application of first law to flow processes;** continuity equation, application to boilers, condensers, turbines, compressors, nozzles, diffusers and throttling devices. **Second law of thermodynamics**: concept of the heat engine; cycle efficiency; Reversibility and irreversibility. Engine efficiency. The Carnot cycle. Absolute temperature scale. Entropy; determination and property diagrams. **Working fluids:** properties of fluids and vapours; thermodynamic properties of steam; properties diagrams. Avogadro's law, the equation of state of a perfect gas, specific heats and non-flow gas processes.

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

- Describe the first law of thermodynamics and its applications to non-flow and flow processes
- Describe the second law of thermodynamics and its applications to the heat engine, the Carnot cycle and entropy.
- Describe and quantify the properties of working fluids
- Interpret and use thermodynamic property diagrams
- Describe the equation of state of a perfect gas

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING MATERIALS
Code	TMEE3621
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite	TEGT3522 Materials Science

Content: Classification of steels and cast irons: plain carbon, alloy and stainless steels. Grey, nodular and austempered ductile cast irons. **Technical heat treatment of steels**: annealing, normalizing, quench hardening, tempering, hardenability. Other strengthening methods: solid solution hardening, strain hardening, cold working, precipitation-hardening, **Non-ferrous alloys**: copper, aluminium, titanium, nickel and their alloys. **Non-metallic materials:** engineering polymers and plastics, composites, introduction to ceramics.

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

- Distinguish between various classes of steels and cast irons and their uses
- Demonstrate the various techniques used to harden and strengthen metallic materials
- Describe the characteristics and uses of non-ferrous metals and alloys based on aluminium, copper and titanium.
- Describe the characteristics and uses of non-metallic materials such as plastics, composites and ceramics.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FLUID MECHANICS
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	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; elementary analysis of fluid machinery; interaction of pump in system; pipe networks (simple branching circuits, single node reservoir systems, Hardy Cross method for pipe reticulation systems). **Laminar viscous flow**: Differential equations of motion; torsional viscometer; applications (flow with pressure gradient between parallel plate, pipe and channel flows, damper systems).

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisite	TCME3591 Computing Fundamentals

Content: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Problem solving and algorithms using **C++.** Programming in **C++. Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming exercises.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Write a computer program using C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Contents: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**ENGINEERING MATHEMATICS IV**
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Contents: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**STRUCTURAL GEOLOGY**
Code	TMNE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite	TMNE3621 Introduction to Engineering Geology

Content: 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.

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

- Describe processes leading to the formation of folds and faults
- Describe ore forming processes and the classification of ore deposits
- Demonstrate knowledge of the world's major ore deposits
- Demonstrate knowledge of African geology
- Interpret geological maps

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ECONOMICS FOR ENGINEERS
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of marketing

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ELECTRICAL MACHINES AND DRIVES
Code	TETE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3541 Fundamentals of Electrical Engineering

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Statics: Properties of three-dimensional force systems. Equilibrium of rigid bodies subjected to two- and three- dimensional force systems. Application of principles of rigid body equilibrium to trusses, frames, and machines. Introduction to the method of virtual work for equilibrium and stability analysis of interconnected systems. **Mechanics of Solids**: Second moment of area. Normal and shear stress and strain. Statically indeterminate problems. Geometric compatibility. Thermal and assembly stresses. Torsion of shafts. Bending of beams. Combined bending and direct stresses. Bending and torsional stresses. Transformation of stresses and strains. Mohr's circle.

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

- Analyse equilibrium of rigid bodies subjected to two and three dimensional force systems
- Describe the principles of rigid body equilibrium to trusses, frames and machines
- Apply the method of virtual work for equilibrium and stability analysis
- Apply properties of areas in solving mechanics problems
- Analyse statically determinate and statically indeterminate problems
- Analyse thermal and assembly stresses and incorporate them in stress analysis
- Analyse stresses and strains under torsion, bending and combined bending and torsion
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle

Issue Date: January 2009
Next Revision: January 2013

Module Title:	EXCAVATION ENGINEERING
Code	TMNE3612
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TMNE3542 Introduction to Mining Engineering

Content: Powering systems: Fundamentals of powering systems for machines: electrical, pneumatic, hydropower and hydraulic (mineral oil and emulsion systems). **Mechanical Excavation:** Mechanics of cutting with picks, discs, toothed roller cutters, button cutters. Application in terms of machine design and operation to coal cutters, continuous miners, longwall drum shearers, tunnel and shaft borers, rotary drilling. **Mechanics of impact breaking.** Application in terms of machine design, operation and impact breaking machines for hard rock tabular mining.

Rock drilling and explosives: Principles of rock drilling, percussive drilling, rotary drilling, drilling machines and consumables, drilling cost. History, classification and composition of explosives, chemical and physical characteristics, fundamental chemical calculations, mechanics of detonation, hydrodynamic theory of detonation, ideal and non-ideal detonation, theory of initiation. **Rock breaking and blasting applications**: Mechanism of rock breaking: propagation of shock waves in solid medium, interaction of compressive waves from free face, mechanics of breaking rock, crack propagation, interaction of cracks, current research. **Underground blasting:** Stoping practice, sequential firing, ring blasting, development and shaft sinking. **Surface mining blasting:** practical applications: bench blasting, initiation patterns, drilling patterns, ground vibrations and air blast.

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

- Describe various powering systems used in the mining industry
- Describe the various techniques of mechanical excavation of rock and earth matter
- Demonstrate knowledge of the mechanics of impact breaking of solid materials
- Demonstrate knowledge of rock drilling and use of explosives in mining
- Describe various rock breaking and blasting techniques
- Demonstrate knowledge of blasting techniques for underground and surface mining

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3691 Engineering Mechanics II

Content: Analysis of stress and strain, Revision of Mohr's circle, Theories of failure. Torsion: Solid non-circular shafts, Thin-walled tubes, Residual stresses. Bending: Unsymmetrical bending, Inelastic Bending, Residual Stresses. Transverse Shear: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **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.

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

- Apply mathematical and graphical methods (Mohr's circle) to analyse stresses and strains and their applications to torsion, bending and shear
- Analyse deflection of beams using integration, discontinuity functions and method of superposition.
- Apply energy methods in stress and strain analysis, deflection and impact loading
- Describe and apply Castigliano's theorem to engineering situations

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 OF B.Sc. (MINING ENGINEERING)

SEMESTER 1

Module Title	**MINING METHODS**
Code	TMNE3791
NQF Level	7
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Pre-requisite	TMNE3621 Introduction to Engineering Geology

Content: Primary access to underground workings through shafts: adits and inclines; shaft sinking through consolidated and unconsolidated ground; large excavations (hoist chambers, pump chambers); raise boring and tunnel boring. **Tabular mining methods**: primary and secondary developments and panel layout in coal mines. Introduction to coal mining methods and equipment. **Access to reef deposits**: primary and secondary developments (haulages, raises, winzes and ore passes); slope design. Introduction to reef mining methods and equipment. **Massive mining methods**: access to massive orebody mining methods and equipment. Access to surface orebodies. Vegetation removal; topsoil and subsoil removal and storage. Haul access and initial box cuts. **Introduction to open-pit and strip mining methods**.

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

- Demonstrate an understanding of techniques for primary access
- Demonstrate an understanding of the principles and application of major underground mining methods,
- Describe techniques for open pit and strip mining methods

Issue Date: January 2009
Next Revision: January 2013

Module Title	**TECHNICAL VALUATION**
Code	TMNE3721
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Statistical valuation methods: Overview of descriptive statistics; inference from normal distributions, estimation of mean and standard deviation, confidence levels on parameters, hypothesis testing. Student's T and F-ratio's tests, correlation and regression methods, tests of significance, multivariate regression and trend surface analysis, inference from lognormal distributions, estimation of mean and confidence levels. Grade/tonnage curves. **Geo-statistical valuation methods**: inverse distance techniques, calculation and modelling of semi-variograms, estimation of unknown values, ordinary and universal rigging, volume/variance relationships. **Geo-statistical applications**: valuation and mine economics; mine process flow; mining factors; economic effects of dilution and recovery; SAMREC code; reporting of resources and reserves; paylimits; economic and planning cut-off grades; grade control.

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

- Demonstrate an understanding of statistical valuation methods and how to apply them
- Demonstrate an understanding of the various methods of geo-statistical valuation in the mining context
- Apply geo-statistical methods in the valuation of mines

Issue Date: January 2009
Next Revision: January 2013

Module Title	**MINE TRANSPORTATION MACHINERY**
Code	TMNE3731
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Pre-requisite:	TMNE3542 Introduction to Mining Engineering

Module Description: 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 handing**: (a) Conveyor systems: conventional, cable belt, Japan pipe conveyor, high angle conveyors, calculation of power requirements and carrying capacity of belts. (b) Chairlifts. (c) Underground scraper winch systems. (d) Railway tramming systems for rock, men and material. (e) Loading machines: rope shovels, hydraulic mining shovels, front end loaders, trackless load haul dump units. **Selected topics**: (a) Off highway haul trucks and traceless haul trucks. (b) Mine water distribution service, collection, treatment, storage and pumping. (c) Pneumatic conveying of solids in pipelines.

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

- Demonstrate an understanding and knowledge of modern mining machinery and mine handling system
- Design and select appropriate underground mining machinery equipments and systems for loading and hauling
- Analyze and control haulage operations (belt conveyors, hoists, trucks, railways)
- Describe fluid power systems in mining (hydraulics, pumps, piping networks, compressors, pneumatic equipment).
- Describe electrical systems (electrical machinery, distribution networks, controls) as used in mining operations
- Describe the principles of materials handling and power system consideration and performance

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER APPLICATIONS IN MINING
Code	TMNE3701
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TEGT3661 Computer Aided Drawing; TCME3621 Computer Science for Engineers

Description: This course builds on the basic computing skills learnt in Computer Aided Drawing and extends to the use of these skills in applications relevant to Mining Engineering. Topics covered include applications of GIS software, Contouring packages, CAD packages, MATLAB applications in mining and mine design packages. A mini project on an approved topic will be included.

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

- Demonstrate application of Computer Aided Drawing in the mining industry
- Demonstrate knowledge of GIS, Contouring packages and MATLAB in the mining industry
- Demonstrate knowledge of computer applications for mine design

Issue Date: January 2009
Next Revision: January 2013

Module Title	ORE BODY MODELLING
Code	TMNE3741
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	TCME3621 Computer Science for Engineers; TMNE3622 Structural Geology

Module Description: Representation of deposits and excavations by plans, sections and isometric drawings. Practical and theoretical methods of exploring ore deposits and evaluating ore deposits. Ore body modelling and its role in mineral deposit evaluation and exploitation. Practical exercises on ore body modelling.

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

- Describe the practical and theoretical techniques for the gathering, compilation, synthesis and presentation of mine geological data
- Demonstrate a thorough understanding of ore body modelling and its applications in mineral deposit evaluation
- Demonstrate practical methods of ore body modelling

Issue Date: January 2009
Next Revision: January 2013

Module Title	MINE GRAPHICS AND DESIGN
Code	TMNE3761
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50%; Examination 50% (1 x 2hours paper
Pre-requisite:	TEGT3661 Computer Aided Drawing

Contents: 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. The plane-meter and areas. **Interpretation of maps and plans**. Applications to specific mine design problems. Introduction to computer-aided drafting, design and cartography.

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

- Demonstrate knowledge of producing and analysing plans, maps and photographs of mines
- Demonstrate knowledge of interpreting map projections, geometrical constructions and diagonal scales
- Demonstrate ability to work with rectangular and polar coordinates for contours and cartographic sections
- Analyse and interpret maps and plan with their applications in mine design
- Apply computer aided drafting and design techniques in the mining context.

