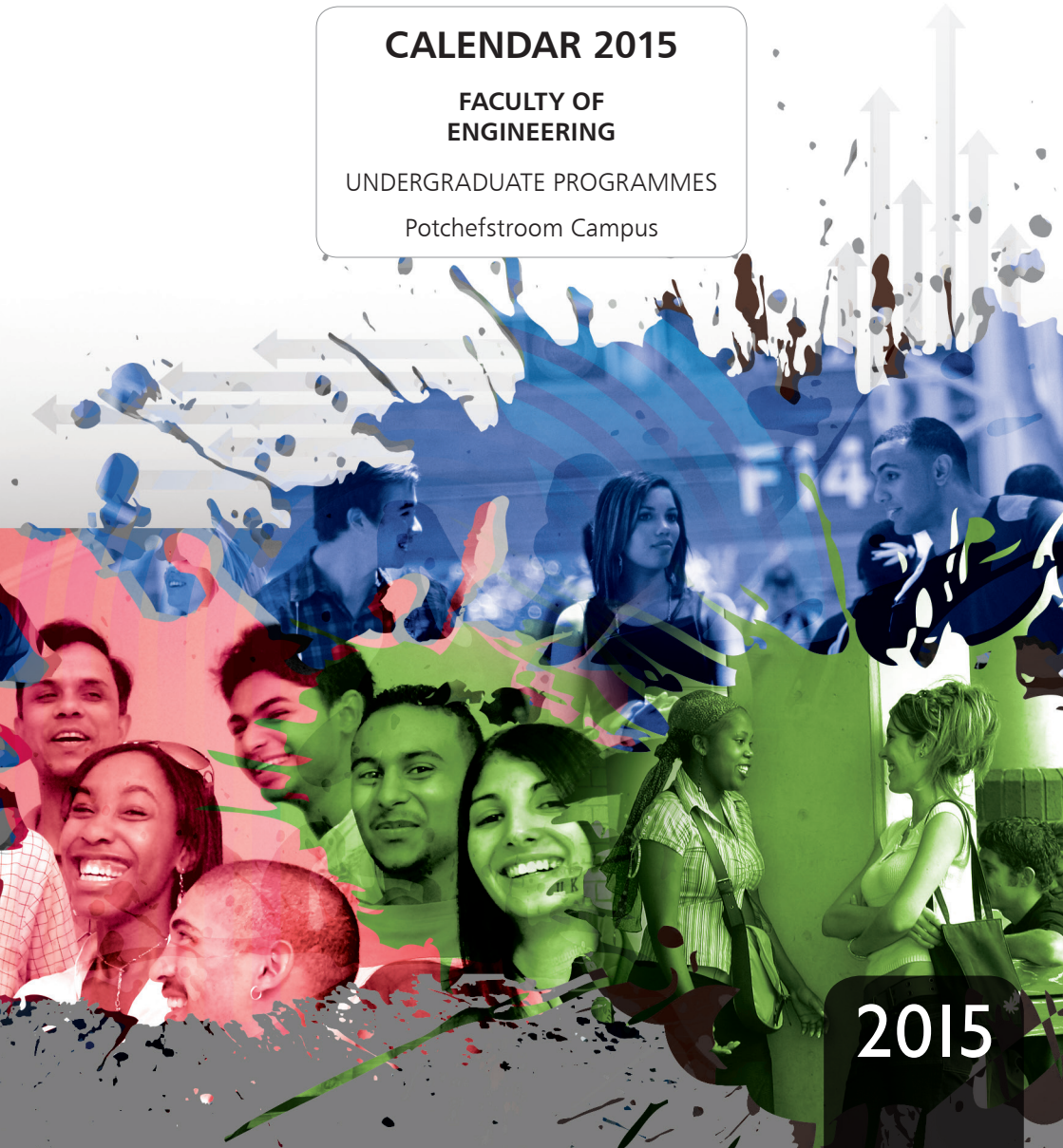
NORTH-WEST UNIVERSITY ®
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

CALENDAR 2015

FACULTY OF ENGINEERING

UNDERGRADUATE PROGRAMMES

Potchefstroom Campus



2015

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PLEASE MENTION YOUR UNIVERSITY NUMBER IN ALL CORRESPONDENCE.

The General Academic Rules of the University, to which all students have to subject themselves and which apply to all the qualifications offered by the University, appear in a separate publication and are available on the web page at: http://www.puk.ac.za/jaarboek/index_e.html.

Please note: Although the information in this Calendar has been compiled with the utmost care and accuracy, the Council and the Senate of the University accept no responsibility whatsoever for errors that may occur. Before students finally decide on the selection of modules, they must consult the class timetable. If a clash occurs in the planned selection of a student, the relevant module combination is not permitted.

TABLE OF CONTENTS

OFFICE BEARERS

DEAN

Prof LJ Grobler, PhD (University of Pretoria), CEM, CMVP, PrEng

SCHOOL DIRECTORS AND MANAGERS: FACULTY OF ENGINEERING

School of Chemical and Minerals Engineering
Prof FB Waanders, PrEng, PrSciNat, PhD (PU for CHE)

School of Electrical, Electronic and Computer Engineering
Prof JA de Kock, PrEng, PhD (Stellenbosch)

School of Mechanical and Nuclear Engineering
Prof JH Wichers, PrEng, PhD (PU vir CHO)

THRIP PROJECTS

Manager: Mnr AG Hattingh, PrIng, MEng (UP)
,

Centre for Research and Continued Engineering Development (Pretoria)
Manager: Prof EH Mathews, PrEng, PhD (US)

Centre for Research and Continued Engineering Development (Vaal Triangle)
Manager: Prof PW Stoker, PrEng, PhD (Eng)

TEACHING AND LEARNING AND QUALITY AFFAIRS

Chairperson Teaching and Learning Committee: Dr M le Roux, BEng (Chem), M.Eng (Chem), Ph.D (Eng) (NWU)
Ms V Pretorius (Senior Administrative Assistant)

RESEARCH DIRECTOR

Unit for Energy systems
Director: Prof ASJ Helberg,

ADMINISTRATIVE MANAGER (Undergraduate students)

Mrs MCJ Potgieter, BA (Communication) (PU for CHE), HonsBA (Library and Information Sciences (PU for CHE)

FACULTY COUNCIL

Chairperson:
Prof LJ Grobler (Dean)

School directors, programme managers and academic staff:

School of Chemical and Minerals Engineering
Prof FB Waanders (director)
Programme managers: Profs S Marx (Chemical Engineering) and HWJP Neomagus (post-graduates programmes)

School of Electrical, Electronic and Computer Engineering
Prof JA de Kock (director)
Programme managers: prof AJ Hoffman (Computer and Electronic Engineering) and Ms MJ Grobler (post-graduates programmes)

School of Mechanical and Nuclear Engineering
Prof JH Wichers (acting Director)
Programme managers: Drs L van Dyk (Mechanical and Industrial Engineering) and Dr J Janse Van Rensburg (post-graduates programmes)

Academic representative Faculty of Natural Sciences:
Prof HCM Vosloo

Teaching and Learning and Quality affairs
Dr M le Roux (chairperson Teaching and Learning Committee)
Ms V Pretorius (Senior Administrative Assistant)

THRIP-projects
Manager: Mnr AG Hattingh

Unit for energy systems:
Director: Prof ASJ Helberg

Centre for Research and Continued Engineering Development [CRCED (Pretoria)]
Manager: Prof EH Mathews

Centre for Research and Continued Engineering Development [CRCED (Vaal)]
Manager: Prof PW Stoker

Recruitment, Selection, Bursaries and Student Affairs
Manager: Ms EC Hattingh

Administrative manager (Undergraduate students)
Mrs MCJ Potgieter

Senior Administrative Officer: Post-Graduate Administration
Ms Y Viljoen

Student representative:
Chairperson: ESA

Engineering Faculty's representative on the Council of the Faculty of Natural Sciences:
Prof FB Waanders, *School of Chemical and Minerals Engineering*(director)

SCHOOL DIRECTORS: FACULTY OF NATURAL SCIENCES

School of Physical and Chemical Sciences
Prof CA Strydom, PrSciNat, PhD (UP)

School of Computer, Statistical and Mathematical Sciences
Prof GJ Groenewald, HonsBSc (UWC), MSc (Univ. of Illinois at Urbana-Champaign), MSc (UCT), PhD (Vrije Univ. Amsterdam).

I.1 INTRODUCTION

I.1.1 THE FACULTY

The Faculty of Engineering of the NW University officially came into existence in 1982. In 1992 the Faculty relocated from the Vaal Triangle to Potchefstroom. The Faculty comprises four schools offering training, teaching, post-graduate study and research in five specialised fields in Engineering.

The Faculty strives to

* instil scientific innovative thought, as well as generally form the student to empower him/her to fulfil his/her vocation and be proficient;
* deliver high-level manpower, equipped with the knowledge to succeed in a broad technological environment, with emphasis on the application of proven engineering and operational principles;
* exploit and develop by research new knowledge which will contribute to the development of the country and all its people;
* be a recognized centre of expertise, with high standards and with a unique character; and
* cultivate a spirit of innovation and entrepreneurship in students.

The Faculty offers research opportunities to promising persons who wish to pursue a research career after completion of the Bachelors degree (BEng) and are interested in postgraduate study towards a masters' degree (MEng) and/or the doctorate (PhD) in Engineering. In the Faculty of Engineering there are research centres of excellence, enjoying support from industry and statutory bodies. The Faculty may also award the higher doctorate (DEng) for outstanding research conducted without direct supervision.

For information regarding postgraduate study, you are referred to the Postgraduate Calendar.

I.1.2 THE ENGINEERING PROFESSION

I.1.2.1 The Role of the Professional Engineer

Engineering refers to the practice of the organising of the design, construction and operation of artefacts (products, processes or systems) which transform the physical world around us, in order to satisfy certain identified needs. Engineers study science and use it to solve problems of practical importance, typically by a process known as creative synthesis or design. Engineers are members of a profession and are responsible for the discerning application of their knowledge with a view to the sustainable economic progress and welfare of humanity.

Although engineering as a profession has its origin in the earliest development of humankind, it was only in the middle of the nineteenth century that scientific methodology was first systematically applied to solve engineering problems and when a start was made with the establishment of engineering schools, leading to engineering being recognized as a "learned profession".

With the impact of technology on our society engineering plays an increasingly important role with respect to economic development. Excellent work

opportunities exist for engineers in almost all sectors of the economy, both locally and overseas.

The purpose of the BEng degree is to equip students with the necessary knowledge to be able to practise as professional engineers.

I.1.2.2 Professional ethics

Engineers are subject to a professional code of conduct. The Engineering Council of South Africa (ECSA) is vested with powers to lay down standards for education and to register qualified persons as professional engineers. Registration as a Professional Engineer (PrEng) certifies that a person is authorised to practise as an engineer. ECSA also has the authority to take disciplinary action against engineers who are guilty of misconduct.

Due to the high ethical standards in the engineering profession it is improbable that a person who has been convicted and sentenced in a court of law or against whom disciplinary measures have been taken as a result of conduct which suggests dishonesty, will be admitted to the engineering profession, notwithstanding good academic results.

More information regarding the engineering profession is available on the website of the Engineering Council of South Africa at http://www.ecsa.co.za/.

I.1.3 PROFESSIONAL STATUS

The bachelors' degree awarded in the Faculty of Engineering is recognized by:

- The Engineering Council of South Africa (ECSA) as a qualifying degree for registration as professional engineer (PrEng) in terms of the Engineering Profession Act (Act nr 46 of 2000).
- The following Engineering societies for membership:

  SA Institute of Chemical Engineering (SACHI)
  SA Institute of Electrical Engineering (SAIChE)
  SA Institute of Mechanical Engineering (SAIMI)
  SA Institute of Mining and Metallurgy (SAIMM)

- Other local universities and universities abroad for advanced postgraduate study.

In terms of the Engineering Profession Act, ECSA requires that a graduate engineer has to undergo in-service training for a period of three years under the guidance of a professional engineer before registration as a Professional Engineer is possible. This period may be shortened with one year after obtaining an advanced university degree.

In terms of the Washington Accord, reached in June 2000 and of which South Africa is a signatory, the BEng degree awarded by this Faculty is also recognized in the USA, Canada, Australia, New Zealand, the UK and Hong Kong as a qualifying degree for registration as a professional engineer in those countries. Visit http://www.ecsa.co.za/ for more information.

I.1.4 SCHOOLS IN THE FACULTY OF ENGINEERING

The Faculty of Engineering consists of four Schools. At the head of each school is the Director who is assisted by programme leaders. The schools are responsible for teaching the undergraduate and graduate programmes. The

schools and the programmes offered in each school are shown in the following table:

School	Programmes
School of Chemical and Minerals Engineering	• Chemical Engineering • Chemical Engineering with specialization in Minerals Processing
School of Electrical , Electronic and Computer Engineering	• Electrical and Electronic Engineering • Computer and Electronic Engineering
School of Mechanical and Nuclear Engineering	• Mechanical Engineering • MEng in Nuclear Engineering • Industrial Engineering

Post graduate programmes:

Masters' and Doctoral level	Programmes
	• Bio Engineering • Chemical and Minerals Engineering • Electrical, Electronic and and Computer Engineering • Engineering Management • Mechanical Engineering • Nuclear Engineering

The director of the research Unit for Energy Systems is responsible for the management of the research component of the faculty, as well as for the masters and PhD programmes.

RESEARCH UNIT	Focus of research
UNIT FOR ENERGY SYSTEMS	• Nuclear Energy • Hydrogen Energy • Fossil Energy • Renewable Energy • Energy Management

Further information is available on the web page of the research unit at http://www.nwu.ac.za/p-fe/currentres.html

I.1.5 QUALIFICATIONS, PROGRAMMES AND CURRICULA

In the Faculty of Engineering different qualifications (degrees) can be obtained. A particular qualification can be obtained in one of five fields. In each programme a set curriculum is followed.

Information on and the rules for the different qualifications, study directions/ programmes and curricula for undergraduate study, are expounded in this Calendar.

The Faculty of Engineering is entitled to award the following degrees:

FIRST BACHELOR DEGREES				
Qualification	**Programme and Code**	**Curriculum and Code**	**Method of Delivery**	**NQF Level**
Bachelor of Engineering (BEng)	Chemical Engineering 700 105	I103P	Full-time	8
Bachelor of Engineering (BEng)	Chemical Engineering with specialization in Minerals Processing 700 106	I104P	Full-time	8
Bachelor of Engineering (BEng)	Electrical and Electronic Engineering 700 107	I203P	Full-time	8
Bachelor of Engineering (BEng)	Computer and Electronic Engineering 700 108	I204P	Full-time	8
Bachelor of Engineering (BEng)	Electro Mechanical Engineering 700 113	I205P	Full-time	8
Bachelor of Engineering (BEng)	Mechanical Engineering 700 109	I303P	Full-time	8
Bachelor of Engineering (BEng)	BEng Industrial Engineering 700 112	I304P	Full-time	8

I.1.6 EVALUATION OF ACADEMIC LITERACY

a) In order to evaluate their ability to function in an academic environment, all undergraduate students who register at the University for the first time must report for a compulsory skills test in academic literacy, at a time and place determined by the University. The purpose of this test is to identify students who, due to inadequate academic skills, may fail to complete their study programme within the stipulated period, (A.5.2).

b) Students have the option of writing the compulsory skills test in English or Afrikaans. With the exception of students who are identified as borderline cases by the test, each student has only one opportunity to write the test. Students, who are regarded as borderline cases, will be granted a second opportunity to write the test. It is the student's responsibility to establish his/her result within 14 days of writing the test and to register for the correct module and in in the correct semester.

c) Students who are regarded as at-risk cases must register for the module AGLA111 [Afrikaans] or AGLE111 [English], depending on the language in which the compulsory skills test was written. These modules are not calculated in terms of curriculum credits, but the credits earned in this way are regarded as additional credits.

d) Admission to the examination for AGLA111/AGLE111 requires a participation mark of 35%. Students who are not admitted to the examination for AGLA111/AGLE111 or who fail the relevant examination as well as two or more other modules, will have to be re-evaluated by the Evaluation Committee if they want to continue their studies in the following semester. In order to avoid the termination of studies, AGLA111/AGLE111 must be completed at the end of the student's second historic year, at the very latest. *AGLA/E121consists of three

papers, viz. Academic Literacy, Computer and Information Skills and Reading Skills. There is a subminimum in each of the three components. The student must pass each of the three components in the same semester in which he/she has registered for the module in order to pass the module.

e) *Engineering programmes include the compulsory module FIAP172 (24 credits), which includes the outcomes of AGLA121/AGLE121. Engineering students who failed the module AGLA111/AGLE111, but passed FIAP172, may have the result of AGLA111/AGLE111 conditionally condoned by the relevant School Director to allow for a pass mark in the module. A module mark of at least 40% for AGLA111/AGLE111 must have been obtained and this permission is only valid if FIAP172 is passed in the same year.

f) Admission to the module AGLA121/AGLE121, which is compulsory for all students who register at the University for the first time, requires that a student should first complete AGLA111/AGLE111 and must obtain a mark of at least 40% for AGLA111/AGLE111. The module AGLA121 / AGLE121 carries a value of 12 credits, forming part of the curriculum for which the student has registered, and must be taken in the language in which the compulsory skills test and AGLA111/AGLE111 were taken.

g) Students who failed the module AGLA111/AGLE111, but were allowed to continue with AGLA121/AGLE121 and who passed the examination in this module, may have the result of AGLA111 / AGLE111 condoned by the relevant School Director to allow for a pass mark in the module.

h) Students who have already successfully completed a module(s)/ course(s) equivalent to AGLA111,121/AGLE111,121 at another institution and can provide proof in this regard, may apply in writing to the Head of the Centre for Academic and Professional Language Practice for formal recognition.

I.1.7 WARNING AGAINST PLAGIARISM:

Assignments are individual tasks and not group activities (unless explicitly indicated as group activities). For further details see: http://www.puk.ac.za/beheer-bestuur/beleid-reels/index_e.html

I.1.8 CAPACITY STIPULATION

Please take cognizance of the fact that, owing to specific capacity constraints, the University reserves the right to select candidates for admission to certain fields of study. This means that prospective students who comply with the minimum requirements may not necessarily be admitted to the relevant course.

I.1.9 AUTHORITY OF THE GENERAL RULES

The Faculty Rules valid for the different qualifications, programmes and curricula of this faculty and contained in this faculty calendar are subject to the General Rules of the University, as determined from time to time by the Council of the University on recommendation of the Senate. The faculty rules should, therefore, be read in conjunction with the General Rules. See http://www.puk.ac.za/jaarboek/index.html

I.1.9.1 General provisions

In accordance with the General Academic Rules of the North-West University the following apply with regard to application and interpretation:

These rules must be read with and applied subject to the *Higher Education Act*, 1997 and the *Statute of the North-West University* and in conjunction with policies as determined by Senate and Council, such as, but not limited to, the Admission Policy, the Recognition of Prior Learning Policy and the Assessment and Moderation Policy, as well as the schedule of payable fees as determined annually by the University.

Senate must compile a manual for post-graduate studies within the framework of the provisions of these Rules, which manual has the status of a binding policy document of the University, in order to regulate matters relating to the preparation for, progress, guidance and completion of post-graduate studies.

Except where expressly provided for otherwise, these Rules apply to all qualification programmes listed in the Programme and Qualification Mix of the North-West University and offered by the University and prevail over faculty rules.

In instances where a faculty rule may contain provisions that are in conflict with these rules, the latter will prevail.

Where functions and decision-making authority are entrusted by these Rules to persons or structures, Senate or the campus senate committee concerned may at any time resolve to require the person or structure concerned to report on the performance of the relevant function or the making of the decision, and Senate or the campus senate committee concerned may, within the limits of reasonableness taking into account the implications for those affected thereby, replace or revoke the act or decision concerned. (General Rules 1.1).

I.1.10 REGISTRATION

The following General Rules for registration, apply:

A student may not be registered simultaneously at the University and at another higher education institution without written permission granted by the campus registrar concerned on recommendation of the dean concerned and with the concurrence of the other institution, (1.3.2).

A student may not be registered simultaneously for more than one qualification within the University without prior written permission granted by the campus registrar concerned on recommendation by the dean or deans concerned, (1.3.3).

Subject to specific exceptions granted by the campus registrar concerned, only registered students are entitled to utilize the University's facilities, (1.3.4).

By signing and submitting the application and registration forms either on paper or electronically a student agrees to be bound by all rules, policies and decisions of the University for the duration of the student's study at the University, (1.3.5).

A student who is admitted to and registered at the University continues to be a student of the University for the duration of the validity of the registration or until such time as the registration is validly terminated by the student or by the University, (1.3.6).

The University reserves the right to cancel any erroneous registration and to withdraw any qualification that was awarded erroneously after the conclusion of a disciplinary process or the completion of a thorough administrative enquiry, (1.3.7).

I.1.10.1 Annual registration

The following apply for annual registration (General Rules 2.3.1):

A student who has been admitted to the University registers for a specific qualification programme per annum or per semester for the duration of the study at the time determined in the annual calendar for that purpose, by paying the prescribed registration fee, completing the registration form either on paper or electronically, acquiring the required approval from faculty advisers and other functionaries concerned and submitting the form to the campus registrar concerned, upon which proof of registration is issued to the student, (2.3.1.1).

Students who attend lectures, write tests, submit assignments and who write examinations without officially being registered, receive no credits, even if the prescribed fees have been paid, (2.3.1.2).

A student registers on the date of registration in accordance with the rules relating to the qualification programme, curriculum and module concerned as provided for in faculty rules, (2.3.1.3).

It is the personal responsibility of the student to ensure that all requirements for registration for the qualification programme, curriculum and module are complied with and that no class, test or examination time table clashes between modules for which the student registers, will occur. The University reserves the right to refuse or cancel a registration where this condition is not met, (2.3.1.4).

A student may, in terms of the prescribed university procedures, change his/her registration within the period determined annually by the University.

I.1.10.2 Module exemptions

A student who has studied at another recognised higher education institution and who applies to register in a qualification programme at the University, may apply in writing to the dean concerned for recognition or exemption of modules required for the qualification programme for which the student wishes to register, provided that the dean may grant recognition or exemption for no more than half the credits, preferably regarding the modules in the junior year levels of the qualification programme concerned, (2.3.2.1).

A student who has acquired a qualification from the University or any other recognized higher education institution and who applies for registration in a qualification programme at the University, may apply in writing to the dean concerned for recognition or exemption of modules required for the qualification programme for which the student wishes to register, provided that the dean may grant recognition or exemption for no more than half of the credits, preferably regarding the modules in the junior year levels of the qualification programme concerned, (2.3.2.2).

Any registered student who wishes to change to a different curriculum, may within the framework of the applicable faculty rules, apply in writing to the dean concerned for the recognition or exemption of modules already passed which are included in the curriculum to which the student wishes to change, (2.3.2.3).