Issue Date: January 2009
Next Revision: January 2013

Module Title	MINE MANAGEMENT PRINCIPLES
Code	**T**MNE3781
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2hours paper
Pre-requisite:	TEGT3682 Economics for Engineers

Content: Management Principles: History of management theory; managerial conceptual thinking; management work within the business; organizing and determinants of organization; planning, controlling, leading, daily 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.

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

- Demonstrate knowledge of general management principles
- Describe techniques of time management
- Demonstrate knowledge of industrial relations and legislation pertaining to the mining industry.
- Describe principles and functions of risk management
- Demonstrate knowledge of the Mine Health and Safety Act.

Issue Date: January 2009
Next Revision: January 2013

Module Title	SURVEYING FOR ENGINEERS
Code	TCVE3741
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2hours paper
Pre-requisite:	TEGT3571 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)

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	GEOTECHNICAL ENGINEERING
Code	TCVE3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENTREPRENEURSHIP
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	UNDERGROUND MINING
Code	TMNE3712
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Co-requisite:	TMNE3791 Mining Methods

Contents: Historical and present-day methods of exploitation of hard rock deep tabular orebodies; selection of a mining technique; sitting of shafts; pillar extraction; mine design parameters; shaft sinking; shaft station layouts; shaft safety; major development layout; level and raise spacing, boxholes; conventional and specialised development. **Mechanization of operations and special technologies**. Design: practical design exercises for exploiting tabular ore deposits. **Exploitation of massive orebodies**: open stoping, room and pillar mining, cut and fill stoping, shrinkage mining, post pillar cut and fill mining, block caving, continuous block caving, forced caving, sublevel caving, sundry mining methods. **Trackless mining**: selection and operation of underground trackless equipment for massive mining. Practical design exercise.

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

- Design and select mining methods and specify parameters for safe underground extraction
- Describe different design techniques and mechanical technologies used in massive mining
- Demonstrate an understanding of the mining systems dealt with and factors to take into account in order to provide a safe working environment.

Issue Date: January 2009
9Next Revision: January 2013

Module Title	MINE VENTILATION AND CLIMATE CONTROL
Code	TMNE3762
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	TMEE3661 Engineering Thermodynamics I

Contents: Ventilation: air availability in mines, presence of other gases, mechanics of fluids, Bernoulli equation, airflow in airways, ventilation networks, regulators, booster fans, fan characteristics, fans in series and parallel, ventilation software. **Deep level mining climate control**: Psychrometry, heat, acclimatization, refrigeration, cooling plant, cooling towers, spray chambers, ice plant. **Typical ventilation systems** in a coal mine, gold mine and uranium mine.

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

- Describe and apply the principles of fluid flow to ventilation systems.
- Describe and apply fan behaviour to ventilation systems.
- Design a ventilation system for a mine.
- Describe environmental hazards found in mines and outline the control measures that detect, monitor, minimise and/or manage these hazards.
- Describe typical ventilation systems in selected mines such as coal, gold and uranium mines.

Issue Date: January 2009
9Next Revision: January 2013

Module Title	ORE DRESSING AND EXTRACTIVE METALLURGY
Code	TMNE3792
NQF Level	7
Contact Hours	**3**L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper
Pre-requisite:	TMEE3621 Engineering Materials; TMEE3661 Engineering Thermodynamics I

Module Description: Ore dressing: basic principles of crushing, grinding, screening, classification, gravity concentration, magnetic and electrostatic separation, floatation, sedimentation, thickening and filtration. **Coal preparation**: coal processing principles and technology of coal usage after mining. **Hydrometallurgy**: basic principles of main unit operations such as leaching, heap leaching, solvent extraction, ion exchange and electro-winning refining. Industrial metal extraction process such as for gold, copper, uranium, zinc, etc. **Pyrometallurgy**: roasting and calcinations of concentrates; smelting, converting. Industrial metal extraction process for copper, lead, zinc, iron. Steel making processes.

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

- Demonstrate an understanding of the basic principles of ore dressing technologies
- Describe coal processing principles and its associated technologies
- Describe the principles of hydro-metallurgy as applied to extraction of gold, copper, uranium and zinc
- Demonstrate an understanding of pyro-metallurgy as applied to the extraction of copper, lead, zinc and iron
- Demonstrate a thorough understanding of steel making processes

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTERIZED MINE DESIGN
Code	TMNE3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Co-requisite:	TMNE3741 Ore Body Modelling; TMNE3761 Mine Graphics and Design

Content: Introduction to data processing, including the design of databases. Computer Aided Design (CAD) techniques. Graphical systems and spread sheet systems. **Geological modelling** of ore bodies, geo-statistical evaluation packages. **Design of access systems**, mining methods and production scheduling. Capture of production data for management and control purposes.

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

- Describe data processing techniques and design of databases
- Apply computer aided design software to the design of mines
- Demonstrate knowledge of the geological modelling of ore bodies
- Design access systems
- Describe techniques for capture of production data for management and control of mines

Issue Date: January 2009
Next Revision: January 2013

Module Title	ROCK MECHANICS
Code	TMNE3722
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	TMEE3642 Solid Mechanics I, TMNE3622 Structural Geology

Module Description: 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.

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

- Perform two dimensional analysis of stresses and strains on rocks using linear elasticity and extend these to three-dimensional elasticity
- Demonstrate knowledge of the strength and deformation characteristics of rock masses
- Describe useful mechanical properties of rock masses
- Describe failure criteria for rocks and rock masses

Issue Date: January 2009
Next Revision: January 2013

Module Title	HYDROGEOLOGY
Code:	TMNE3782
NQF Level:	7
Contact Hours:	2L + 1T/week
Credits:	8
Assessment:	Continuous 50%; Examination50%; (1x3hours paper)
Pre-requisites:	TMNE3622 Structural Geology, TEGT3612 Engineering Mathematics IV

Contents: Groundwater flow equations and flow net analysis: piezometer, piezometer nests and potentiometric surface map; regional groundwater flow systems; ground recharge mechanisms and estimation techniques. **Aquifer Hydraulics:** Theis equation; computing drawdown; aquifer parameters from time-drawdown data; slug tests; intersecting pumping cones and well interference; effect of hydro geologic boundaries; aquifer test design; well loss; well efficiency; well specific capacity & optimum pumping rates; solute transport in aquifers: diffusion; advection; dispersion; retardation; sorption reactions; redox reactions; cation exchange; carbonate dissolution & precipitation reactions. **The advection-dispersion equation**; mass transport with reaction; first order kinetic reactions; equilibrium sorption reactions. **Groundwater flow modelling**: types of groundwater flow models; governing equations; numerical and analytical techniques; conceptual model design; boundary conditions; initial conditions; steady state and transient simulations; model calibration; sensitivity analysis; predictive modelling; finite difference and finite element models; different types of computer codes. **Contaminant hydrogeology**: contaminant plumes; fluid tracer tests; multiphase fluid systems. **Groundwater and ore deposits**: roll-front uranium deposits; saline soils and evaporates; groundwater exploration and management; groundwater resource evaluation and budgets; conjunctive use of groundwater and surface water; groundwater pollution processes.

Exit Learning Outcomes: Upon completion of this module, the student will be able to:

- Demonstrate understand of the mechanics of groundwater recharge and its analysis.
- Describe the theory of aquifer hydraulics and be able to model underground aquifers and evaluate them.
- Describe reactions governing underground solutions
- Describe the effect of groundwater and its pumping on underground openings.
- Design pumping systems and sequences for underground mining purposes.
- Demonstrate methods of controlling and predicting contamination levels of underground water by minerals and other solutions.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3600 Industrial Attachment I

Description: 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 OF B.Sc. (MINING ENGINEERING)

SEMESTER 1

Module Title:	**SOCIETY AND THE ENGINEER**
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

Contents: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **Labour laws**. Trade Union laws. HIV/AIDS education and its impact on the workforce. **Intellectual property rights.**

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**PROJECT MANAGEMENT FOR ENGINEERS**
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**HEALTH, SAFETY AND MINING ENVIRONMENT**
Code	TMNE3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TMNE3762 Mine Ventilation and Climate Control

Contents: Mine Safety: Safety organization in mines; first aid; accident statistics and records keeping; industrial hygiene; analysis of health and safety problems in the Namibian mining industry. **Mine environment**: Mine dust, mine gases, mine fires, mine water, noise, illumination, mine air, radioactive and toxic substances. Health, safety and environmental issues in the mining of radioactive substances like uranium. **Mine Communication. Mine Law**: Mining and the environment; mining legislation; mineral rights. **Environmental Issues**: Environmental Impact Assessment (EIA); pollution control; rehabilitation, mine closure. **Case Studies**: Typical case studies on health and safety problems in mines.

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

- Demonstrate knowledge of safety and health issues at the mine and how to control them
- Demonstrate knowledge of environmental issues of mining projects and how to control them
- Describe various techniques used in mine communication
- Demonstrate knowledge of legal aspects of mining, the environment, mineral rights and the general mine law
- Describe procedures for carrying out environmental impact assessment (EIA) of mine projects

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COAL MINING
Code	TMNE3841
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite:	TMNE3712 Underground Mining;

Contents: Coal mining methods: the safe and efficient exploitation of underground coal deposits by means of board and pillar, pillar extraction, rib-pillar, short wall, long wall and specialized thick- and thin-seam techniques. **Coal mining equipment**, panel design and production potential. **Coal as a commodity**: coal quality, coal utilization and marketing. **Design**: geological modelling of a coal deposit from borehole longs, market identification, plant design, mine design, layout scheduling and financial valuation of a coal mine.

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

- Describe the mineralogical properties of coal; exploration strategy and mining systems for coal
- Select appropriate coal mining equipment; plan mine layouts and describe coal treatment
- Use appreciate computer software for geological modelling of coal deposits
- Design a coal plant and a coal mine and carry out scheduling and financial valuation

Issue Date: January 2009
Next Revision: January 2013

Module Title:	SURFACE MINING
Code	TMNE3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite:	TMNE3791 Mining Methods

Contents: Open pit design; slope stability in relation to design; haul road design; economics and stripping ratios; economic cut-offs; pit optimization. **Strip mining of coal**; strip mine design and planning; economics of strip mining; environmental considerations; dragline operations; range diagrams. **Marine mining**; dredging; mechanized earth- moving; hydraulic mining; equipment selection; power systems; matching and fleet optimization; economic considerations of equipment selection & purchase; type life; cycle times. Practical exercise.

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

- Demonstrate a clear understanding of surface mining technologies (open pit) and their design and operations
- Design layouts for strip mining of coal and include important economical and environmental considerations
- Describe the technology for marine mining and include important economical and environmental considerations

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ROCK ENGINEERING
Code	TMNE3881
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite:	TMNE3722 Rock Mechanics

Contents: Introduction and theoretical considerations: The design process, relationship with Code of Practice to combat rock burst and rock fall accidents, behaviour of rocks and rock masses, continuum behaviour, behaviour of beams, discontinium behaviour, stability of slopes in open pit mines and quarries. Applications considerations: **Behaviour of jointed rock masses**, rock mass classification, methods of improving stability, support of mining excavations including pillar and installed support design, shafts and their protection, rock bursts, rock falls, probability and risk. **Mine Tour**: visits to mines and mining-related institutions.

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

- Describe developments in modern rock engineering practice with respect to mine design
- Assess the significance of rock strength and joined rock masses in mine design
- Evaluate rock engineering conditions for selection of appropriate design criteria and factors of safety
- Apply modern rock engineering software for mine design incorporating rock engineering processes.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FINANCIAL VALUATION
Code	TMNE3891
NQF Level	8
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

Contents: 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: economic analysis, financial analysis, intangible analysis, risk assessment and risk management.