Faculty rules may stipulate that recognition or exemption of modules will apply for a specific period or that the dean may grant exemption or recognition of only certain modules, (2.3.2.4).

An undergraduate or diploma student who has written a module examination and has failed that module and has to repeat the module, may apply in writing to the dean concerned to be exempted in the year after the module was failed from the practical work in the module, in which case the student registers for the module and makes the necessary arrangements with the lecturer concerned for the transfer of the mark for practical work from the previous year in order to form part of the participation mark, (2.3.2.5).

A student who failed a module and has in the opinion of the relevant school director complied with the class attendance requirements in the previous year, may on the recommendation of the school director concerned be exempted once from class attendance in that module by the dean concerned, subject to conditions provided for in the faculty rules, (2.3.2.6).

I.2 RULES FOR THE DEGREE OF BACHELOR OF ENGINEERING

The BEng degree may be taken in one of five programmes:

- Chemical Engineering
- Chemical Engineering with specialization in Minerals Processing
- Electrical and Electronic Engineering
- Computer and Electronic Engineering
- Mechanical Engineering

These programmes, which are described in detail below, may be taken by full-time study only.

During their studies students may change from one programme to another or change the programmes for which they are registered only with the consent of the relevant school director.

I.2.1 FACULTY RULES

By virtue of General Rule 1.6 the following is stipulated:

i) Every faculty board makes, subject to these Rules, faculty rules with regard to the qualification programmes offered by the specific faculty and submits those rules to Senate for approval.

ii) Faculty rules may where appropriate, in addition to matters provided for in these Rules, provide for arrangements that may be necessary for the accommodation of qualification-specific requirements and faculty-specific procedures and structures.

iii) The venue or venues where every qualification programme or curriculum is presented as well as the method of delivery thereof, are determined by faculty rules within the framework of institutional policies.

iv) The minimum and maximum duration of a qualification programme and the required amount of credits for a module or qualification programme are set out in the faculty rules with regard to every module and the curriculum of every qualification programme.

v) Faculty rules are published in the calendar of the relevant faculty.

vi) Where faculty rules are amended before the next version of the calendar is published, steps that are reasonably necessary must be taken to bring the amendments to the attention of students who are affected thereby.

I.2.2 MINIMUM AND MAXIMUM DURATION

The minimum full-time study period for the degree is four years and the maximum time for the completion of the degree is six years.

I.2.3 ADMISSION REQUIREMENTS FOR THE QUALIFICATION

I.2.3.1 General

For admission to BEng degree studies the following apply:

Full matriculation exemption, with an APS score of at least 31, Mathematics level 6 (70-79%) and Physical Sciences level 5 (60-69%). Consult http://www.puk.ac.za/vstudente/index_e.html for the requirements for undergraduate studies and the calculation of the APS score

The Language requirement is a pass at level 5 (60-69%) in the language of instruction on either the Home or First Additional Language level.

The number of students allowed into a school may be restricted.

I.2.3.2 Selection test

Prospective first year applicants for any engineering programme, who comply with the minimum requirements as given above, must write an engineering admission test. June matric results are requires for the compulsory test.

a) Prospective students who do comply with the minimum admission requirements, with a APS score of 40, an average percentage of 80%, Mathematics 90% and Physical Sciences 80% will be accepted unconditionally. They write the test before registration.

b) Prospective students who do comply with the minimum admission requirements, with an average percentage of 65% or more, will be invited to write the engineering admission test.

c) Prospective students who do comply with the requirement of a APS count of 31, with an average percentage of less than 65%, will be on a waiting list

d) Prospective students who do not comply with the requirement of the APS count, will not be considered for admission.

Enquiries: Elza Hattingh
Project manager: Engineering
Elza.hattingh@nwu.ac.za
(018) 299 1318

I.2.3.3 Admission requirements: application switching from BSc to BEng

Prospective students who do not comply with the admission requirements for BEng programmes offered by the Faculty, register on year level 1 of a BSc programme in the Faculty of Natural Sciences.

At the end of his/her first year a new application for admission to a programme offered by the Faculty of Engineering can be submitted. Admission is subject to performance and the requirement that all the first year modules must be passed.

An engineering admission test must also be passed.

By virtue of General Rule 2.3.2.3 a student who desires to change to another curriculum has to apply, in writing, to the relevant Faculty for recognition of modules already passed and which form part of the curriculum to which he/she wants to change.

I.2.3.4 Joining from another university

a) Students who started their studies in Engineering at another university and who are desirous to continue their studies at this University, are strongly advised to complete only the first year level of the programme at that university before applying to continue with the second level programme at this University.

b) Applications from students who started their engineering studies at another university and who wish to continue at this university, will only be considered if the first year of study has been completed successfully at the previous university. An application to continue with the second year of the BEng programmes at this university, will be considered.

c) Students who studied Engineering at another university are subject to selection. Their applications for admittance to one of the BEng programmes will be treated on an *ad hoc* basis.

d) Students who studied Engineering at another university and who were not allowed to continue at that university, will not be allowed to register for any BEng programme at NWU.

e) Applications for admission to one of the BEng programmes for a particular year, close on **31 July** of the previous year and application for acceptances of modules on the grounds of corresponding modules passed at another university, must be directed to the Dean before the beginning of the academic year.

f) Students who started their studies in Engineering at another university and who are desirous to continue their studies at this University must, at the start of their study at the other university, already have complied with the admission requirements of the Faculty of Engineering of the NWU.

Technikon diplomats seeking admission to the Faculty must contact the Admissions Office. Every application will be judged on merit and previous learning will be taken into consideration.

Enquiries:
Admissions Office
Building F20
(018) 299 2624

I.2.4 RECOGNITION OF PRIOR LEARNING

The requirements regarding prior learning are stipulated in General Rules 2.3.2.3.

I.2.5 COMPOSITION OF THE CURRICULUM

I.2.5.1 Introduction

The curricula of all the undergraduate engineering programmes are compiled in order to comply with the exit level outcomes required by the Engineering Council of South Africa, namely

- engineering problem solving;
- application of scientific and engineering knowledge;
- engineering design and synthesis;
- investigations, experimentation and data analysis;

- engineering methods, skills and tools, including information technology;
- professional and general communication;
- impact of engineering activities on the environment;
- individual, team and multidisciplinary action;
- independent learning;
- professionalism and ethics.

The curriculum for the first year of study consists mainly of natural science modules, namely Chemistry, Mathematics, Applied Mathematics, Physics and Computer Programming. Certain introductory engineering modules are also presented in the first year. These include Professional Practice I in which the work of engineers in the different disciplines, the principles and theory of project management, the principles and theory of systems engineering, computer programmes such as Word, Excel and Power Point and learning, listening, reading and writing strategies are presented.

In the second year of study more engineering science modules are offered, together with selected natural science modules, which differ for the different branches.

The curricula for the third and fourth years of study consist mainly of engineering science modules with a few science and management modules. In the final year the emphasis is on design and synthesis, with design and project modules fulfilling an important part.

While formal modules in computer science and information technology are offered up to second year level, great emphasis is placed throughout the curriculum on computer applications in engineering.

I.2.5.2 Qualification outcomes

Knowledge

At the end of his/her studies the student will have scientific knowledge and insight stretching across one or more areas. This will include factual knowledge, but especially also knowledge of and insight into concepts, structures, procedures, models, theories, principles, research methods and the place and boundaries of science in human existence.

Skills

At the end of the study the student should be able to demonstrate competence to:

Identify, assess, formulate and solve convergent and divergent engineering problems creatively and innovatively;

Apply knowledge of mathematics, basic science and engineering sciences from first principles to solve engineering problems;

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

Design and conduct investigations and experiments;

Use appropriate engineering methods, skills and tools, including those based on information technology; and

Communicate effectively with engineering audiences and the community at large, both orally and in writing.

Values

The following values are pursued:

Critical awareness of the impact of engineering activity on the social, industrial and physical environment.

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

Competence to engage in independent learning through well-developed learning skills.

Critical awareness of the need to act professionally and ethically and to exercise judgement and take responsibility within own limits of competence.

I.2.5.3 Articulation possibilities

After the successful completion of a programme those graduates who performed satisfactorily, will have direct access to the masters' study in one of the core modules of the programme.

Credit will be given for modules passed in other faculties or at other universities, provided those modules contribute to the outcomes and total credit requirements of the relevant programme.

The basic and applied skills which the graduates, with this qualification, will have acquired in the mathematical, computer and basic scientific and engineering disciplines, will equip them to continue with learning in various specialized areas at other institutions.

I.2.5.4 Relationship between credits, teaching periods and examination papers

Modules are grouped according to their level of advancement, which may also be related to the year of study in which the modules are taken in a specific programme, if the programme is to be completed in the minimum study period.

The engineering curricula are put together with a view to the minimum period of four years (BEng degree) or three years (BSc degree). A Student may apply to spread the modules of a programme over a longer period. Extension of the maximum study time of a programme due to a lack of progression by the student, will only be allowed in exceptional circumstances.

The order in which the modules are taken is not arbitrary, but is designed to ensure that subsequent learning builds on previous learning.

I.2.6 FACULTY-SPECIFIC RULES FOR THE QUALIFICATION

I.2.6.1 Language

The full-time undergraduate BEng programmes are presented in Afrikaans. Interpretation from Afrikaans to English is available in all engineering modules. In all programmes the examinations and other evaluations may be written and correspondence conducted in either Afrikaans or English.

I.2.6.2 Transition measures

The director of every relevant school, in consultation with the programme leaders, will issue, where necessary, transition measures aimed at making the transition from existing programmes to new programmes possible.

I.2.6.3 Registration according to time-table

A student is not allowed to register for a module if, according to the standard time-table for lectures, tests and examinations, there is a schedule clash with respect to another module for which the student is registered.

If a module has to be repeated the relevant module has again to be taken and a participation mark built again. No exemption from class attendance will be given.

Before deciding finally on the choice of modules, students must take full cognizance of the class time-table. If the intended choice leads to a clash, the relevant choice is not allowed.

Such cases must be discussed with the relevant persons at the Faculty administration.

I.2.7 EXAMINATION

I.2.7.1 Admission to examination

The requirements regarding undergraduate examination are stipulated in General Rule 2.4.

A student who achieved the required participation mark or proof of participation prescribed by the faculty rules, is admitted to the examination in the module concerned.

"Proof of participation" is a confirmation by the lecturer in a specific module that a student participated satisfactorily in the teaching-learning activities and in the performance of teaching-learning assignments in accordance with the curriculum requirements, whereby the student is admitted to a final assessment in that module or part of that module.

In the Faculty of Engineering a minimum participation mark of 40% must be achieved for admission to the examination.

The participation mark for a module is made up of marks for tests, assignments and practical work. For each teaching-learning task (class tests, assignments, reports, etc.) executed by means of formative assessment in a module, a mark will be awarded. A student's participation mark is the weighted average of these marks.

Admission to the examination in any module is obtained by the achievement of a proof of participation which will only be issued to a student if he/she

a) has fulfilled the specific requirements required for the relevant module as explained in the study guide;

b) where applicable, has completed the practical work required for a module; and

c) has achieved a participation mark of at least 40%.

The relationship between theory and practical work for the calculation of the participation mark of a module is explained in the relevant study guide.

The proof of participation the student achieved for a module for the first examination opportunity, is carried over to the second examination opportunity.