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

- Demonstrate an understanding of financial management and financial analysis principles
- Describe various funding sources and funding mechanisms for mines
- Describe current trends in the metals and minerals markets
- Demonstrate a clear understanding of the applications of financial analysis in mining project
- Apply financial analysis in the decision making process

Issue Date: January 2009
Next Revision: January 2013

Module Title:	MINE SURVEYING
Code	TMNE3801
NQF Level	8
Contact Hours	2L + 1T or 1 PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TCVE3741 Surveying for Engineers

Contents: Theory: introduction to the importance of mine surveying in the efficient and safe running of a mine; understanding map projections, developable surfaces and distortions; principles of surveying and mine surveying; transfer of surface surveys to the underground environment; underground mine surveying methods, application to mine planning, design and safety; surveying legal requirements and their application to the mining industry; mathematical and surveying principles for solving three dimensional mine design problems; interpretation of mine surveying results for improved decision making. **Practical**: distance measurement, measuring errors; levelling traversing (with tapes & total stations); vertical surveys; care of surveying equipment; using a gyro-theodolite to determine azimuth; GPS instruments; observations and producing mine surveying records in terms of the mining laws.

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

- Describe principles of surveying as applied to mines
- Demonstrate detailed knowledge of underground mine surveying methods
- Analyse and interpret mine surveying data for decision making
- Demonstrate practical knowledge of surveying in the field
- Analyse map projections and interpret mine surveying data
- Use GPS instruments for mine survey purposes.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT III
Code	TEGT3800
NQF Level	8
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3700 Industrial Attachment II

Description: During Industrial Attachment III, students will work under company supervision at the level of Engineer 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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**RESEARCH PROJECT**
Code	TMNE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**MINING DESIGN PROJECT**
Code	TMNE3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

M. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING

M.1. B.Sc. (CIVIL ENGINEERING) 19BCVE

M. 2 AIM

The curriculum for the degree of B.Sc. (Civil Engineering) aims at producing Graduate Engineers with knowledge, skills and abilities in civil engineering and who can competently work in design, structural analysis, construction management and water systems engineering.

M. 3 CURRICULUM STRUCTURE

YEAR 1 OF B.Sc. (CIVIL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	*8*	*None*
1	*Contemporary Social Issues*	*UCSI3429*	*4*	*8*	*None*
Total Credit				***84***	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**CREDITS**	**PRE & COREQUISITE**
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	Introduction to Civil Engineering	TCVE3542	5	8	TEGT3591
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				**92**	

NB: Students who have done UCSI3429, ULEA3419, TEGT3421, SPHY3571, SPHY3572 and SCHM3572 will be exempted from taking them in this year.

YEAR 2 OF B.Sc. (CIVIL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Engineering Mathematics III	TEGT3671	6	16	TEGT3572
1	Introduction to Engineering Geology	TMNE3621	6	8	None
1	Engineering Mechanics II	TEGT3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Building Materials I	TCVE3621	6	8	TEGT3522
1	Fluid Mechanics	TMEE3611	6	16	TEGT3592
1	Computer Aided Drawing	TEGT3661	6	8	TCME3591 TEGT3591
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
Total Credit				**88**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
2	Engineering Mathematics IV	TEGT3672	6	16	TEGT3572
2	Introduction to Environmental Science	TCVE3662	6	8	TCVE3542
2	Civil Engineering Planning & Design Methodology	TCVE3682	6	8	TCVE3542
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Computer Applications in Civil Engineering	TCVE3692	6	12	TCME3591
2	Solid Mechanics I	TMEE3642	6	8	TEGT3592
2	Strength of Materials	TMEE3622	6	8	TEGT3691
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**72**	

YEAR 3 OF B.Sc. (CIVIL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Hydrology	TCVE3781	7	8	TMNE3621
1	Hydraulics I	TCVE3731	7	16	TEGT3691
1	Theory of Structures	TCVE3771	7	16	TMEE3622
1	Building Materials II	TCVE3721	7	8	TCVE3621
1	Construction Methods and Management	TCVE3791	7	12	TCVE3621 TEGT3682
1	Finite Element Methods	TCVE3761	7	8	TCVE3771
1	Surveying for Engineers	TCVE3741	7	8	TEGT3571
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
Total Credit				**84**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**CREDITS**	**PRE & COREQUISITE**
2	Water Supply	TCVE3722	7	8	TCVE3731
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Hydraulics II	TCVE3782	7	8	TCVE3731
2	Infrastructure Planning	TCVE3762	7	8	TCVE3682
2	Geo-Technical Engineering	TCVE3742	7	8	TMNE3621
2	Reinforced and Pre-stressed Concrete Design	TCVE3772	7	16	TCVE3771
2	Design of Steel & Timber Structures	TCVE3792	7	12	TCVE3771
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**72**	

YEAR 4 OF B.Sc. (CIVIL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE & COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Transport Engineering	TCVE3841	8	8	TCVE3771
1	Design of Buildings	TCVE3811	8	16	TCVE3792
1	Contract Management and Laws of Contract	TCVE3821	8	8	TCVE3791
1	Water Quality Management	TCVE3861	8	8	TCVE3781
1	Engineering Geology	TCVE3881	8	8	TCVE3742
1	Public Health Engineering	TCVE3831	8	16	TCVE3782
Total Credit				**80**	
SEMESTER	**MODULE**	**CODE**	**NQF LEVEL**	**CREDITS**	**PRE & COREQUISITE**
2	Research Project	TCVE3839	8	24	All 3rd Year Modules
2	Civil Engineering Design Project	TCVE3819	8	24	All 3rd Year Modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

4 DETAILED COURSE CONTENTS

YEAR 1 OF B.Sc. CIVIL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS I**
Code	TEGT3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	None

Content: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENGINEERING DRAWING**
Code	TEGT3591
NQF Level	5
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly – reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ELECTRICAL ENGINEERING
Code	TEGT3541
NQF Level	5
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	None

Content: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. Electrical machines: transformers, DC motors, generators. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS II
Code	TEGT3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT3571 Engineering Mathematics I

Content: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. The iron-iron carbide alloy system: Steel-portion of the $Fe\text{-}Fe_3C$ system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. Properties of materials: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INTRODUCTION TO CIVIL ENGINEERING
Code	TCVE3542
NQF Level	5
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Co-requisites	TEGT3591 Engineering Drawing

Content: Civil engineering and physical infrastructure: Introduction to common infrastructure services in Namibia: water engineering(resources, treatment, supply and solid waste management); hydrology; transportation related engineering(surface, rail, air and sea); building design and construction management; urban and built environment; soil-mechanics; surveying; quantity surveying. **Appropriate construction technologies and employment creation:** Impact of the supply of civil engineering services on the national economy. Environmental engineering and public health. Types, sources and uses of building materials. Indigenous construction technologies. **Civil engineering standards and practices in Namibia**: Building materials design properties: physical; mechanical; acoustics; thermal; electrical conductivity; optical. Concepts: energy efficiency and energy saving designs. Maintenance and safety concepts. Social beneficiation. Value principles which underpin civil engineering product design: health; safety; comfort; security; and aesthetics. **Principles of stress and strain applied to civil engineering design**: Design exercises to choose materials with properties to satisfy specified beneficiation value. Design processes in civil engineering industries.

Issue Date: January 2009
Next Revision: January 2013

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
Equivalent to:	SCHM3512 Chemistry 1B

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

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 OF B.Sc. CIVIL ENGINEERING

SEMESTER 1

Module Title:	**ENGINEERING MATHEMATICS III**
Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**INTRODUCTION TO ENGINEERING GEOLOGY**
Code	TMNE3621
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING MECHANICS II
Code	TEGT3691
NQF Level	6
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Mohr's circle. Thermal stress and strain. Assembly problems. Torsion of circular sections. Combined loading. Introduction to statically indeterminate problems.

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

- Competently express motion of a body in terms of position, velocity and acceleration
- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Analyse stresses and strains in two & three dimensions with cases for plane stress and plane strain
- Apply Hooke's Law for normal and shear stresses
- Analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER SCIENCE FOR ENGINEERS
Code	TCME3621
NQF Level	6
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites	TCME3591 Computing Fundamentals

Content: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Problem solving and algorithms using **C++.** Programming in **C++. Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming exercises.

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Write a computer program using C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	BUILDING MATERIALS I
Code	TCVE3621
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisite	TEGT3522 Materials Science

Content: Overview of properties of engineering materials. **Concrete:** Composition and production of concrete, hydraulic binders. Aggregates used in concrete mix. Composition dosage. Concrete adjuvants. Properties of fresh concrete. Preparation, treatment and pouring of concrete. Concrete testing. Grades of concrete. Concrete for special applications. **Steels:** Properties of carbon steel; selection and testing of structural steels. Steels for concrete reinforcement.

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

- Distinguish between various properties of materials
- Describe the composition and characteristics of concrete and aggregates
- Illustrate various concrete testing techniques
- Describe the characteristics and uses of carbon steels as used in civil engineering

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FLUID MECHANICS
Code	TMEE3611
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite	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; elementary analysis of fluid machinery; interaction of pump in system; pipe networks (simple branching circuits, single node reservoir systems, Hardy Cross method for pipe reticulation systems). **Laminar viscous flow**: Differential equations of motion; torsional viscometer; applications (flow with pressure gradient between parallel plate, pipe and channel flows, damper systems).

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING
Code	TEGT3522
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisites:	TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STATISTICS FOR ENGINEERS
Code	SSTS3691
NQF Level	6
Contact Hours	**3**L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Contents: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	ENGINEERING MATHEMATICS IV
Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Contents: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INTRODUCTION TO ENVIRONMENTAL SCIENCE
Code	TCVE3662
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TCVE3542 Introduction to Civil Engineering

Content: Environmental science as a discipline: the role of the civil engineers in environmental problem solving; sustainable development; agenda 21 and global environmental issues and problems; our common future growth versus development; population growth dynamics; tragedy of the commons; environmental problems as externalities; government intervention in environmental problem solving; environmental quality criteria and standards; environmental laws and regulations; integrated pollution control and waste management strategy, environmental management. **Environmental impact assessment**; environmental monitoring and auditing; environmental planning; environmental institutions, sources, characteristics and effects of environmental contaminants; environmental pollution and degradation in Southern Africa. **Systems approach to environmental problem solving**: system dynamics and feedback loops; modelling environmental systems using Stella, decision making strategies and the environment.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CIVIL ENGINEERING PLANNING & DESIGN METHODOLOGY
Code	TCVE3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 100%
Co-requisite	TCVE3542 Introduction to Civil Engineering

Content: Civil Engineering drawings: plans, projections, sections and detailing of houses, storey buildings, bridges, storage tanks and other civil engineering structures. Drawings of foundations and roof structures. Interpreting and working with architectural drawings. **The general design process**: creative thinking techniques, engineering methodology; modelling; system analysis; decision-making. **Planning:** scenario planning, task scheduling, multi-tasking, forecasting. Presentation of reports with relevant technical specifications.