I.2.7.2 Pass requirements

By virtue of General Rule 2.4.3 the following applies for the Faculty of Engineering:

A final assessment mark in a module will be considered a pass mark if a student, admitted to assessment, has attained the required final module mark of at least 50% in the assessment and provided that the sub-minimum as laid down in the faculty rules has been achieved. (For Engineering modules 40% is the sub-minimum for the examination).

Where a first-time entering student who has registered for the first time for an undergraduate programme at the University fails any first-year module with no less than 40% in the first semester, but achieves an examination mark of at least 50% in that module, the school director concerned may allocate a pass mark of 50% to the student, (2.4.3.2).

The final module mark is made up in accordance with the faculty rules, of the mark attained by the student in the examination and the participation mark in respect of the module, provided that in the calculation of the module mark the weight attached to the participation mark will not be less than 30% and not more than 70%, depending on the specific requirements of the different academic disciplines. The sub-minimum for examinations in all modules will be 40% except where a higher sub-minimum has been laid down in the faculty rules, (2.3.3.1).

The module mark for each module is, therefore, calculated by the average of the participation mark and the examination mark. The relevant study guide must explain the calculation if it differs from the above. General Rule 2.3.3.1 must be applied.

For all modules being moderated by an external examiner, the final results obtained will be those awarded after the process has be finalised according to Faculty procedures and guidelines for this.

I.2.7.3 Number of examination opportunities

The number of examination opportunities are in accordance with General Rule 2.4.4.

For undergraduate examinations there are two examination opportunities per module, of which the student may utilise one or both.

A student who utilises the second examination opportunity will be liable for the prescribed fee.

Where the student utilises both opportunities, the module mark is calculated with reference to the participation mark which gave admission to the first examination opportunity and the mark achieved in the second examination.

Faculty rules may exclude specific modules from a second examination opportunity.

A student who, having used all ordinary examination opportunities, has passed all modules but one required for a qualification, may apply to the dean concerned to be granted a final assessment opportunity in the outstanding module, provided that the student was registered for that module in that academic year and had a participation mark that admitted him/her to the examination, (2.4.4.5).

The proof of participation the student achieved for a module for the first examination opportunity, is carried over to the second examination opportunity.

I.2.7.4 Medical certificates for absence

No medical certificate is required for missed examinations: students must avail themselves of the first and/or the second examination opportunity.

Regarding absence from a semester test due to illness a valid medical certificate, which attests to the students inability to write the test, has to be handed in. This certificate has to be submitted to the school director within five working days of the consultation with the doctor, or the date of the test, whichever was first.

I.2.7.5 Repetition of modules

If a student does not pass either of the two examination opportunities following the achievement of a participation mark for a relevant module, the module must be repeated and a new participation mark built up.

Furthermore, it is assumed that if a module is discontinued after the semester test, it will be considered that the module has been taken during that semester.

I.2.7.6 Registration for additional modules

General Rules 2.3.4 stipulate:

A student who registers for the first year level of a curriculum may only be allowed to register additionally for one module on first year level per semester not required for the curriculum concerned, provided that no timetable clashes are brought about thereby.

A student who has already passed the first year of a curriculum may, with the permission of the dean concerned – which may be granted in accordance with the faculty rules - register for a maximum of two modules per semester or two year modules or one semester module and one year module, additional to the modules required for the curriculum, provided that no timetable clashes are brought about thereby and that the student passed all the modules of the previous semester.

A student who failed modules may in accordance with the faculty rules be allowed by the dean concerned to register for a maximum of two modules per semester or two year modules or one semester module and one year module, additional to the modules required for the curriculum, provided that no timetable clashes are brought about thereby.

Where a dean is satisfied that a particular student should be allowed to register for more modules than provided for in 2.3.4.1, 2.3.4.2 or 2.3.4.3 above, the specific decision is subject to the approval of the relevant faculty board.

I.2.8 ASSUMED LEARNING-BASED PROGRESS IN A CURRICULUM

In compiling each curriculum care has been taken that assumed learning, i.e. the necessary prior knowledge and the general level of insight and experience needed to complete the modules prescribed in a specific semester of a curriculum with ease, have been acquired in the preceding semesters.

A student, having failed one or more modules in a preceding semester will, therefore, probably not be adequately equipped to take the modules of the following semester. Such students are advised to consult the director of the relevant school beforehand to find out which modules of the semester concerned they may take with a reasonable expectancy of success.

The aim of the rules is to make sure that a student in any semester will only take those modules for which he has at least the minimum prior knowledge.

When students change from one programme to another, the entrance level in the new programme will have to be determined in consultation with the director of the school under which the relevant curriculum falls.

A module in any curriculum may only be taken if it conforms to the requirements regarding the assumed learning, as indicated in the list of modules.

I.2.8.1 Requirements with respect to assumed prior learning

Regarding the requirements with respect to assumed prior learning of engineering modules, the following apply:

a) Where a first semester module in a certain year level is a prerequisite for assumed prior learning of a second semester module, or a module from one year level is a prerequisite with respect to assumed prior learning of a module of the following year level, a pass mark (module mark) of at least 50% has to be achieved in that prerequisite module, before the following module may be taken.

b) An auxiliary module has to be taken in the same semester as the module on which it has a bearing.

c) A student registered for a degree that leads to professional or statutory registration (i.e. BEng programmes too) may only register for final year modules after all preceding modules have been passed (General Rule 2.3.3.4).

I.2.9 UNSATISFACTORY ACADEMIC PERFORMANCE

Subject to exceptions that may be provided for in faculty rules, "unsatisfactory academic performance" means that a full-time student achieves in a semester less than half the credits required for the curriculum concerned or passes less than half of the modules registered for in the semester.

A student whose academic performance is unsatisfactory receives a formal warning from the dean and is referred for academic advice and study counselling, (General Rule 2.4.7).

In terms of the above the following procedure will apply in the Faculty of Engineering:

A student's studies can be terminated if he/she has already received **three** written warnings from the Faculty. A warning letter is issued when:

i) a student has in one semester not obtained admission to the examination for half or more of the modules, and/or fails half or more modules in the examination;

ii) in any three semesters a student does not achieve at least half of the work/credits prescribed for the three semesters;

iii) a student fails a module twice or more; and

iv) it appears that the maximum duration for the degree will be exceeded.

Students, who do not perform satisfactorily in terms of these rules, probably do not have the aptitude or motivation to complete the relevant curriculum successfully.

I.2.10 TERMINATION OF STUDIES

In terms of General Rule 2.4.8, the Rules following below apply in the Faculty of Engineering:

Where a student has already received three warnings from the dean as referred to in 2.4.7.2 and fails for the fourth time to show satisfactory academic performance, or did not obtain permission as referred to in 2.4.6.1 to exceed the maximum duration of the study period, the campus rector may, on the advice of the dean concerned, terminate the student's studies, and must report such termination to Senate.

A student whose studies have been terminated is not admitted to the same study programme in the subsequent academic year.

A student whose studies have been terminated may apply in the normal manner to be admitted to another study programme, but must in the course of the application mention the termination.

in the event of an application for re-admission the dean concerned has the discretionary authority to set reasonable conditions for such re-admission and must report such conditions to the Vice-Rector.

I.2.11 PRACTICAL TRAINING IN INDUSTRY DURING STUDY PERIOD

Specified training in industry during December/January or July is compulsory for all students. Arrangements in this regard will be made with the assistance of the Faculty Administration. Complete information about arrangements will be made available to all students at the beginning of each year of study, and every student is expected to make application according to the Rules. The training consists of the following:

I.2.11.1.1 Vacation training for first years (Workshop Practice)

During the first or second year of study, students are required to attend a two-week module in Workshop Practice. A short report on the training received by students, privately or with their sponsors, must be handed in on returning to the University. Students register for this module at the University, only after completion and handing in of the report.

Bursars must preferably complete the module at their sponsor's facilities. Non-bursars may complete the module with any company/person, provided prior permission is obtained from the Faculty.

Workshop training is a prerequisite for the module Final year Project.

I.2.11.1.2 Occupational safety course

It is expected of all students in their third year of study to complete a course in occupational safety (SHE Solutions).

After the successful completion of the course, a certificate will be issued, of which a certified copy will have to be handed in, together with the report after completion of the discipline-specific training at the end of the third year.

I.2.11.1.3 Vacation training for seniors (discipline-specific)

During, or after completion of the third year of study, a student has to undergo discipline-specific training with a minimum duration of six weeks.

If a student can prove that he/she has been unsuccessful to arrange vacation training at a company, a special concession will be made to him/her to receive accelerated vacation training at a Faculty-approved company during the July vacation. No remuneration will be receivable and, possibly, costs will be incurred in arranging the training.

A report on the training, as well as an employer's report, has to be handed in when the student returns to the University. Students register for this module at the University, only after completion and handing in of the report.

The completion of a short course in occupational safety, presented at the University, is a precondition for the module.

I.2.12 ATTAINMENT OF QUALIFICATION

I.2.12.1 Satisfaction of requirements

The BEng degree is obtained when a student has passed in the examination of all the modules prescribed for the curriculum concerned.

I.2.12.2 Awarding the degree with distinction

In order to receive the degree of Bachelor of Engineering with distinction, a student must complete the degree in the minimum period (four years) and must have achieved a weighted average of 75% for all the modules of the degree over the four years of study.

In the calculation the credit values of modules are also taken into account. Furthermore, year one will count 10%, year two 20%, year three 30% and year four 40 % of the total average.

A student must pass all modules of a relevant engineering programme at the NWU Potchefstroom campus. No module passed elsewhere can be presented with a view to the awarding of the degree with distinction.

A module is passed with distinction if a module mark of 75% is achieved.

I.2.13 OTHER REGULATIONS

I.2.13.1 Equipment

A lecturer has the right, with the consent of the Director, to expect students to acquire certain basic equipment, computer equipment, software, components or consumables if the use of such equipment or material will enhance the value of the module. In considering the possible enhancement of the value of the module, the lecturer will keep the financial implications in mind.

From the second year of study every student has to possess a personal computer (PC). The computer has to be Windows compatible with a hard disk and colour monitor. All assignments in all modules in the Faculty have to be completed using a word processing package.

I.2.13.2 Network services

It is expected of all fourth year students in the Faculty of Engineering to have full access to international e-mail, Internet and WWW in order to facilitate the completion of their mini-theses.

Access to these services will be supplied by the LAN of each school and via the Uninet with the co-operation and under the final supervision of the division of Information Technology, Potchefstroom Campus.

All regulations issued by the University, and revised from time to time, with respect to the use of the computer facilities of the University, will also be applicable to students and the services utilized by them. Regulations issued by the Faculty of Engineering, and revised from time to time, are also relevant. Any transgression of these Regulations may lead to disciplinary steps.

I.2.13.3 Use of pocket calculators during examinations

The following policy with respect to calculators has been approved:

a) Prescribed calculators may be used, but are not supplied centrally.
b) If the calculators in question cannot be described adequately, the examiner must be present in person in order to check the calculators.
c) The chief invigilator must, at the start of each examination session/test, direct the candidates' attention specifically to the requirement that only calculators indicated on the examination paper may be used.
d) No student may borrow a calculator from another student during an examination/test session.
e) Any deviation from these Regulations will constitute an infringement of the examination and test Regulations.
f) Regarding the use of non-standard calculators during examinations, the following applies:
g) In exceptional cases, permission for the use of non-standard calculators may be given. An application with motivation to this effect has to be handed in two weeks before the commencement of the examination. In each case measures must be taken to clear the memory of the calculator before it is taken into the examination hall. On each examination paper it must be stated whether a pocket calculator with memory may be used and, if so, that the memory must be cleared. The student and the invigilator must ascertain this and they then have to sign a statement to this effect.

I.3 SCHOOL OF CHEMICAL AND MINERALS ENGINEERING

Two BEng programmes, Chemical Engineering and Chemical Engineering with specialization in Minerals Processing, are offered in the School.

Chemical Engineers are involved in the research, design, development and management of industrial processes where raw materials are converted to products with higher economic value.

Chemical Engineering involves the research, development, construction, operation and management of those industrial processes in which raw materials are transformed by chemical or physical means to products with a higher economic value. These processes are concerned with the areas of plastics, synthetic fibres, oil refining, explosives, food processing, fertilisers, pharmaceutical drugs and nuclear installations. The modern chemical engineer may be involved in any stage, from the conception phase of a process to the sale of the final product.

These processes exist in the manufacturing of plastic, synthetic fibres, fuel refining, explosives, processing of foods, fertilisers, pharmaceutical and nuclear industries. Think of processes such as the ones that turn corn to cornflakes, hops to beer, coal to petrol and algae to electricity.

Minerals Processing is a specialist field in Chemical Engineering and deals with the physical and chemical processes used especially to extract metals from ores.

I.3.1 CHANGING A PROGRAMME

During their study, students may only change their programme with the consent of the School Director.

I.3.2 PRESCRIBED MODULES

In the curriculum of each programme there are a number of compulsory modules: FIAP172, FIAP271 (Professional Practice I and II), WVTS211 (Understanding the Technological World) and WVIS321 (Science, Technology and Society). A fixed curriculum is followed for both branches.

I.3.3 TOTAL CREDIT VALUE OF PROGRAMMES

The curricula of the programmes in this branch of engineering consist of modules with a total credit value of at least **624** for Chemical Engineering and **632** for Chemical Engineering with specialization in Minerals Processing.

In the following programme curricula, the total number of credits is spread over four years of study.

I.3.4 CURRICULA

I.3.4.1 Curriculum I103P: **BEng Chemical Engineering**

Qualification code 700 105

Compilation of curriculum

This curriculum is composed as follows:

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
CHEM111	Introductory Inorganic and Physical Chemistry	C	12
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
ITRW112	Introduction to Computers and Programming	C	12
WISN111	Introductory Algebra and Analysis I	C	12
FIAP172	Professional Practice I *(year module)*	F	24

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI121	Process Principles I	C	16
CHEM121	Introductory Organic Chemistry	C	12
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
ITRW126	Programming for Engineers (Visual Basic)	C	12
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
CEMI211	Materials and Corrosion (*offered as from 2011)*	C	12
EERI212	Electrotechnics	C	16
CHEN211	Analytical Methods I	C	8
TGWN211	Dynamics I	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8
WVTS211	Understanding the Technological World	F	12
FIAP271	Professional Practice II *(year module)*	F	24
MEGI271	Workshop Practice vacation training	C	8

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI222	Chemical Thermodynamics I	C	16
CEMI224	Process Principles II	C	8
CHEN223	Organic Chemistry II	C	8
TGWN222	Numerical Analysis	C	8
WISN221	Analysis IV	C	8
WISN222	Linear Algebra II	C	8
FIAP271	Professional Practice II *(year module)*	F	

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
CEMI311	Transport Phenomena I	C	16
CEMI313	Chemical Thermodynamics II	C	16
CEMI315	Biotechnology I	C	8

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI321	Transport Phenomena II	C	16
CEMI322	Separation Processes I	C	16
CEMI323	Chemical Reactor Theory I	C	16

YEAR LEVEL 3 (continued)			
First semester			
Code	**Module name**	**C/F**	**Cr**
CEMI316	Particle Systems	C	16
STTK312	Engineering Statistic	F	16
TGWN312	Partial Differential Equations (Numerical)	C	16

YEAR LEVEL 3 (continued)			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI326	Process Modelling for Control (*new module from 2015)*	C	16
CEMI328	Plant Design I	C	12
WVIS321	Science, Technology and Society	F	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
BIOT411	Biotechnology II	F	16
CEMI411	Separation Processes II	C	16
CEMI414	Process Control	C	16
CEMI415	Chemical Reactor Theory II	C	16

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI477	Plant Design II *(year module)*	32	C
CEMI479	Project *(year module)*	28	C
CEMI471	Vacation Training seniors	8	C

BEng Chemical Engineering I103P (700 105)							
Year level 1		**Year level 2**		**Year level 3**		**Year level 4**	
1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.
48	100	80	88	88	88	64	68
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
148		**168**		**176**		**132**	
Total credits of programme: 624							

I.3.4.2 Curriculum I104P: **BEng Chemical Engineering with specialization in Minerals Processing**

Qualification code 700 106

I.3.4.2.1 Total number of credits

Re-alignment of programmes and modules between the three campuses of the NWU has occurred. The implementation of revised programmes for the Faculty of Engineering began in 2010.

Credits and contents of modules are revised and a few adjustments have been made to the programmes. The credit values indicated in the tables below are those of the new programmes and for seniors they differ as a result of adjustments forced by the phasing out of old programmes.

I.3.4.2.2 Compilation of curriculum

This curriculum is composed as follows:

YEAR LEVEL 1			
First semester			
Code	Module name	C/F	Cr
CHEM111	Introductory Inorganic and Physical Chemistry	C	12
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
ITRW112	Introduction to Computers and Programming	C	12
WISN111	Introductory Algebra and Analysis I	C	12
FIAP172	Professional Practice I *(year module)*	F	24

YEAR LEVEL 1			
Second semester			
Code	Module name	C/F	Cr
CEMI121	Process Principles I	F	16
CHEM121	Introductory Organic Chemistry	C	12
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
ITRW126	Programming for Engineers (Visual Basic)	C	12
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	

YEAR LEVEL 2			
First semester			
Code	Module name	C/F	Cr
CEMI211	Materials and Corrosion *(as from 2011)*	C	12
EERI212	Electrotechnics	C	16
CHEN211	Analytical Methods I	C	8
TGWN211	Dynamics I	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8
WVTS211	Understanding the Technological World	F	12
FIAP271	Professional Practice II *(year module)*	F	24
MEGI271	Workshop Practice vacation training	C	8

YEAR LEVEL 2			
Second semester			
Code	Module name	C/F	Cr
CEMI222	Chemical Thermodynamics I	C	16
CEMI224	Process Principles II	C	8
CHEN223	Organic Chemistry II	C	8
TGWN222	Numerical Analysis	C	8
WISN221	Analysis IV	C	8
WISN222	Linear Algebra II	C	8
FIAP271	Professional Practice II *(year module)*	F	

YEAR LEVEL 3			
First semester			
Code	Module name	C/F	Cr
CEMI311	Transport Phenomena I	C	16
CEMI313	Chemical Thermodynamics II	C	16
CEMI316	Particle Systems	C	16

YEAR LEVEL 3			
Second semester			
Code	Module name	C/F	Cr
CEMI321	Transport Phenomena II	C	16
CEMI322	Separation Processes I	C	16
CEMI323	Chemical Reactor Theory I	C	16

YEAR LEVEL 3 (continued)			
First semester			
Code	**Module name**	**C/F**	**Cr**
GENL311	Mineralogy and Petrology	C	16
STTK312	Engineering Statistic	C	16
TGWN312	Partial Differential Equations (Numerical)	C	16

YEAR LEVEL 3 (continued)			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI326	Process Modelling for Control *(new module from 2015)*	C	16
CEMI328	Plant Design I	C	12
WVIS321	Science, Technology and Society	F	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
CEMI411	Separation Processes II	C	16
CEMI414	Process Control	C	16
CEMI418	Ore Dressing	C	16
CEMI419	Pyrometallurgy	C	16

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI477	Plant Design II *(year module)*	C	32
CEMI479	Project *(year module)*	C	16
CEMI471	Vacation Training seniors	C	8

BEng Chemical Engineering with specialization in Minerals Processing
I104P (700 106)

Year level 1		**Year level 2**		**Year level 3**		**Year level 4**	
1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.
48	100	80	88	96	88	64	68
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
148		**168**		**184**		**132**	

Total credits of programme: 632

I.4 SCHOOL OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

Three BEng programmes, Electrical and Electronic Engineering, Computer and Electronic Engineering and a new programme in Electromechanical Engineering (starting in 2015) are offered in this School.

Electrical Engineers are mostly involved with the generation, management, distribution, design, manufacturing, application and maintenance of electrical and power generation systems.

Electronic Engineers are involved in the testing, development, transmission and signal processing of data and the application of these in information and management systems. It also includes the design and manufacturing of components and circuits for amplifiers, radio transmitters, computers, transistors, integrated circuits, microwaves, super conductors and the prevention of noise in electronic objects.

Computer Engineers are mostly involved with the development of software for microelectronic circuits. These are used in computer systems, which in turn have a wide application in all the branches of electric, electronic and computer engineering. Microchips and super electronic systems form the basis of most electric and electronic devices in the industry, consumer market, the medical field, telecommunication, process management, power distribution systems, transport systems, avionics and specialised applications like artificial intelligence systems.

Electromechanical Engineers bring the principles of electrical and mechanical engineering to the workplace. Many products, like computers, satellites and vehicles, are both electrical and mechanical. Electromechanical engineers need to have strong technical skills and also a creative trend to design good products with good electrical and mechanical features.

Electromechanical engineering refers to the analysis, design, manufacture and maintenance of equipment and products based on the combination of electrical/electronic circuits and mechanical systems.

I.4.1 CHANGING A PROGRAMME

During their study, students may only change their programme with the consent of the relevant School Director.

I.4.2 PRESCRIBED MODULES

In the curriculum of each programme there are a number of compulsory modules: FIAP172, FIAP271 (Professional Practice I and II), WVTS211 (Understanding the Technological World) and WVIS321 (Science, Technology and Society). A fixed curriculum is followed for both branches.

I.4.3 TOTAL CREDIT VALUE OF PROGRAMMES

The curricula of the programmes in this branch of engineering consist of modules with a total credit value of at least **632** for Electrical and Electronic Engineering and **632** for Computer and Electronic Engineering.

In the following programme curricula, the total number of credit points is spread over four years of study.