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

- Demonstrate knowledge of producing and interpreting civil engineering drawings
- Demonstrate knowledge of interpreting architectural drawings
- Describe the methodology for civil engineering design process
- Demonstrate general knowledge of planning, scheduling and forecasting in executing civil engineering projects
- Present information in the form of technical reports

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ECONOMICS FOR ENGINEERS
Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of marketing

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER APPLICATIONS IN CIVIL ENGINEERING
Code	TCVE3692
NQF Level	6
Contact Hours	3L + 2T or 1PS/Week
Credits	12
Assessment	Continuous 60%, Examination 40% (1x 3 hours paper)
Pre-requisites:	TCME3591 Computing Fundamentals

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

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

- Identify and describe common computer packages used in civil engineering
- Demonstrate a working knowledge of the various computer packages in civil engineering

Issue Date: January 2009
Next Revision: January 2013

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

Content: Statics: Properties of three-dimensional force systems. Equilibrium of rigid bodies subjected to two- and three- dimensional force systems. Application of principles of rigid body equilibrium to trusses, frames, and machines. Introduction to the method of virtual work for equilibrium and stability analysis of interconnected systems. **Mechanics of Solids**: Second moment of area. Normal and shear stress and strain. Statically indeterminate problems. Geometric compatibility. Thermal and assembly stresses. Torsion of shafts. Bending of beams. Combined bending and direct stresses. Bending and torsional stresses. Transformation of stresses and strains. Mohr's circle.

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

- Analyse equilibrium of rigid bodies subjected to two and three dimensional force systems
- Describe the principles of rigid body equilibrium to trusses, frames and machines
- Apply the method of virtual work for equilibrium and stability analysis
- Apply properties of areas in solving mechanics problems
- Analyse statically determinate and statically indeterminate problems
- Analyse thermal and assembly stresses and incorporate them in stress analysis
- Analyse stresses and strains under torsion, bending and combined bending and torsion
- Apply the principles of transformation of stresses and analyse stresses and strains using Mohr's circle

Issue Date: January 2009
Next Revision: January 2013

Module Title:	STRENGTH OF MATERIALS
Code	TMEE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisites	TEGT3691 Engineering Mechanics II

Content: Analysis of stress and strain, Revision of Mohr's circle, Theories of failure. Torsion: Solid non-circular shafts, Thin-walled tubes, Residual stresses. Bending: Unsymmetrical bending, Inelastic Bending, Residual Stresses. Transverse Shear: Shear stresses in beams, Shear flow in built-in members, Shear flow in thin-walled members, Shear centre. **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.

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

- Apply mathematical and graphical methods (Mohr's circle) to analyse stresses and strains and their applications to torsion, bending and shear
- Analyse deflection of beams using integration, discontinuity functions and method of superposition.
- Apply energy methods in stress and strain analysis, deflection and impact loading
- Describe and apply Castigliano's theorem to engineering situations

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 OF B.Sc. CIVIL ENGINEERING

SEMESTER 1

Module Title	HYDROLOGY
Code	TCVE3781
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	TMNE3621 Introduction to Engineering Geology

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

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

- Describe the hydrological cycle and describe methods for determination of evaporation and transpiration
- Describe methods of modelling floods and measuring stream flow
- Demonstrate an understanding of the processes that lead to soil erosion and sediment production
- Describe methods for flow measurement and hydrological modelling.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	HYDRAULICS I
Code	TCVE3731
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TEGT3691 Engineering Mechanics II

Content: Introduction to hydraulics and its applications; Fluid properties; Hydrostatics; **Basic hydrodynamics**; Bernoulli equation, force, momentum, flux equation, continuity equation; ideal flow patterns, streamlines, flow nets; real flow, including laminar and turbulent flow, boundary layers and drag; flow resistance in pipes and channels; dimensional analysis and models. **Design of pipeline networks**. Permanent pressurized flows. **Design of pumps**. Variable pressure flows. Water hammer.

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

- Demonstrate knowledge of fluid properties and applications of Bernoulli equation
- Demonstrate knowledge of Bernoulli equation and its application to fluids
- Describe characteristics of laminar flow and turbulent flow in fluids
- Describe flow characteristics in pipes and channels
- Describe basic features of pipeline network design
- Demonstrate basic knowledge of pump design

Issue Date: January 2009
Next Revision: January 2013

Module Title:	THEORY OF STRUCTURES
Code	TCVE3771
NQF Level	7
Contact Hours	4L + 2T or 1PS/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Pre-requisite:	TMEE3622 Strength of Materials

Content: Overview of static mechanics and strength of materials. Energy principles for analysis of elastic structures. Influence lines. **Matrix analysis of statically-determinate structures.** Theory of linear transformations. **Beams, arches and trusses**. Analysis of statically-indeterminate structures: Force method, displacement method. Instability of structures. **Structure dynamics**. **Analysis of plates and simple shells**. Dynamic analysis. Yield line analysis. Plastic analysis of steel beams and frames. Moment distribution. **Analysis of reinforced-concrete beams and columns**. Yield line analysis of concrete slabs. Ultimate limit-state design of structural steel works and concrete beams. Laboratory work.

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

- Analyse elastic structures using energy principles
- Use matrix analysis in solving statically-determinate structures
- Analyse forces and stresses in beams, arches and trusses
- Analyse statically-indeterminate structures
- Demonstrate knowledge of analysis of plates and simple shells
- Describe techniques for analysis of reinforced-concrete beams and columns

Issue Date: January 2009
Next Revision: January 2013

Module Title:	BUILDING MATERIALS II
Code	TCVE3721
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	TCVE3621 Building Materials I

Content: Non-ferrous metals: Production, properties and uses of copper and its alloys, aluminium and its alloys. Properties and uses of nickel, titanium, zinc and lead. **Raw clay and ceramics:** Soil-cement: properties and applications; soil-line: stabilization with potassium silicate. Properties and applications of raw clay and of technical ceramics. Porous materials: bricks, tiles and refractories. Non-porous materials: stoneware and porcelain. **Bitumen and asphalt technology**. Thatch and wood.

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

- Describe properties and uses of common non-ferrous metals
- Demonstrate knowledge of the characteristics and uses of ceramic materials
- Describe properties and characteristics of clays, bricks, tiles and common refractories
- Demonstrate knowledge of the properties and characteristics of stoneware and porcelain
- Describe properties and uses of bitumen and asphalt
- Describe general characteristic of thatch and wood as used in the building industry

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CONSTRUCTION METHODS AND MANAGEMENT
Code	TCVE3791
NQF Level	7
Contact Hours	3L + 2T/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TCVE3621 Building Materials I, TEGT3682 Economics for Engineers

Content: Construction processes and equipment: Steel construction. Single reinforced and pre-stressed concrete works. **Earthworks.** Rock evaluation and crushing. Foundation piles. River and offshore works. Building works and management of work yards. Programming methods and work control: PERT, CPM, Grant's diagram. **Cost calculation of work**. Staff equipment, materials. Fixed and variable costs. **Bill of quantities**. Legislation for works contracts. The construction industry. **Work safety**. Standardisation and mass production. **Quality control** principles.

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

- Describe principle used in steel constructions
- Demonstrate knowledge of reinforced and pre-stressed concrete works
- Demonstrate basic knowledge of foundation design
- Describe principles of construction management and work control
- Demonstrate knowledge of the application of bill of quantities in the construction industry.
- Describe measures taken to ensure safety at work
- Describe basic principle of quality control

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FINITE ELEMENT METHODS
Code	TCVE3761
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite	TCVE3771 Theory of Structures

Contents: **Principles of Finite Element Method of analysis**. Definitions and mathematical analysis. Application of principles of Finite Element Methods to the design and analysis of civil engineering structures. Analysis of practical engineering problems using Finite Element Methods. **Application of computer software in Finite Element analysis.**

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

- Describe the principles of finite element method of analysis
- Apply Finite Element Methods to the design and analysis of civil engineering structures
- Apply Finite Element Methods to analyse practical engineering problems
- Perform Finite Element analysis using appropriate computer packages

Issue Date: January 2009
Next Revision: January 2013

Module Title	SURVEYING FOR ENGINEERS
Code	TCVE3741
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2hours paper)
Pre-requisite:	TEGT3571 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)

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS
Code	TEGT3741
NQF Level	7
Contact Hours	2L + 1T or 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	SSTS3691 Statistics for Engineers

Content: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	**WATER SUPPLY**
Code	TCVE3722
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Co-requisite:	TCVE3731 Hydraulics I

Content: Introduction; importance of water supply to communities; legislation and codes, water demand, water drawing; elevation, adduction and storage; distribution networks; pipelines, water quality; treatment of drinking water; water facilities in buildings. Project on water supply.

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

- Demonstrate knowledge of water supply systems
- Describe legislation and codes pertaining to water supply, water drawing water storage
- Demonstrate knowledge of water distribution networks, water quality determination and water treatment

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**ENTREPRENEURSHIP**
Code	TEGT3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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**.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**HYDRAULICS II**
Code	TCVE3782
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Co-requisite:	TCVE3731 Hydraulics I

Content: Introduction to the study of flows over free surfaces: Flows with uniform regiments. Critical regime. **Design of canals**: Smoothly varying regime: backwater curves. Quickly varying flows: the hydraulic jump. Flow through spillways and holes. **Flows in bridges and culvers**.

Exit Learning Outcomes

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

- Describe characteristics of flows over free surfaces
- Demonstrate knowledge of design of canals
- Describe characteristics of flows in spillways and holes
- Describe characteristics of flows in bridges and culvers

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**INFRASTRUCTURE PLANNING**
Code	TCVE3762
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	TCVE3682 Civil Engineering Planning & Design Methodology

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	**GEOTECHNICAL ENGINEERING**
Code	TCVE3742
NQF Level	7
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	**REINFORCED AND PRE-STRESSED CONCRETE DESIGN**
Code	TCVE3772
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Co-requisite:	TCVE3771 Theory of Structures

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	DESIGN OF STEEL AND TIMBER STRUCTURES
Code	TCVE3792
NQF Level	7
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Co-requisite:	TCVE3771 Theory of Structures

Content: Introduction to steel and timber constructions. Mechanical behaviour of materials. Traditional members. Steel members under compression. Rafters and trusses. Steel plate girders. Timber Beams. **Design for torsion and eccentric loading**. Column, hinges, supports in steel structures. Complex connections. Portal frames and trusses. **Roofing and special structures**. Compound beams. Composite structures. Introduction to plastic design.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	INDUSTRIAL ATTACHMENT II
Code	TEGT3700
NQF Level	7
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite	TEGT3600 Industrial Attachment I

Description: 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 OF B.Sc. CIVIL ENGINEERING

SEMESTER 1

Module Title:	SOCIETY AND THE ENGINEER
Code	TEGT3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title:	PROJECT MANAGEMENT FOR ENGINEERS
Code	TEGT3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3682 Economics for Engineers

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	TRANSPORT ENGINEERING
Code	TCVE3841
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment:	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite:	None

Content: Traffic and resistance to traffic: General technical features of roads and railway layouts; geometry of roads and railways; Infrastructure for roads and railways. **Drainage of works**; soil properties; mechanical stabilization of soils. **Design of Roads**: bituminous roads; gravel roads; road underpasses & overpasses. Design of pavements. Design exercises.

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

- Describe general layouts and geometry of roads and railways
- Demonstrate knowledge of the infrastructure for roads and railways
- Describe properties and stabilization methods for soils
- Make basic designs of roads and pavements

Issue Date: January 2009
Next Revision: January 2013

Module Title:	DESIGN OF BUILDINGS
Code	TCVE3811
NQF Level	8
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Co-requisite:	TCVE3792 Design of Steel and Timber Structures

Content: Introduction to Buildings. **Building topologies**. Drawings and other components of a project. Modular coordination in building. The drawings comprising a building project. Quoting the sizes of buildings. Drawing of services and facilities. Finishes. **Relationship between architectural forms and structural systems**. Relevant National Building Regulations. Introduction to industrialized building systems. Building specifications. **Complex building construction**. "High-tech" construction. Air conditioning, acoustics, working drawings. **Associated reports**; Bill of quantities. Aspects of professional practice.