I.4.4 CURRICULA

I.4.4.1 Curriculum I203P: **BEng Electrical and Electronic Engineering**

Qualification code 700 107

Compilation of curriculum

This curriculum is composed as follows:

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI112	Computer Engineering I	C	16
FIAP172	Professional Practice I *(year module)*	F	24
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
INGM111	Engineering Graphics I	C	12
ITRW115	Programming for Engineers I (C++)	C	12
WISN111	Introductory Algebra and Analysis I	C	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI123	Computer Engineering II	C	16
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
INGM122	Materials Science I	C	16
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	24

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI213	Electrotechnics II	C	16
FSKS211	Electricity and Magnetism	C	8
TGWN211	Dynamics I	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8
WVTS211	Understanding the Technological World	F	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI221	Electrical Systems I	C	16
EERI222	Signal Theory I	C	16
EERI223	Electronics I	C	16
EERI224	Linear Systems	C	12
TGWN222	Numerical Analysis	C	8
WISN221	Analysis IV	C	8
WISN222	Linear Algebra II	C	8
FIAP271	Professional Practice II *(year module)*	F	24
MEGI271	Workshop Practice vacation training	C	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI311	Electrical Systems II	C	16
EERI313	Electromagnetics	C	16
EERI315	Signal Theory II	C	16
EERI316	Engineering Programming II	C	16
STTK312	Engineering Statistic	C	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EEII321	Power Systems I	C	16
EEII327	Electrical Design	C	16
EERI321	Control Theory I	C	16
EERI322	Electronics II	C	16
WVIS321	Science, Technology and Society	F	12

YEAR LEVEL 4			
First semester			
Code	Module name	C/F	Cr
EEII411	Power Systems II	C	16
EERI412	Electronics III	C	16
EERI413	Signal Theory III	C	16
EERI418	Control Theory II	C	16
EERI419	Project	C	8

YEAR LEVEL 4			
Second semester			
Code	Module name	C/F	Cr
EEII421	Power Electronics	C	16
EERI423	Telecommunication Systems	C	16
EERI429	Project (continued)	C	16
EERI471	Vacation Training seniors	C	8
EERI472	Introduction to Project Management	C	8

BEng Electrical and Electronic Engineering I203P (700 107)							
Year level 1		Year level 2		Year level 3		Year level 4	
1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.
64	92	68	116	80	76	72	64
Total: year level 1		Total: year level 2		Total: year level 3		Total: year level 4	
156		184		156		136	
Total credits of program: 632							

I.4.4.2 Curriculum I204P: **BEng Computer and Electronic Engineering**

Qualification code 700 108

Compilation of curriculum

This curriculum is composed as follows:

YEAR LEVEL 1			
First semester			
Code	Module name	C/F	Cr
EERI112	Computer Engineering I	C	16
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
INGM111	Engineering Graphics I	C	12
ITRW115	Programming for Engineers I (C++)	C	12
WISN111	Introductory Algebra and Analysis I	C	12

YEAR LEVEL 1			
Second semester			
Code	Module name	C/F	Cr
EERI123	Computer Engineering II	C	16
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
INGM122	Materials Science I	C	16
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	24

YEAR LEVEL 2			
First semester			
Code	Module name	C/F	Cr
EERI213	Electrotechnics	C	16
EERI214	Engineering - programming I	K	8
FSKS211	Electricity and Magnetism	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8

YEAR LEVEL 2			
Second semester			
Code	Module name	C/F	Cr
EERI222	Signal Theory I	C	16
EERI223	Electronics I	C	16
EERI224	Linear Systems	C	12
REII221	Computer Engineering III (b)	C	16
TGWN222	Numerical Analysis	C	8
WISN221	Analysis IV	C	8

YEAR LEVEL 2 (continued)			
First semester			
Code	Module name	C/F	Cr
WVTS211	Understanding the Technological World	F	12

YEAR LEVEL 2 (continued)			
Second semester			
Code	Module name	C/F	Cr
WISN222	Linear Algebra II	C	8
FIAP271	Professional Practice II *(year module)*	F	24
MEGI271	Workshop Practice vacation training	C	8

YEAR LEVEL 3			
First semester			
Code	Module name	C/F	Cr
EERI313	Electromagnetics	C	16
EERI315	Signal Theory II	C	16
EERI316	Engineering - programming II	C	16
REII311	Computer Engineering IV	C	16
STTK312	Engineering Statistic	C	16

YEAR LEVEL 3			
Second semester			
Code	Module name	C/F	Cr
EERI321	Control Theory I	C	16
EERI322	Electronics II	C	16
REII321	Computer Engineering III (a) *(discontinued Dec 2015)*	C	16
REII327	Computer Engineering Design	C	16
WVIS321	Science, Technology and Society	F	12

YEAR LEVEL 4			
First semester			
Code	Module name	C/F	Cr
EERI412	Electronics III	C	16
EERI413	Signal Theory III *(discontinued Dec 2015)*	C	16
EERI418	Control Theory II	C	16
REII411	Computer Engineering IV *(discontinued Dec 2015)*	C	16
REII413	Engineering Programming II	C	16
EERI419	Project	C	8

YEAR LEVEL 4			
Second semester			
Code	Module name	C/F	Cr
EERI423	Telecommunication Systems	C	16
EERI429	Project *(year module)*	C	16
REII422	Software Engineering	C	16
EERI471	Vacation Training seniors	C	8
EERI472	Introduction to Project Management	C	8

BEng Computer and Electronic Engineering I204P (700 108)							
Year level 1		Year level 2		Year level 3		Year level 4	
1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.
64	92	68	116	80	76	88	64
Total: year level 1		Total: year level 2		Total: year level 3		Total: year level 4	
160		184		156		152	
Total credits of program: 648							

I.4.4.3 Curriculum I205P: **BEng Electromechanical Engineering**

Qualification code 700 113
(This is a new programme phasing in from 2015, year level 1. The first graduates will complete this programme in 2018).

Compilation of curriculum

This curriculum is composed as follows:

From 2015:

YEAR LEVEL 1			
First semester			
Code	Module name	C/F	Cr
EERI112	Computer Engineering I	C	16
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
INGM111	Engineering Graphics I	C	12
ITRW115	Programming for Engineers I (C++)	C	12
WISN111	Introductory Algebra and Analysis I	C	12

YEAR LEVEL 1			
Second semester			
Code	Module name	C/F	Cr
EERI123	Computer Engineering II	C	16
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
INGM121	Engineering Graphics II	C	12
INGM122	Materials Science I	C	16
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	24

From 2016:

YEAR LEVEL 2			
First semester			
Code	Module name	C/F	Cr
EERI213	Electrotechnics	C	16
INGM211	Strength of Materials I	C	12
TGWN211	Dynamics I	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8

YEAR LEVEL 2			
Second semester			
Code	Module name	C/F	Cr
EERI221	Electrical Systems I	K	16
EERI223	Electronics I	K	16
EERI228	Measure and Control	C	16
INGM222	Thermodynamics I	C	12
TGWN222	Numerical Analysis	C	8
WISN222	Linear Algebra II	K	8
INGM271	Workshop Practice vacation training	C	8
FIAP271	Professional Practice II *(year module)*	F	24

From 2017:

YEAR LEVEL 3			
First semester			
Code	Module name	C/F	Cr
EERI311	Electrical Systems II	C	16
INGM311	Thermodynamics II	C	12
INGM312	Fluid Mechanics I	C	12
INGM 313	Strength of Materials II	C	12
STTK312	Engineering Statistic	C	16
WVTS211	Understanding the Technological World	F	12

YEAR LEVEL 3			
Second semester			
Code	Module name	C/F	Cr
EEII321	Power Systems I	C	16
EERI321	Control Theory I	C	16
INGM321	Fluid Mechanics II	C	8
INEM327	Electro Mechanical Design	C	16
IURI224	Labour Law	C	12
WVIS321	Science, Technology and Society	F	12

From 2018:

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
EEII411	Power Systems II	C	16
INGM411	Thermal Machines	C	12
INGM412	Heat Transfer	C	12
INGM414	Air conditioning and Refrigeration	C	16
INEM419	Project	C	8

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EEII421	Power Electronics	C	16
INGM421	Machine Dynamics	C	16
INEM429	Project	C	16
EERI471	Vacation Training seniors	C	8
EERI472	Introduction to Project Management	C	8

BEng Electromechanical Engineering I205P (700 113)							
Year level 1		**Year level 2**		**Year level 3**		**Year level 4**	
1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.
64	104	60	108	80	84	64	64
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
168		**168**		**160**		**128**	
Total credits of program: 624							

I.5 SCHOOL OF MECHANICAL AND NUCLEAR ENGINEERING

Two BEng programmes, viz. Mechanical Engineering, and a new programme in Industrial Engineering (starting in 2015) are offered in this School.

Specialization In Nuclear Engineering is possible from year level three, with the offering of the elective modules Nuclear Energy, Nuclear Engineering I and II as well as a Project in Nuclear Engineering in the final year. This will ensure the proven learning skills for post-graduate studies in Nuclear Engineering.

Mechanical Engineers are involved with the development, manufacturing, management and maintenance of transport, energy conversion, manufacturing, generator, weapon and cooling and heating systems, as well as industry installations, process equipment, manufacturing machinery and mining equipment.

The Mechanical Engineering programme maintains a good balance between training in the basic sciences, engineering science and design. Strong emphasis is placed on creative synthesis (design), in order to enable engineers to apply their knowledge in finding solutions to complicated technological problems.

Nuclear Engineers design systems that utilizes nuclear processes for energy. Ultimately **Mechanical and Nuclear Engineers** play important roles in all engineering projects to ensure that designs are innovative, well planned, safe, effectively implemented, manufactured and maintained.

Industrial Engineers enable people, technology, information, materials, methods and money to work together productively and effectively.

It is an Industrial Engineer who helps on an airport to decide when and from which gate should airplanes depart or in a hospital how many beds and nurses to be allocated to each hospital ward. Whether you use a motor vehicle, a chocolate bar or a cell phone or whether you withdraw money or withdraw blood, you can be pretty sure that an Industrial Engineer was involved in the design, manufacturing or distribution of that product or service.

I.5.1 CHANGING A PROGRAMME

During their study, students may only change their programme with the consent of the relevant School Director.

I.5.2 PRESCRIBED MODULES

In the curriculum of each programme there are a number of compulsory modules: FIAP172, FIAP271 (Professional Practice I and II), WVTS211 (Understanding the Technological World) and WVIS321 (Science, Technology and Society). A fixed curriculum is followed.

I.5.3 TOTAL CREDIT VALUE OF THE PROGRAMME

The curriculum of the programme for Mechanical Engineering consists of modules with a total credit value of at least **624**. The Industrial Engineering Programme starts in 2015, year level 1.

In the following programme curricula the total number of credit points is spread over four years of study.

I.5.4 CURRICULA

I.5.4.1 Curriculum I303P: **BEng Mechanical Engineering**

Qualification code 700 109

Compilation of curriculum

This curriculum is composed as follows:

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
CHEM111	Introductory Inorganic and Physical Chemistry	C	12
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
INGM111	Engineering Graphics I	C	12
ITRW112	Introduction to Computers and Programming	C	12
WISN111	Introductory Algebra and Analysis I	C	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
INGM121	Engineering Graphics II	C	12
INGM122	Materials Science I	C	16
ITRW126	Programming for Engineers (Visual Basic)	C	12
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	24

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI212	Electrotechnics	C	16
INGM211	Strength of Materials I	C	12
INGM212	Engineering Materials I	C	12
TGWN211	Dynamics I	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8
WVTS211	Understanding the Technological World	F	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI228	Measure and Control	C	16
INGM222	Thermodynamics I	C	12
INGM224	Applied Computer Methods	C	8
TGWN221	Dynamics II	C	8
TGWN222	Numerical Analysis	C	8
WISN221	Analysis IV	C	8
FIAP271	Professional Practice II *(year module)*	F	24
INGM271	Workshop Practice vacation training	C	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
INGM311	Thermodynamics II	C	12
INGM312	Fluid Mechanics I	C	12
INGM 313	Strength of Materials II	C	12
STTK312	Engineering Statistic	C	16
TGWN312	Partial Differential Equations (Numerical)	C	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI321	Control Theory I	C	16
INGM321	Fluid Mechanics II	C	8
INGM327	Mechanical Design	C	16
INGM322	Structural Analysis **and**	C	12
INGM323	Machine Design ***or***	C	12

YEAR LEVEL 3 (continued)			
First semester			
Code	Module name	C/F	Cr

YEAR LEVEL 3 (continued)			
Second semester			
Code	Module name	C/F	Cr
NUCI321	Nuclear Energy **and**	C	12
NUCI326	Nuclear Engineering I	C	12
WVIS321	Science, Technology and Society	F	12

YEAR LEVEL 4			
First semester			
Code	Module name	C/F	Cr
INGM411	Thermal Machines	C	16
INGM412	Heat Transfer	C	12
INGM413	Fluid Machines	C	12
INGM417	Systems Engineering	C	12
INGM472	Introduction to Project Management	C	8
Choose one:			
INGM414	Air conditioning and Refrigeration *(this module is not presented in 2015)*	C	16
INGM415	Failure of Materials	C	16
INGM416	Aircraft Design	C	16

YEAR LEVEL 4			
Second semester			
Code	Module name	C/F	Cr
INGM421	Machine Dynamics **or**	C	16
NUCI421	Nuclear Engineering II	C	16
INGM423	Manufacturing Technology	C	12
INGM427	Thermal Fluid System Design	C	16
INGM471	Vacation Training seniors	C	8
INGM479	Project *(year module)* **or**	C	16
NUCI479	Project in Nuclear Engineering *(year module)*	C	16

BEng Mechanical Engineering I303P (700 109)							
Year level 1		**Year level 2**		**Year level 3**		**Year level 4**	
1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.	1st sem.	2nd sem.
60	100	84	92	68	76	76	68
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
160		**180**		**144**		**140**	
Total credits of program: 624							

I.5.4.2 Curriculum I304P: **BEng Industrial Engineering**
Qualification code 700 112
(This is a new programme phasing in from 2015, year level 1. The first graduates will complete this programme in 2018).