Exit Learning Outcomes

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

- Describe various building topologies and illustrate them with engineering drawings
- Incorporate essential services into building drawings
- Describe the relationship between architectural forms and structural systems
- Demonstrate good knowledge of building specifications and building regulations
- Demonstrate knowledge of design of high-tech building designs with air-conditioning and acoustics features
- Prepare reports of bill of quantities and working drawings
- Demonstrate knowledge of civil engineering professional practice

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CONTRACT MANAGEMENT AND LAWS OF CONTRACT
Code	TCVE3821
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite	TCVE3791 Construction Methods and Management

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WATER QUALITY MANAGEMENT
Code	TCVE3861
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Pre-requisite	TCVE3781 Hydrology

Content: **Water quality as a dimension of water**: water quality determinants, water quality criteria as a function of water use, water quality standards, water quality guidelines, water quality and environmental health, water quality and analysis, sample preservation and storage, analytical instrumentation & techniques, physical parameters, chemical parameters, microbiological parameters, laboratory practices for water quality determination, quality control and quality assurance. **Water quality monitoring**: objectives, systems approach, monitoring versus surveys, sampling, analysis, interpretation, design of quality monitoring systems, statistical analysis of water quality data, contemporary issues in water quality.

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

- Demonstrate knowledge of water quality determinants and water quality standards
- Describe analytical techniques and instrumentation for determining water quality
- Describe techniques for quality control and quality assurance for water
- Describe techniques for water quality monitoring including statistical analysis of water quality data

Issue Date: January 2009
Next Revision: January 2013

Module Title:	ENGINEERING GEOLOGY
Code	TCVE3881
NQF Level	8
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50% Examination 50% (1 x 2 hours paper)
Co-requisite	TCVE3742 Geotechnical Engineering

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

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

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

Issue Date: January 2009
Next Revision: January 2013

Module title:	PUBLIC HEALTH ENGINEERING
Code	TCVE3831
NQF Level	8
Contact Hours	4L + 2T/Week
Credits	16
Assessment:	Continuous 50% Examination 50% (1 x 3 hours paper)
Co-requisite:	TCVE3782 Hydraulics II

Content: Waste Water Management: Technology review, appropriate technologies, advanced technologies, theory and basic design of processes used in water and wastewater treatment, sludge treatment and disposal, process train selection procedures, linking source water quality to process design – principles, experimental and pilot plant studies, design criteria, evaluation parameters for the design of water and wastewater treatment processes. Legislation and codes. Rural and semi-urban sewerage. Domestic and industrial sewerage. Evaluation and purification of sewers. **Solid Waste management:** Characterization of solid wastes, sources, quantities, characteristics, solid waste collection & transportation systems, ultimate disposal systems, design of landfills, site selection, impact assessment design.

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

- Demonstrate knowledge of methods and technologies used in waste water treatment
- Describe methods for sludge treatment and sludge disposal
- Describe parameters for the design of water and wastewater treatment
- Demonstrate knowledge of legislation and codes of practice for wastewater treatment
- Describe characteristics of solid waste and techniques for solid waste management
- Demonstrate knowledge of solid waste disposal systems and design of landfills

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title:	RESEARCH PROJECT
Code	TCVE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	CIVIL ENGINEERING DESIGN PROJECT
Code	TCVE3819
NQF Level	8
Contact Hours	10 hours of design work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite	All third year modules

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

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

N. CURRICULUM FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

N.1 B.Sc. (ELECTRICAL ENGINEERING) 19BECE

N.2. AIM

The curriculum for the degree of B.Sc.(Electrical Engineering) aims at producing Graduate Engineers with knowledge, skills and abilities in electrical engineering, and who can competently work in the design, planning, operation of electric power systems and devices, power generation, transmission, distribution, control of electrical energy systems/components and related service industries.

N.3. CURRICULUM STRUCTURE:

YEAR 1 OF BSC (ELECTRICAL ENGINEERING

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Engineering Mathematics I	TEGT3571	5	16	None
1	Engineering Drawing	TEGT3591	5	12	None
1	*Physics for Physical Sciences I*	*SPHY3511*	*5*	*16*	*None*
1	Fundamentals of Electrical Engineering	TEGT3541	5	8	None
1	Computing Fundamentals	TCME3591	5	12	None
1	Workshop Practice	TEGT3509	5	4	None
1	*Fundamentals of Engineering*	*TEGT3421*	*4*	*8*	*None*
1	*Contemporary Social issues*	*UCSI3429*	*4*	*8*	*None*
Total Credit				***84***	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Engineering Mathematics II	TEGT3572	5	16	TEGT3571
2	Materials Science	TEGT3562	5	8	None
2	*Physics for Physical Sciences II*	*SPHY3512*	*5*	*16*	*SPHY3511*
2	*Chemistry 1B*	*SCHM3512*	*5*	*16*	*None*
2	Fundamentals of Electronics	TETE3542	5	8	TEGT3541
2	Engineering Mechanics I	TEGT3592	5	12	SPHY3511
2	*English for Academic Purposes*	*ULEA3419*	*4*	*16*	*None*
Total Credit				***92***	

NB: Students who have done UCSI3429, ULEA3419, TEGT3421, SPHY3571, SPHY3572 and SCHM3572 will be exempted from taking them in this year.

YEAR 2 OF BSC (ELECTRICAL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Engineering Mathematics III	TEGT 3671	6	16	TEGT3572
1	Engineering Mechanics II	TEGT 3691	6	12	TEGT3592
1	Computer Science for Engineers	TCME3621	6	8	TCME3591
1	Principles of Electronics Design	TETE3621	6	8	TETE3542
1	Statistics for Engineers	SSTS3691	6	12	TEGT3571
1	Computer Organisation and Assembly Language	TCME3641	6	8	TCME3591
1	Applied Electromagnetics	TETE3681	6	8	SPHY3512
1	Computer Aided Drawing	TEGT3661	6	8	TCME3591; TEGT3591
Total Credit				**80**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
~~2~~	Engineering Mathematics IV	TEGT3672	6	16	TEGT3572
2	Electric Circuit Theory	TETE 3612	6	16	TETE3542; TEGT3671
2	Signals and Systems	TETE3692	6	12	TEGT3572 ; TEGT3671
2	Introduction to Telecommunication Engineering	TETE3682	6	8	TETE3542
2	Economics for Engineers	TEGT3682	6	8	TEGT3421
2	Object Oriented Programming	TCME3692	6	12	TCME3621
2	Electrical Machines and Drives	TETE3622	6	8	TEGT3541
2	Industrial Attachment I	TEGT3600	6	4	TEGT3509
Total Credit				**84**	

YEAR 3 OF B.SC (ELETRICAL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Fundamentals of Power systems	TECE3731	7	16	TETE3622; TETE3681
1	Programmable Electronics Design	TETE3741	7	8	TETE3542; TETE3681
1	Power Electronics	TETE3791	7	12	TETE3542; TETE3612
1	Computer Aided Circuit Design	TETE3721	7	8	TETE3612; TETE3621
1	Electrical Machines Analysis & Design	TECE3711	7	16	TETE3622; TETE3681
1	Electronics Materials	TETE3761	7	8	TEGT3562; TEGT3541
1	Experimental and Research Methods	TEGT3741	7	8	SSTS3691
Total Credit				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Electrical Engineering Laboratory	TECE3742	7	8	TECE3731; TECE3711
2	High Voltage Generation and Measurement Techniques	TECE3732	7	16	TECE3731; TETE3621
2	Electrical Engineering Design	TECE3762	7	8	TECE3711; TECE3731
2	Computer Networks	TCME3722	7	8	TCME3621
2	Renewable Energy Technology	TECE3792	7	12	TEGT3541
2	Entrepreneurship	TEGT3742	7	8	TEGT3682
2	Switching and Protection of High Voltage Systems	TECE3782	7	8	TETE3612; TECE3731
2	Industrial Attachment II	TEGT3700	7	4	TEGT3600
Total Credit				**72**	

YEAR 4 OF B.SC (ELECTRICAL ENGINEERING)

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
1	Society and the Engineer	TEGT3821	8	8	TEGT3421
1	Control Engineering	TETE3851	8	16	TEGT3671
1	Project Management for Engineers	TEGT3861	8	8	TEGT3682
1	Power Transmission and Distribution	TECE3831	8	16	TECE3782; TECE3731
1	Computation methods in Power Engineering	TECE3891	8	12	TECE3782; TECE3731
1	Digital Electronics and Microprocessor Systems	TECE3831	8	16	TETE3621; TCME3692
Total Credit				**76**	

SEMESTER	MODULE	CODE	NQF LEVEL	CREDITS	PRE &COREQUISITE
2	Research Project	TECE3839	8	24	All 3rd Year modules
2	Electrical Engineering Design Project	TECE3819	8	24	All 3rd Year modules
2	Industrial Attachment III	TEGT3800	8	4	TEGT3700
Total Credit				**52**	

N.4. DETAILED COURSE CONTENTS FOR B.Sc. ELECTRICAL ENGINEERING

YEAR 1 B.Sc. (ELECTRICAL ENGINEERING)

SEMESTER 1

Module Title	ENGINEERING MATHEMATICS I
Code	TEGT 3571
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Lines and planes: vector equation of a line, Cartesian and parametric equation of a plane, intersections of lines and planes. **Matrix Algebra**: row reduced echelon form, determinant, adjoint, singular and non-singular matrices, inverse of a matrix, matrices and systems of linear equations, solution by Cramer's rule. **Functions**: Limits and continuity of functions: limit at a point, improper limit, 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. Engineering applications. **Complex numbers**: operations on complex numbers. **Differentiation**: Definition of the derivative, differentiation rules, chain rule, differentiation of trigonometric functions, derivatives of higher order, concavity and curve sketching, optimization, related rates. **Integration**: anti-derivatives, Riemann sums, the definite integral, fundamental theorem of calculus, integration techniques, integration of trigonometric functions. **Applications of the definite integral**: area of a region bounded by graphs, volumes of solids of revolution, arc length, curved surface area. Parametric curves.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENGINEERING DRAWING
Code	TEGT 3591
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	None

Module Description: Foundations of Representing Technical Bodies: Principle of orthographic projection, drawing equipment, drawing formats, types of lines, simplified representations, scales, advice to free-hand sketching, free – hand drawing of machine parts in orthographic projection, cut section-dimensioning, lettering, little block, elaboration of part drawings. Essential Problems Descriptive Geometry: **Isometric and oblique representations**, sections of cones – interpenetrations, developments. **Particular mechanical and civil engineering drawings**; assembly –reading of drawings, part drawings and assembly drawing, particular dimensioning rules, surface finish symbols, semi-finished products. Various kinds of Civil engineering drawings.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

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

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Module Description: Introduction to electric circuits: Ohm's law, Resistance, Resistor networks, Resistors in series and parallel, Circuit laws : Kirchoffs laws, mesh and nodal analysis ,Superposition Theorem, Thevenin's Theorem, Power, Capacitance, Capacitors in series and Parallel, Time constant, Electromagnetic Induction, Inductance, RMS Value of an ac waveform, Resistive circuit at ac, Capacitive circuit at ac, Inductive circuit at ac, 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, Power at ac, Series resonance, Parallel resonance. time and frequency response, phasor calculation, Electrical machines: transformer, motors, generators. Basics of circuit simulation. **Elementary power systems:** Three phase ac systems. Power rectification. The components in a modern power system. Tariff philosophies and power factor correction.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTING FUNDAMENTALS
Code	TCME3591
NQF Level	5
Contact Hours	**3**L + 1PS/Week
Credits	12
Assessment	Continuous 60%; Examination 40% (1 x 3 hour paper)
Pre-requisites	None

Content: Review of the Windows environment. **Principles of information processing:** Word-processing, Spreadsheets, Presentations, Databases. Nature and use of software. Practical exercises. **The logical basis of computing.** The binary system, Boolean logic and number representation. Elementary information theory. Logic gates and fundamental circuits. **The von Neumann model of the computer**. The nature of algorithms. Computer languages. Procedural programming constructs. **Concepts of operating systems and networks**. Elements of machine architecture.