Compilation of curriculum
This curriculum is composed as follows:
From 2015:

YEAR LEVEL 1			
First semester			
Code	Module name	C/F	Cr
CHEM111	Introductory Inorganic and Physical Chemistry	C	12
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat	C	12
INGM111	Engineering Graphics I	C	12

YEAR LEVEL 1			
Second semester			
Code	Module name	C/F	Cr
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	C	12
INGB121	Process Drawings	C	12
INGM122	Materials Science I	C	16

YEAR LEVEL 1 (continued)			
First semester			
Code	Module name	C/F	Cr
ITRW112	Introduction to Computers and Programming	C	12
WISN111	Introductory Algebra and Analysis I	C	12

YEAR LEVEL 1 (continued)			
Second semester			
Code	Module name	C/F	Cr
ITRW126	Programming for Engineers (Visual Basic)	C	12
TGWN121	Statics and Mathematical Modelling	C	12
WISN121	Introductory Algebra and Analysis II	C	12
FIAP172	Professional Practice I *(year module)*	F	24

From 2016:

YEAR LEVEL 2			
First semester			
Code	Module name	C/F	Cr
EERI212	Electrotechnics	C	16
ITRW214	Decision Support Systems I	K	16
TGWN211	Dynamics I	C	8
TGWN212	Differential Equations and Numerical Methods	C	8
WISN211	Analysis III	C	8
WISN212	Linear Algebra I	C	8
WVTS211	Understanding the Technological World	F	12

YEAR LEVEL 2			
Second semester			
Code	Module name	C/F	Cr
EERI228	Measure and Control	C	16
INGB221	Operational Management for Engineers	12	K
INGM222	Thermodynamics I	C	12
TGWN221	Dynamics II	C	8
WISN221	Analysis IV	C	8
FIAP271	Professional Practice II *(year module)*	F	24
INGM271	Workshop Practice vacation training	C	8

From 2017:

YEAR LEVEL 3			
First semester			
Code	Module name	C/F	Cr
INGB311	Engineering Economics	C	16
INGB312	Operations Research I	C	16
INGB313	Logistics Management	C	16
INGB314	Industrial Ergonomics	C	16
STTK312	Engineering Statistic	C	16

YEAR LEVEL 3			
Second semester			
Code	Module name	C/F	Cr
INGB327	Information Systems Design	C	16
INGM324	Manufacturing Processes	C	12
ITRW325	Decision Support Systems II	C	16
TGWN322	Optimization	C	
WVIS321	Science, Technology and Society	F	12

For 2018:

YEAR LEVEL 4			
First semester			
Modulekode	Module name	C/F	Cr
INGB412	Reliability Engineering		
INGB413	Quality Management		
INGB417	Facilities Design		
INGM417	Systems Engineering	C	12

YEAR LEVEL 4			
Second semester			
Modulekode	Modulenaam	C/F	Cr
INGB427	Business Engineering and Design		
INGB471	Vacation Training seniors	C	8
INGM472	Introduction to Project Management	C	8
INGB479	Industrial Project		

BEng Industrial Engineering I304P (700 112)							
Year level 1		**Year level 2**		**Year level 3**		**Year level 4**	
1st sem. 60	2nd sem. 100	1st sem. 76	2nd sem. 88	1st sem. 80	2nd sem. 72	1st sem. 60	2nd sem. 56
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
160		**164**		**152**		**116**	
Total credits of program: 592							

I.6 LIST OF PROGRAMME MODULES

I.6.1 MODULE TYPES

Core modules mean those modules at all levels of a programme or curriculum which have been designated as such by the faculty concerned (A.1.13).

Fundamental modules mean those modules which give expression to the critical cross-field outcomes and which students have to take in order to comply fully with the education, training or further learning required for the attainment of a qualification (A.1.33).

I.6.2 METHOD OF DELIVERY

All modules are presented full-time by means of contact teaching. A few modules entail vacation training, which is performed during the university vacation.

I.6.3 ASSESSMENT METHODS

Arrangements and requirements in connection with assessment will be communicated to students at the start of each semester. They are also fully explained in each relevant study guide.

Assessment methods include:

- Formative assessment methods - homework, class tests, semester tests, practical reports, assignments and other applicable methods.
- Summative assessment methods – Usually a 2 to 3 hour examination-paper. Exceptions are indicated in the study guides of the relevant modules.

I.6.4 CREDIT VALUE AND PREREQUISITES

The list of modules from which the curricula of all the programmes are compiled and the credit value of each module is given in the table below. The requirements with respect to assumed learning are given for each module in the last column in the table. (See also I.2.8)

Regarding the requirements with respect to assumed prior learning of engineering modules, the following apply:

a) Where a first semester module in a certain year level is a prerequisite for assumed prior learning of a second semester module, or a module from one year level is a prerequisite with respect to assumed prior learning of a module of the following year level, a pass mark (module mark) of at least 50% has to be achieved in that prerequisite module, before the following module may be taken.

b) An auxiliary module has to be taken in the same semester as the module on which it has a bearing.

Module code	Descriptive name	Cr	Prerequisites
Faculty of Natural Sciences modules			
CHEM111	Introductory Inorganic and Physical Chemistry	12	None
CHEM121	Introductory Organic Chemistry	12	None
CHEN211	Analytical Methods I	8	CHEM111 and CHEM121
CHEN223	Organic Chemistry II	8	CHEM111 and CHEM121
FSKS111	Mechanics, Oscillations, Waves and Theory of Heat.	12	None
FSKS121	Electricity, Magnetism, Optics, Atomic and Nuclear Physics	12	FSKS111 and WISN111
FSKS211	Electricity and Magnetism	8	FSKS121 and TGWN122
GENL311	Mineralogy and Petrology	16	None
ITRW112	Introduction to Computers and Programming	12	None
ITRW115	Programming for Engineers I (C++)	12	None
ITRW126	Programming for Engineers (Visual Basic)	12	ITRW112
STTK312	Engineering Statistic	16	WISN121
TGWN121 (BEng)	Statics and Mathematical Modelling	12	WISN111 and FSKS111
TGWN211	Dynamics I	8	WISN121 and (TGWN121 of TGWN122)
TGWN212	Differential Equations and Numerical Methods	8	WISN121
TGWN221	Dynamics II	8	TGWN212 and (TGWN121 or TGWN122)
TGWN222	Numerical Analysis	8	WISN121
TGWN312	Partial Differential Equations (Numerical)	16	WISN221
TGWN321	Dynamics III	16	TGWN221
WISN111	Introductory Algebra and Analysis I	12	None
WISN121	Introductory Algebra and Analysis II	12	WISN111
WISN211	Analysis III	8	WISN121
WISN212	Linear Algebra I	8	WISN121
WISN221	Analysis IV	8	WISN211
WISN222	Linear Algebra II	8	WISN212
Module code	**Descriptive name**	**Cr**	**Prerequisites**
Engineering modules			
BIOT411	Biotechnology II	16	CEMI315, CEMI321, CEMI323
CEMI121	Process Principles I	16	None
CEMI211	Materials and Corrosion	12	None
CEMI222	Chemical Thermodynamics I	16	CEMI121
CEMI224	Process Principles II	8	CHEM111; CHEM121 and CEMI121
CEMI311	Transport Phenomena I	16	CEMI224

Module code	Descriptive name	Cr	Prerequisites
Engineering modules			
CEMI313	Chemical Thermodynamics II	16	CEMI222 and CEMI224
CEMI315	Biotechnology I	16	None
CEMI316	Particle Systems	16	CEMI121
CEMI321	Transport Phenomena II	16	CEMI311 and CEMI313
CEMI322	Separation Processes I	16	CEMI313
CEMI323	Chemical Reactor Theory I	16	CEMI313 and CEMI224
CEMI326	Process Modelling for Control *(new module from 2015)*		CEMI313; WISN222 and TGWN212
CEMI328	Plant Design I	12	CEMI121 and CEMI222
CEMI411	Separation Processes II	16	CEMI313 and CEMI322
CEMI414	Process Control	16	CEMI324
CEMI415	Chemical Reactor Theory II	16	CEMI224 and CEMI323
CEMI418	Ore Dressing	16	None
CEMI419	Pyrometallurgy	16	CEMI321
CEMI471	Vacation Training seniors	8	None
CEMI477	Plant Design II	32	CEMI328 Student has to be in final year and must be able to complete degree (all previous modules passed)
CEMI479	Project *(Year module)*		Student has to be in final year and must be able to complete degree
EEII321	Power Systems I	16	EERI221 and EERI311
EEII327	Electrical Design	16	Student must be able to complete year level 3
EEII411	Power Systems II	16	EEII321
EEII421	Power Electronics	16	EERI311 and EERI321
EERI112	Computer Engineering I	16	None
EERI123	Computer Engineering II	16	EERI112 and ITRW115
EERI212	Electrotechnics (for Chemical, Minerals Processing and Mechanical students)	16	FSKS111; FSKS121; WISN111 and WISN121
EERI213	Electrotechnics II (E/E/C students)	16	FSKS111; FSKS121; WISN111 and WISN121
EERI214	Engineering Programming I	8	ITRW115; WISN111; WISN121; TWGN121; TGWN212; WISN221 and WISN212
EERI221	Electrical Systems I	16	EERI213
EERI222	Signal Theory I	16	EERI213; TGWN211; TGWN212; WISN212 and WISN211
EERI223	Electronics I	16	EERI213
EERI224	Linear Systems *(New module from 2015)*	12	EERI213 and WISN212 Co-required: WISN222
EERI228	Measure and Control	16	EERI212 or EERI213
EERI229	Linear Systems	12	EERI213 and WISN212 Co-required: WISN222