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

- Use a computer under the Windows operating system
- Differentiate between word processors, spreadsheets, presentations and databases
- Describe how a computer processes information using the binary numbering system.
- Apply Boolean logic to predict the outcome of an event
- Describe the characteristics of logic gates and their circuits
- Describe the von Neumann model of the computer
- Describe basic features of operating systems and computer networks.
- Identify the fundamental elements of computer machine architecture.

Issue Date: January 2009
Next Revision: January 2013

Module Title:	WORKSHOP PRACTICE
Code	TEGT3509
NQF Level	5
Contact Hours	1 hour lecture plus 3 hours practical per week
Credits	4
Assessment	Continuous 100%
Pre-requisites	None

Content: Principles and Practice of Woodwork, Brickwork, Plumbing and Pipe fitting, Welding and Fabrication, Sheet Metal Work, Machining (Drilling, Cutting, Lathe, Milling, Shaping), Brick Laying, Auto Mechanics, Electrical Installation, Electrical Wiring, Air-Conditioning and Refrigeration, Radio and Television, Basic Computer Hardware.

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

- Describe general safety procedures applicable to engineering workshops
- Describe specific hand tools used in engineering workshops with respect to sheet metal
- Make a prescribed component using the principles of carpentry
- Make basic wall structures using brick work and cement mortar.
- Differentiate between the functions of a lathe, a shaping machine and a milling machine.
- Differentiate between arc welding and gas welding
- Describe the general operation of a four-stroke internal combustion engine
- Design basic electric circuits and use then to perform specified activities
- Describe the general principles of refrigeration and air conditioning
- Describe the transmission and reception of radio signals

Issue Date: January 2009
Next Revision: January 2013

Module Title:	FUNDAMENTALS OF ENGINEERING
Code	TEGT3421
NQF Level	4
Contact Hours	2L + 1T/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 Hour paper)
Pre-requisites	None

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

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	ENGINEERING MATHEMATICS II
Code	TEGT 3572
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites	TEGT 3571 Engineering Mathematics I

Module Description: Further differentiation and integration: Implicit differentiation, partial differentiation, the chain rule, differentiation of algebraic functions. Further integration techniques: integration by parts, integration of powers of trigonometric functions (sine, cosine, tangent, cotangent, secant and cosecant), integration by trigonometric substitution. **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. **Matrices**: Eigenvalues and eigenvectors. Hermitian and unitary matrices. Quadratic forms and change of axes. Linear mappings. **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. The binomial theorem.

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

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

Issue Date: January 2009
Next Revision: January 2013

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

Content: Structure of materials: Atomic structure, electronic configuration, atomic bonding; Crystallographic planes and directions using Miller indices; Bragg's law; Defects in crystals; Diffusion in solids; Metals and alloys; Equilibrium phase diagrams: unary, binary and ternary systems. Invariant reactions: eutectic, eutectoid, peritectic, peritectoid systems. Proportion of phases based on the lever rule. Practical phase diagrams from non-ferrous alloy systems. The iron-iron carbide alloy system: Steel-portion of the Fe-Fe_3C system, annealed microstructures, eutectoid reaction, characteristics of pearlite and bainite, martensitic transformation, isothermal time-temperature and continuous cooling transformation diagrams. Properties of materials: mechanical, electrical, magnetic, optical, and thermal properties. Methods of determining material properties. Effects of environment on materials: corrosion and oxidation of metals, electrode potential, electrochemical cell, mechanisms of corrosion, corrosion prevention, degradation of polymeric materials.

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

- Competently describe the structure of materials from the electronic level to the alloy state.
- Describe the formation of metals and alloys using binary phase diagrams
- Describe the various classifications of properties of engineering materials
- Describe methods of determining materials properties.
- Describe the processes that take place during corrosion and techniques used to control corrosion and degradation.

Issue Date: January 2009
Next Revision: January 2013

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 & Solubilty Equilibria: The Common Ion Effect; Buffer Solution; Acid – Base Titrations; Acid-Base Indicators; Solubility Equilibria; Separation of Ions by Fractional Precipitation; The Common Effect and Solubility; pH and Solubility; Complex Ion Equilibria and Solubility. Entropy, Free Energy and Equilibrium: The Three Laws of Thermodynamics; Spontaneous Processes; Entropy; The Second Law of Thermodynamics; Gibbs Free Energy; Free Energy and Chemical Equilibrium; Thermodynamics in Living Systems. Introduction to Electrochemistry: Galvanic Cells; Standard Reduction Potentials; Spontaneity of Redox Reactions; Effect of Concentration of Cell EMF; Electrolysis. Introduction to Organic Chemistry: Classes of Organic Compounds; Structure and Nomenclature Main Functional Groups (alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides). Introduction to carbohydrates, lipids and porphyrins.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title:	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.

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	FUNDAMENTALS OF ELECTRONICS
Code	TETE 3542
NQF Level	5
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Co-requisites	TEGT 3541 Fundamentals of Electrical Engineering

Module Description: Analogue electronics : Introduction to semi-conductor theory, Electronic components: Inductor, capacitors, resistors, diodes, transistors, thyristors/triacs, IC's. **Simple electronic circuits**: Clamping circuits, rectifying circuits, simple amplifier (single stage RC). **Digital Technique**: Logic operation of integrated circuits. Boolean algebra, number systems, codes and parity, analysis and synthesis of combinatorial logic, latches and flip-flops, analysis and synthesis of sequential logic, MSI building blocks of sequential logic, design principles of digital systems, physical properties of digital circuits.

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

- Distinguish between passive and active devices, and between power supplies & signals.
- Describe, construct and test wave rectifier circuits using diodes
- Recognize terminology of basic electronic devices and apply DC laws to electronic circuit calculations.
- Practice circuit construction/assembling and use multi-meters and oscilloscope and RLC meters to perform electronic measurement and do basics trouble-shooting.
- Identify and apply electronic devices and their schematic symbols in a circuit.
- Analyse & describe the operation of p-n semiconductor diodes transistors and Op-Amps.
- Use the binary number system to carry out basic arithmetic operations, and implement digital circuits
- Use Boolean algebra and related techniques to simplify logical expressions, analyze simple combinational logic circuits, with logic gates, simple sequential logic circuits and standard flip-flops.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ENGINEERING MECHANICS I
Code	TEGT 3592
NQF Level	5
Contact Hours	4L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisites	SPHY3511 Physics for physical Sciences I

Module Description: Statics: Coplanar forces, addition of forces, couples and moments, resultants and equivalent systems. Equilibrium of a rigid body in two dimensions, line of action, free body diagram, adequacy of constraints and equilibrium positions. Analysis of forces in a truss: Method of joints, method of sections; Equilibrium in three dimensions. Forces in submerged surfaces, buoyancy. Distributed forces: centroids and center of gravity; Pappu's second moment. **Friction**: Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. **Beams**: shear force and bending moment diagrams, Bending Stress, Shear stress. Analysis of frames and machines. **Virtual work**.

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 2 OF BSC (ELECTRICAL ENGINEERING)

SEMESTER 1

Module Title	**ENGINEERING MATHEMATICS III**

Code	TEGT3671
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

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

Exit Learning Outcomes

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title:	**ENGINEERING MECHANICS II**

Code	TEGT3691
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Co-requisites	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 equation. Linear and angular momentum. Momentum–Impulse relationships. Power and efficiency. **Kinetics of a system of particles**. Generalized Newton's Second Law. Work, energy, impulse, momentum relationships. **Strength of Materials**: Concept of stress and strain: Internal effects of forces, axial tension test; Hooke's Law; Modulus of elasticity; Stress-strain relations. Normal stress, normal strain, shear stress and strain, bending stress. Analysis of stress and strain, Thermal stress and strain. Assembly problems. Introduction to statically indeterminate problems.

Exit Learning Outcomes

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

- Apply principles of kinematics and kinetics to describe motion and causes of motion
- Use rectangular and curvilinear coordinates in solving dynamics problems
- Analyse linear, angular, projectile and relative motion of particles and systems thereof
- Apply equations of motion in rectilinear and plane curvilinear motion
- Apply the work-energy principle and impulse-momentum principle to solve dynamics problems
- Apply Hooke's Law for normal and shear stresses and analyse general strain systems that include thermal strains
- Analyse stresses in beams under pure bending
- Solve basic statically-indeterminate problems

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	COMPUTER SCIENCE FOR ENGINEERS

Code TCME3621
NQF Level 6
Contact Hours 2L + 1PS /Week
Credits 8
Assessment Continuous 60%, Examination 40% (1x 2 hours paper)
Pre-requisites TCME3591 Computing Fundamentals

Module Description: Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues. **Binary Trees and their applications.** Applets, Events and Graphics. **Computer Architecture**: the design and structure of a computer. Introduction to Assembler Level programming. Introduction to problem solving and algorithms with C++. **Programming using MATLAB**. Application of MATLAB programming to actual engineering situations. Programming project.

Exit Learning Outcomes

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

- Generate data structures and algorithms
- Apply binary trees to specific programming environment
- Describe computer architecture and write a simple assembler-level programme
- Describe and apply the methodology of problem solving and algorithms in C++
- Use MATLAB for programming and solving engineering problems

Issue Date: January 2009
Next Revision: January 2013

Module Title	PRINCIPLES OF ELECTRONICS DESIGN

Code TETE 3621
NQF Level 6
Contact Hours 2L + 1P/S /Week
Credits 8
Assessment Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites: TETE3542 Fundamentals of Electronics

Module Description: Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modelling and analysing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA –conversion and principles of VLSI-technology.

Exit Learning Outcomes:

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

- Describe the basic operation and structures of diodes, transistors and operational amplifiers.
- Bias a BJT, FET or MOSFET device to achieve a desired quiescent operating point.
- Describe the concepts of analogue electronic design techniques and internal structure of digital circuits
- Apply the principles of AD/DA –conversion and principles of VLSI-technology.

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTER ORGANISATION AND ASSEMBLY LANGUAGE

Code TCME3641
NQF Level 6
Contact Hours 2L + 1PS/Week
Credits 8
Module Assessment Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites TCME3591 Computing Fundamentals

Content: Computer organization, description of the basic computer functions, representation of information, computer memory hierarchy and its implementation, input/output operations, use of assembly language programming, basic instruction sets, arithmetic and logical operations, addressing modes and macro definition, assembly language programming assignment.

Exit Learning Outcomes

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

- Describe computer organization and identify various computer functions
- Demonstrate an understanding of the operation of digital computer
- Describe computer memory organization and its implementation
- Use of assembly language programming, basic instruction sets, arithmetic and logical operations,
- Addressing modes and macro definition.
- Solve an engineering problems using assembly language programming

Issue Date: January 2009
Next Revision: January 2013

Module Title	APPLIED ELECTROMAGNETICS

Code TETE3681
NQF Level 6
Contact Hours 2L + 1PS/Week
Credits 8
Assessment Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisites SPHY3512 Physics II

Module Description: This course examines concepts of electromagnetism, electrostatic fields, Coulomb's Law, Gauss's Law, magnetostatic fields, Ampere's Law, electromagnetic induction, Faraday's Law, transformer ,Maxwell equations and time-varying fields, wave equations, wave propagation, dipole antenna, polarization, energy flow, and applications.

Exit Learning Outcomes

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

- Demonstrate an understanding of theories and applications of electromagnetic fields and waves
- Demonstrate an understanding of the physical meaning and significance of Maxwell's equations;
- Describe electromagnetic and time varying l fields and waves, and their implications in modern communication systems

Issue Date: January 2009
Next Revision: January 2013

Module Title:	COMPUTER AIDED DRAWING

Code TEGT3661
NQF Level 6
Contact Hours 2L + 1T/Week
Credits 8
Assessment Continuous 100%
Co-requisites: TCME3591 Computing Fundamentals**;** TEGT3591 Engineering Drawing

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

Exit Learning Outcomes

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	STATISTICS FOR ENGINEERS

Code SSTS3691
NQF Level 6
Contact Hours **3**L + 2T/Week
Credits 12
Assessment Continuous 50%, Examination 50% (1 x 3 hour paper)
Co-requisites TEGT 3571 Engineering Mathematics I

Module Description: Probability: Theory (Random experiments, Random events), Conditional Probability, Mathematical Expectation and Decision making; **Probability Distributions and Densities:** Binomial, Geometric, Hypergeometric, Poisson, Normal, Uniform, Gamma, Beta, Weibull; **Sampling Distributions**: Mean, Variance; Inferences concerning Mean, Variance and Proportions: Point and Interval Estimations, Parametric tests, Nonparametric tests; **Linear Regression and Correlation:** Simple and Multiple Linear Regression, Correlation; **Analysis of Variance**: Completely Randomized and Randomized Block Designs, Multiple Comparisons; **Applications to Quality Assurance:** Control Charts for Measurements and for Attributes, Tolerance Limits, OC Curves, Acceptance Sampling; **Applications to Reliability and Life Testing**: Reliability, Failure-time distributions, Exponential Model in Reliability and in Life Testing, Weibull Model in Life Testing.

Exit Learning Outcomes

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

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

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	**ENGINEERING MATHEMATICS IV**

Code	TEGT3672
NQF Level	6
Contact Hours	4L + 2T/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TEGT3572 Engineering Mathematics II

Module Description: Linear differential equations with constant coefficients; The Cayley-Hamilton theorem and applications to differential equations. Simple harmonic motion; vertical oscillations of a particle hanging on an elastic string; damped oscillations; forced oscillations; moments of inertia; rotation of a rigid body; matrix methods: systems of oscillating particles; difference equations; partial differential equations, waves in a stretched elastic string. **Integral Calculus of Functions of Several Variables**: Double and triple integrals. Double, triple and iterated integrals, line integrals in the plane, Green's Theorem, independence of path, surface integral, the divergence theorem, Stoke's Theorem, irrotational and solenoidal fields, physical and engineering applications. **Numerical methods**: Zeros of functions, boundary value problems, different numerical differentiation and integration, **Computational linear algebra**. Numerical solution of nonlinear equations. Numerical computation of Eigenvalues and Eigenvectors. Polynomial interpolation and Least Squares approximation. **Numerical differentiation and integration.** Numerical solution of ordinary differential equations.

Exit Learning Outcomes

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	**ELECTRIC CIRCUIT THEORY**

Code	TETE 3612
NQF Level	6
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites:	TEGT3542 Fundamentals of Electronics
Co-requisite:	TEGT3671 Engineering Mathematics III

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

Exit Learning Outcomes:

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

- Use principles and methods of analysis and modelling of electric circuits in the steady state.
- Apply Network theorems to the analysis of networks.
- Use of Laplace transformation and bode plots in circuit analysis
- Apply the concepts of frequency response, resonance, and network functions, two port networks including hybrid parameters.

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	SIGNALS AND SYSTEMS

Code	TETE3692
NQF Level	6
Contact Hours	3L + 1T/Week or 1PS/Week
Credits	12
Assessment	Continuous 50%; Examination 50% (1 x 3 hour paper)
Pre-requisite:	TEGT3572 Engineering Mathematics II
Co -requisite	TEGT3671 Engineering mathematics III

Module Description: An introductory course covering the principles of signals and systems. The course combines lectures, Matlab simulation exercises, and design projects to expose students to the theories and concepts of both continuous-time and discrete-time forms of signals and systems, as well as applications of the theories and concepts in communication systems, control systems, and signal processing.

Exit Learning Outcomes

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

- Demonstrate the basic understanding of continuous time and discrete-time signals and systems, and the various methods and approaches used to analyze signals and systems
- Develop knowledge and have a sufficient experience in utilizing MatLab to simulate and solve problems relating to signals and systems

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	INTRODUCTION TO TELECOMMUNICATION ENGINEERING

Code	TTCE 3682
NQF Level	6
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Prerequisites:	TETE3542 Fundamentals of Electronics

Module Description: Terminology, basics of communication networks, key concepts and technologies required in Wireless Communication systems R&D. Fixed line network technology

Exit Learning Outcomes:

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

- Demonstrate an understanding of the basic concepts of telecommunications
- Describe wireless network systems and its application.
- Demonstrate an understanding of the wireless technology network system

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	ECONOMICS FOR ENGINEERS

Code	TEGT3682
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3421 Fundamentals of Engineering

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

Exit Learning Outcomes

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

- Describe the fundamentals of microeconomics
- Describe the fundamentals of macroeconomics
- Describe the fundamentals of financial accounting
- Demonstrate an understanding of the principles of budgeting
- Demonstrate an understanding of the principles of budgeting

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	OBJECT ORIENTED PROGRAMMING

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

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

Exit Learning Outcomes

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title:	ELECTRICAL MACHINES AND DRIVES

Code	TETE3622
NQF Level	6
Contact Hours	2L + 1T/Week
Credits	8
Assessment	Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite	TEGT3541 Fundamentals of Electrical Engineering

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

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	INDUSTRIAL ATTACHMENT I
Code	TEGT3600
NQF Level	6
Contact Hours	Four (4) weeks each preferably during the July/August break in Year 2 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits	4
Assessment	100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Pre-requisite	TEGT3509 Workshop Practice

Module Description: During Industrial Attachment I, students will work under company supervision at the level of an Artisan 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.

Issue Date: January 2009
Next Revision: January 2013

YEAR 3 OF BSC (ELECTRICAL ENGINEERING)

SEMESTER 1

Module Title	FUNDAMENTAL OF POWER SYSTEMS
Code	**TECE 3731**
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Prerequisites	TETE3622 Electrical Machines and Drives, TETE3681 Applied Electromagnetics

Module Description: **Introduction to Power System:** Introduction, History of power system supply, Power system components – generation, transmission, and distribution. Issues related to power system – new and renewable sources, effects to the environment, generating station, independent power producers, and energy policy. **Electricity Generation: Methods** of generation – conventional (gas, thermal, hydro, and nuclear) and new (solar, fuelCell, wind, wave etc.). **Transmission Lines: Types** of lines – overhead and underground, HVAC and HVDC. Design concepts and structures of lines. Line parameters (derivation of formulae and use of tables) - resistance, inductance, and capacitance, Line modelling (using line formulae and ABCD parameters) - short, medium and long Line performance – power flow, efficiency voltage regulation. Methods of voltage control and reactive compensation. **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. **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.

Exit Learning Outcomes:

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

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

Issue Date: January 2009
Next Revision: January 2013

ELECTRICAL MACHINES ANALYSIS & DESIGN

Code	**TECE37111**
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TETE3622 Electrical machines and Drives, TETE3681 Applied Electromagnetics

Module Description: **Electrical Machines Design**: To develop an understanding of the relationship between dimensions and rating of machines; to introduce the principles of winding designs; to develop techniques for the design of permanent magnet machines; to calculate representative winding reactances **Basic Machine Theory:** Emf generation in machines; distribution, coil span and winding factors; mmf developed by distributed windings; development of rotating fields; torque developed; simple AC Windings, the per unit (pu) notation in power systems .**Single and Three Phase Transformers:** Three Phase Transformer connections; Phase shift; equivalent circuit; per unit notation and transformers in parallel .**Induction Motor:** Development of a phasor diagram for starting and running conditions; development of equivalent and approximate equivalent circuits models; current and torque characteristics; rotor resistance variation and deep bar effects; methods of starting and speed control. **Synchronous Machine:** Development of phasor diagram for cylindrical synchronous machines; concept of synchronous reactance; short circuit ratio; operation as an isolated generator and on infinite busbars. **Modelling of Electrical Machines.** Synchronous motors, Induction motors, Transformers. Synchronous generators. Simulation. **Multi-machine System Analysis**: Development of models, Representation of multi-machine systems. **Simulation and Applications. Economics and ergonomics in design:** Application of electrical engineering principles, principles of economics, product costing and ergonomics in realising a practical design.

Exit Learning Outcomes:

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	**POWER ELECTRONICS**

Code	TETE3791
NQF Level	7
Contact Hours	**3**L + 1PS /Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3612 Electric Circuit Theory; TETE3542 Fundamentals of Electronics

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

Exit Learning Outcomes:

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module	COMPUTER AIDED CIRCUIT DESIGN

Code TETE 3721
NQF Level 7
Contact Hours 4L + 1P/S /Week
Credits 16
Assessment Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites TETE3612 Electric Circuit Theory; TETE3621 Principles of Electronics Design

Module Description: Circuit simulators ,Solving network equations, Principles of AC, DC, transient analyses and steady-state simulation methods, Simulation of noise and distortion, Worst-case and statistical analysis and optimization. Physical design and design verification.

Exit Learning Outcomes:

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

- Use CAD software in Electrical and Electronic design, Electronic simulation and Drafting
- Demonstrate an understanding of the concept of computer-aided circuit analysis based on the network circuit theory
- Describe the function and demonstrate the use of computer Aided circuit analysis software (eg. PCSpice, Microcap, Electronic Workbench etc..)
- Demonstrate an understanding of the operation, limitations and application areas of various types of front-end and back-end CAD tools used for analogue and mixed signal design.
- Use the techniques, skills and modern engineering tools necessary for design and simulation of circuit

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRONICS MATERIALS

Code TETE3761
NQF Level 7
Contact Hours 2L + 1T or 1PS/Week
Credits 8
Assessment Continuous 50%, Examination 50% (1 x 2hour paper)
Pre-requisites TEGT3562 Materials Science; TEGT3541 Fundamental of Electrical Engineering

Module Description: Materials for electrical applications: electric conductors; insulators; semiconductors; superconductors; optoelectronic materials; fibre optics; photovoltaic materials; magnetic materials. Electrical materials and their application, Study of materials for IC fabrication including Si, compound semiconductors and advanced Si on insulator structures Study of the basic principles of dielectrics with reference to the use of insulating materials in electronic devices and capacitors Introduction to liquid crystals with reference to their usage in electronic displays An introduction to magnetic materials for information storage, material for optoelectronics devices and transducers.

Exit Learning Outcomes

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

- Competently describe the properties, uses and characteristics of materials used in the electronics and electrical industry
- Demonstrate knowledge of the principles and physical behaviour of magnetic materials used in storage devices
- Demonstrate a clear understand of materials used in semiconductors devices
- Demonstrate an understanding of the basic principles of Integrated Circuit (IC) fabrication

Issue Date: March 2009
Next Revision: March 2013

Module Title:	EXPERIMENTAL AND RESEARCH METHODS

Code TEGT3741
NQF Level 7
Contact Hours 2L + 1T or 1PS/Week
Credits 8
Assessment Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite SSTS3691 Statistics for Engineers

Module Description: Experimentation planning and execution. **Technical report writing**. Logbook exercises. **Research methodology**. Statistical data analysis. Dimensional analysis. **Instrumentation for laboratory systems**. Laboratory measuring systems. **Laboratory work** specific to the discipline.

Exit Learning Outcomes

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

- Describe the principles of experimentation planning and execution
- Write and present a concise technical report
- Describe the principles used in research methodology
- Apply statistical tools to analyse data
- Describe various instrumentation principles and their applications
- Perform discipline specific lab work on instrumentation

Issue Date: January 2009
Next Revision: January 2013

SEMESTER 2

Module Title	**RENEWABLE ENERGY TECHNOLOGY**

Code	TECE3792
NQF Level	7
Contact Hours	3L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TEGT3541 Fundamentals of Electrical Engineering

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

Exit Learning Outcomes:

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	**ELECTRICAL ENGINEERING LABORATORY**

Code	TECE 3742
NQF Level	7
Contact Hours	2L + 1PS /Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite	TECE3731 Fundamental of Power Systems, TETE3711 Electrical machines Analysis &Design

Module Description

Experiments on (Induction motor - Electrical Machines and drives - Power System -- Single-Phase Induction Motor - Self-Excited Induction Generator – Power electronics devices and circuits - Determination of the parameters of the synchronous machine - Induction regulator - Three-phase rotor fed variable speed motor (schorage motor) - Repulsion motor - Single-phase AC series commentator motor - Parameters of three winding transformer) – Run of computer programs for (load flow study - Economical load sharing - Traveling waves along transmission lines - System synchronous stability - Voltage stability criteria – Short circuit analysis - Harmonic analysis – Voltage control techniques – Reactive power management and power factor correction.

Exit Learning Outcomes:

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

- Conduct experiment on electrical machines and drives
- Design and conduct experiments, as well as to analyze and interpret data.
- understand the characteristics, operation and underlying theories of DC motors
- Use the techniques, skills, and modern engineering tools necessary for engineering practice;

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	HIGH VOLTAGE ENGINEERING AND MEASUREMENT TECHNIQUES

Code	TECE3732
NQF Level	7
Contact Hours	4L + 1PS/Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite	TETE3621 Electrical Machines and Drives
Co-Requisite	TECE3731 Fundamental of Power Systems

Module Description: Calibration, measurement amplifiers, interconnections of sensors and amplifiers, spectrum analysers and correlation measurements, noise and interference, grounding, CMR and processing of measurement results. High voltage measurement and testing techniques. Insulation assessment and design considerations for HV equipment.

Exit Learning Outcomes:

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	COMPUTER NETWORKS

Code	TCME3722
NQF Level	7
Contact Hours	2L + 1PS/week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisite	TCME3621 Computer Science for Engineers

Module Description: Physical layer, data link layer, medium access control sublayer, network layer, transport layer, application layer, multimedia, QoS, network management, network security.

Exit Learning Outcomes:

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

- Have a comprehensive description on computer networks, from underlying physical layer up to application layer and today's most popular network applications.
- Identify and use internetworking, broadband, electrical interface, and data transmission concepts

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	SWITCHING AND PROTECTION OF HIGH VOLTAGE SYSTEMS

Code	TECE3782
NQF Level	7
Contact Hours	2L + 1PS/Week
Credits	8
Assessment	Continuous 50%, Examination 50% (1 x 2 hour paper)
Pre-requisites	TETE3612 Electric Circuit Theory
Co-Requisite	TECE3731 Fundamental of Power Systems

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

Exit Learning Outcomes:

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	ENTREPRENEURSHIP

Code TEGT3742
NQF Level 7
Contact Hours 2L + 1T/Week
Credits 8
Assessment Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite TEGT3682 Economics for Engineers

Module Description: 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**.

Exit Learning Outcomes

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT II

Code TEGT3700
NQF Level 7
Contact Hours Four (4) weeks each preferably during the July/August break in Year 3 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits 4
Assessment 100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite TEGT3600 Industrial Attachment I

Module Description: 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.

Issue Date: January 2009
Next Revision: January 2013

Module Title	ELECTRICAL ENGINEERING DESIGN

Code TECE 3762
NQF Level 7
Contact Hours 2L + 1PS/week
Credits 8
Assessment Continuous 50%, Examination 50% (1 x 2 hour paper)
Co-requisite TECE3711 Electrical Engineering machines Analysis & Design
TECE3731 Fundamental of Power Systems

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

Exit Learning Outcomes:

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

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

Issue Date: January 2009
Next Revision: January 2013

YEAR 4 OF BSC (ELECTRICAL ENGINEERING)

SEMESTER 1

Module Title	**DIGITAL ELECTRONICS AND MICROPROCESSOR SYSTEMS**

Code	TECE3831
NQF Level	8
Contact Hours	3L + 1PS/Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TETE3621Principles of electronics Design, TCME3692 Object Oriented Programming

Module Description: Introduction to Digital Electronics: Binary arithmetic, combinational and sequential logic. Design and implementation using CMOS and TTL techniques, to include for example, loading, speed of operations, power dissipation. Hardware design of synchronous and asynchronous logic; flip-flops, registers, counter. **Microprocessors and Microcontrollers:** Introduction to microprocessor system basics, historical background, microprocessor technologies, number systems and codes, microprocessor based system structure and operation, arithmetic logic processing unit, memory devices, microprocessor architectures, designing central processing unit module, designing main memory unit, microprocessor instruction set, microprocessor programming techniques, microprocessor development systems, data communications, basic input/output techniques, microprocessor peripheral units, microprocessor based system applications of digital electronics and microprocessor systems e.g. industrial process control (e.g. speed control of a d.c. motor or similar), robotics, SCADA, vehicle electronics, domestic electronics or similar. Computer Simulation

Exit Learning Outcomes:

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

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

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	**POWER TRANSMISSION AND DISTRIBUTION**

Code	TECE3831
NQF Level	8
Contact Hours	4L + 1PS /Week
Credits	16
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites:	TECE 3782 Switching and Protection of High Voltage Systems, TECE3731 Fundamentals of Power systems

Module Description: Power transmission and distribution network architecture and composition; representation of system elements, per unit quantities, network equations and solutions, load curves; symmetrical components; parameters and equivalent circuits in symmetrical components for overhead and underground lines, transformers, generators and loads; substations; industrial networks; network steady-state analysis; faults; protection systems; switching equipment; voltage and power static control; power system stability and methods of improving stability, surge voltages and protection. Protection: Current and voltage transformers; symmetrical components, fault calculations, characteristics of protective relays; protection of transformers, generators, motors and transmission lines.

Exit Learning Outcomes:

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

- Understand of electric power distribution systems and equipment.
- Provide an insight into the main issues concerning the design and performance of a large power network
- Develop models and analytical techniques used in the calculation of the characteristics and specification of the main items of equipment involved in the generation, transmission and distribution and protection of electrical power
- Develop and demonstrate the use of system models for unsymmetrical fault analysis and load flow studies
- Analyse the stability of power systems and power system protection using appropriate software and tools

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	SOCIETY AND THE ENGINEER

Code TEGT3821
NQF Level 8
Contact Hours 2L + 1T/Week
Credits 8
Assessment Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite TEGT3421 Fundamentals of Engineering

Module Description: Professional ethics. Registration of Engineers. Societies for Professional Engineers. Engineer-society relationship. The engineer and the environment. **Safety and health at the work place.** Safety and health legislation. **Labour laws**. Trade Union laws. HIV/AIDS education and its impact on the workforce. **Intellectual property rights.**

Exit Learning Outcomes

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

- Describe the elements of professional ethics in engineering and the role played by professional engineering societies
- Demonstrate the role of the environment in determining the nature and location of engineering projects
- Demonstrate knowledge of safety and health issues at the work place
- Demonstrate knowledge of relevant labour laws as pertaining to engineering practice
- Describe the role of intellectual property rights in the design and innovation process

Issue Date: January 2009
Next Revision: January 2013

Module Title	CONTROL ENGINEERING

Code TETE3851
NQF Level 8
Contact Hours 4L + 1PSWeek
Credits 16
Assessment Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisite TEGT3671 Engineering Mathematics III

Module Description: Controllability and observability, state estimation and parameter identification. Design and analysis of feedback control system design using frequency-domain and state-space methods. Introduction to optimal control. Design of analogue and digital feedback control systems, review of functions and state variable models for continuous-time and discrete-time systems, sampling, relationship between poles locations and time response, frequency domain design, root locus design, continuous-time and discrete-time compensation techniques, state variable feedback and pole positioning design.

Exit Learning Outcomes

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

- Describe classical and modern control system with analysis techniques, controllability and observability
- Design and analyse feedback control systems using frequency-domain and state-space methods
- Design analogue and digital feedback control systems

Issue Date: January 2009
Next Revision: January 2013

Module Title	PROJECT MANAGEMENT FOR ENGINEERS

Code TEGT3861
NQF Level 8
Contact Hours 2L + 1T/Week
Credits 8
Assessment Continuous 50%; Examination 50% (1 x 2 hour paper)
Pre-requisite TEGT3682 Economics for Engineers

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

Exit Learning Outcomes

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

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

Issue Date: January 2009
Next Revision: January 2013

Module Title	COMPUTATION METHODS IN POWER ENGINEERING

Code	TECE 3891
NQF Level	8
Contact Hours	3L + 1PS /Week
Credits	12
Assessment	Continuous 50%, Examination 50% (1 x 3 hour paper)
Pre-requisites	TECE3782 Fundamental of Power Systems, TECE3782 Switching and Protection of High Voltage Systems

Module Description: Electric power system operation; development of models of transmission line components and networks; computer methods for solving linear and nonlinear systems of network equations; operating problems in load flow, scheduling and economic dispatch.
Load flow analysis – classification of system variables and generation to B – Bus system. Load flow solution using Gauss-Seidal and Newton-Raphson methods. Computer-aided short circuit analysis of large systems; transient stability analysis; overvoltage calculations; and fundamentals of power system protection

Exit Learning Outcomes

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

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

Issue Date:	January 2009
Next Revision:	January 2013

SEMESTER 2

Module Title	RESEARCH PROJECT

Code	TECE3839
NQF Level	8
Contact Hours	10 hours of research work per week
Credits	24
Assessment	Continuous 30% (Two seminar presentations) Dissertation 70% (20% Oral Presentation, 50% Written Dissertation)
Pre-requisite	All third year modules

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

Exit Learning Outcomes

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

- Demonstrate skills necessary to carry out a technological or engineering investigation.
- Carry out research and present research findings in a concise and comprehensive report.

Issue Date:	January 2009
Next Revision:	January 2013

Module Title	ELECTRICAL ENGINEERING DESIGN PROJECT

Code TECE 3819
NQF Level 8
Contact Hours 10 hours of design work per week
Credits 24
Assessment Continuous 30% (Two seminar presentations)
Design Presentation 70% (20% Oral Presentation, 50% Final Design)
Pre-requisite All third year modules

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

Exit Learning Outcomes

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

- Demonstrate practical skills in the design of engineering components, assemblies and/or systems
- Demonstrate knowledge of creativity, innovation, safety, ergonomics and good practice in the design process
- Present technical designs accompanied by detailed analysis, calculations and engineering drawings.

Issue Date: January 2009
Next Revision: January 2013

Module Title	INDUSTRIAL ATTACHMENT III

Code TEGT3800
NQF Level 8
Contact Hours Four (4) weeks each preferably during the July/August break in Year 4 of engineering. About 6 hours/day x 5 days/week) x 4 weeks = 120 total hours. Actual contact time taken is quarter of the total hours, i.e. 30 contact hours.
Credits 4
Assessment 100% Continuous Assessment, made up of Company Assessment (10%); Lecturer Assessment (10%); Daily Logbook (30%); Final Report (50%).
Co-requisite TEGT3700 Industrial Attachment II

Module Description: During Industrial Attachment III, students will work under company supervision at the level of Engineer Trainee and will undertake at least 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 supported by appropriate engineering drawings, design concepts or process charts for assessment at the beginning of the following semester. During attachment, students will be visited at their work place twice by their Lecturers.

Issue Date: January 2009
Next Revision: January 2013