Module code	Descriptive name	Cr	Prerequisites
Engineering modules (continued)			
EERI311	Electrical Systems II	16	EERI212/213 and EERI221
EERI313	Electromagnetics II	16	FSKS211
EERI315	Signal Theory II	16	EERI222, EERI229/EERI224
EERI316	Engineering Programming II		ITRW115; EERI112 and EERI122/EERI123
EERI321	Control Theory I	16	TGWN121; EERI212/213; TGWN212 and WISN212
EERI322	Electronics II	16	EERI223
EERI412	Electronics III	16	EERI322
EERI413	Signal Theory III	16	EERI312
EERI418	Control Theory II	16	EERI321
EERI419	Project	8	Student has to be in final year and must be able to complete degree Co-required: EERI472
EERI423	Telecommunication Systems		EERI313
EERI429	Project *(Year module)*	16	EERI419 Student has to be in final year and must be able to complete degree
EERI471	Vacation Training seniors	8	None
EERI472	Introduction to Project Management New code for Electrical, Electronic and Computer Engineering Programmes from 2015	8	Prerequisites: none Co-required: EERI429
FIAP172*	Professional Practice I *(Year module)*	24	None
FIAP271	Professional Practice II *(Year module)*	24	FIAP172
INGB121	Process Drawings	12	None
INGM111	Engineering Graphics I	12	None
INGM121	Engineering Graphics II	12	INGM111 (40%)
INGM122	Materials Science I	16	None
INGM211	Strength of Materials I	12	WISN121 and TGWN121
INGM212	Engineering Materials I	12	None
INGM222	Thermodynamics I	12	WISN11 Co-required: WISN121
INGM224	Applied Computer Methods	8	INGM211 Co-required: INGM222
INGM271	Workshop Practice (Vacation training)	8	None
INGM311	Thermodynamics II	12	INGM222 (40%)
INGM312	Fluid Mechanics I	12	None
INGM313	Strength of Materials II	12	INGM211
INGM321	Fluid Mechanics II	8	INGM312 and INGM222 (40%)

Module code	Descriptive name	Cr	Prerequisites
Engineering modules			
INGM322	Structural Analysis	12	INGM313 and TGWN222 Co-required: INGM327
INGM323	Machine design	12	TGWN211
INGM327	Mechanical Design	16	INGM313
INGM411	Thermal Machines	16	INGM311 and INGM321
INGM412	Heat Transfer	12	INGM321
INGM413	Fluid Machines	12	INGM321
INGM414	Air conditioning and Refrigeration	16	INGM311 and INGM321
INGM415	Failure of Materials	16	INGM212
INGM416	Aircraft Design	16	INGM321
INGM417	Systems Engineering	12	Co-required: INGM479 or NUCI479
INGM421	Machine Dynamics	16	TGWN312
INGM423	Manufacturing Technology	12	INGM212
INGM427	Thermal Fluid System Design	16	INGM411 and INGM412
INGM471	Vacation Training seniors	8	None
INGM472	Introduction to Project Management (Year *module)*	8	Prerequisite: none Co-required: INGM479
INGM479	Project *(Year module)*	16	INGM271 Co-required:INGM471 Student must be able to complete degree.
MEGI271	Workshop Practice (Vacation training)	8	None
NUCI321	Nuclear Energy	12	None
NUCI326	Nuclear Engineering I	12	Co-required: NUCI321
NUCI421	Nuclear Engineering II	16	NUCI321 and NUCI326
NUCI479	Project in Nuclear Engineering	16	INGM271 Student has to be in final year and must be able to complete degree. Co-required INGM472
REII221	Computer Engineering III (New module from 2015)	16	EERI112 and EERI123
REII311	Computer Engineering IV *(From 2016)*	16	EERI112, EERI122/123
REII321	Computer Engineering II	16	EERI122
REII327	Computer Engineering Design	16	Student must be able to complete year level 3
REII411	Computer Engineering IV	16	REII321
REII413	Engineering Programming II	16	EERI314
REII422	Software Engineering	16	EERI314

Module code	Descriptive name	Cr	Prerequisites
Prescribed modules			
AGLA111#	Introduction to Academic Literacy	12	None
AGLA121*	Academic Literacy	12	AGLA111
WVIS321	Science, Technology and Society	12	None
WVTS211	Understand the Technological World	12	None

Students who have not passed the test in academic literacy, must register for the module AGLE111.

*All Engineering programmes include the compulsory module FIAP172 (24 credits), which includes the outcomes of AGLE121.

I.7 MODULE OUTCOMES

Module code: AGLE111	Semester 1	NQF level: 5
Name: **Introduction to Academic Literacy**		
Module outcomes: After you have completed this module you should be able to • demonstrate basic knowledge of learning strategies, academic vocabulary and register, as well as reading and writing academic texts in order to function effectively in an academic environment; • communicate effectively, orally and in writing, in an appropriate way as an individual and in a group in an academic environment; • understand, interpret and evaluate basic academic texts and to implement academic conventions of appropriate academic genres in a coherent way to write accurate and appropriate scientific texts; and • be able to listen, talk, read, write and learn accurately within an ethical frame of reference.		
Module code: AGLE121	**Semester 2**	**NQF level: 5**
Name: **Academic Literacy**		
Module outcomes: After you have completed this module you should be able to • demonstrate fundamental knowledge of appropriate computer programmes, as well as appropriate learning, listening and writing strategies; implement the academic language register and reading and writing of academic texts in order to function efficiently in the academic environment; • be able to learn effectively as an individual and as a member of a group in an ethically responsible and acceptable way in the academic environment; and, using appropriate IT, be able to communicate academic information orally and in writing according to a prescribed format in assignments; and • search for and collect a variety of relevant scientific information in a variety of study fields; to analyse, interpret, synthesise and evaluate the texts and suggest solutions in a creative way in appropriate genres by using linguistic conventions as customary in formal language registers.		
Module code: BIOT411	**Semester 1**	**NQF level: 8**
Name: **Biotechnology II**		
Module objective: The module objectives are to expose engineering students to the concepts and principles of biotechnology with s specific focus on the application of engineering principles to the design of processes and the solving of problems. *Module outcomes:* After completion of this Module the student should have: <u>Knowledge</u> Methods for determining reaction kinetics for both enzyme reactions as well as processes that make use of micro-organisms. Methods for the scale-up of simple microbiological processes that is used in industry. Use of kinetic data for the design of simple processes. <u>Skills</u> Design of processes/reactors that make use of enzyme and/or micro-organisms by using the knowledge of biotechnology and basic engineering principles. Practical's include brewing of beer and making of different cheeses.		
Credits: 16		
Prerequisite: CEMI315, CEMI321, CEMI323		
Assessment modes: PC 3 hours 1:1		

Module code: CEMI121	Semester 2	NQF level: 5
Name: **Process Principles I**		
Module objective: Teaching of the basic calculations with a focus on material balances, as applicable to Chemical and Minerals engineering. *Module outcomes:* After successful completion of this module, students should have the following: Knowledge: Students obtain formal knowledge of different unit systems, process data handling, dimensional homogeneity, the mol unit, chemical and mineral processes and process variables, fundamentals of material balances, degrees of freedom, stoichiometry, multiple material balances, recovery and bypass streams, reactive processes, combustion processes, single phase processes. Skills: Students develop skills in the conversion between different unit systems, to handle data statistically correctly, to fit linear models and to determine the homogeneity of a model; further skills in the determination, handling and manipulation of process variables such as mol concentration, density, temperature and pressure, as well as to solve and analyse steady-state material balances of simple and complex processes.		
Credits: 16		
Prerequisite: none		
Assessment modes: PC 3 hours 1:1		
Module code: CEMI211	**Semester 1**	**NQF level: 6**
Name: **Materials and Corrosion**		
Module objective: To give the student basic knowledge and insight of selected aspects of metals, ceramics and polymers, suitable for use as engineering materials. To obtain the knowledge of internal structures which give the materials strength and which mechanisms result in failure of the material, such as corrosion. *Module outcomes:* After successful completion of this module, the student should have: Knowledge: Material aspects of well-known metals, ceramics and polymers, microscopic structures and electrochemical corrosion. Skills: Students will develop skills in material identification and characterisation for design purposes. Where problems occur in practice, the student will be able to gather information on the failure that occurred, with the aim to make changes to and improvements of the construction.		
Credits: 12		
Prerequisite: none		
Assessment modes: PC 3 hours 1:1		
Module code: CEMI222	**Semester 2**	**NQF level: 6**
Name: **Chemical Thermodynamics I**		
Module objective: The main objective of this module is to help students develop fundamental skills for applying energy and mass balance equations to solve energy flow and thermodynamic problems. Furthermore, the students will learn how to select specific equations of state or correlations to describe and analyse different processes that are relevant to the chemical process industry.		
Module outcomes: After successful completion of this module, the student should be able to: • carry out basic thermodynamics-related calculations confidently; • apply the first and second law of the thermodynamics to identify, formulate and solve engineering problems; • understand the concept of entropy and describe its molecular basis; • show a grasp of terminology and carry out thermodynamic calculations, taking into account all relevant variables; and		

- co-operate effectively in group work;
- be punctual and act ethically sound in presenting results, findings, interpretations and personal views in problem-solving activities;
- display appropriate communicative skills; and
- be open-minded and think entrepreneurially in all problem-solving activities.

Credits: 16

Prerequisite: CEMI121

Assessment modes: PC 3 hours 1:1

Module code: CEMI224	**Semester 2**	**NQF level: 6**

Name: Process Principles II

Module objective: To understand and apply energy balances for design and operational problems of industrial processes.

Module outcomes:

After successful completion of this module students should have the following:

Knowledge: The student should have knowledge of energy balances, the first law of thermodynamics, forms of energy, heat capacity of gases, liquids and solid matter, enthalpy of mixtures and solutions, enthalpy-concentration diagrams, enthalpy of forming, evaporation, melting and combustion and have to integrate this knowledge to be able to solve energy balances of processes.

Skills: The student should

- understand the concept of energy, work and heat and be able to identify the different forms of energy;
- be able to use thermodynamic forms to perform and solve energy balances for open as well as closed systems, with and without chemical reactions, with phase changes, as well as solutions and mixtures taken into consideration; and
- be able to combine and solve mass and energy balances for simple systems.

Credits: 8

Prerequisite: CHEM111 CHEM121 CEMI121

Assessment modes: PC 3 hours 1:1

Module code: CEMI311	**Semester 1**	**NQF level: 7**

Name: **Transport Phenomena I**

Module objective: An introductory course in the basic fundamentals and applications of momentum transfer. This module has the main objective of introducing the student to the theory and application of momentum transfer so that he/she will be able to apply the acquired knowledge to practical momentum transfer problems.

Module outcomes:

After successful completion of this module, the student should have:

Knowledge: Students obtain a fundamental knowledge about the mechanisms involved in momentum transfer, the macroscopic description of fluid flow with the help of mass, energy and/or momentum balances, the use and derivation of velocity profiles by differential analysis to describe fluid flow on the microscopic level, the fundamental concepts and applications of dimensional analysis, the use of friction factors to describe fluid flow where friction is involved, the description of fluid flow in a boundary layer, the application of all the above in the description of general internal and external flow through pipes and over objects, respectively, the basic fundamentals of pumps and turbines, as well as the use of pump performance curves and the affinity laws in the design and selection of pumps and turbines. Students also obtain basic knowledge in the design of flow systems involving compressible flow.

Skills: Students develop skills in the solving of general momentum transfer problems, which include the description of flow (incompressible and compressible) through conduits and the flow over objects. They also obtain the skills of using pump performance curves and the affinity laws in the up scaling and selection of a pump system. Furthermore, they obtain skills in the use of dimensional analysis to develop relevant dimensionless parameters and

the up scaling of relevant experimental data with the help of the model theory. Skills such as experimental data generation and processing are also developed in the practical's. The students also develop the necessary skills to write an appropriate engineering report on the experimental data and to use specific resources, such as the library and internet, to do research on a specific topic.

Credits: 16

Prerequisite: CEMI224

Assessment modes: PC 3 hours 1:1

Module code: CEMI313	**Semester 1**	**NQF level: 7**

Name: **Chemical Thermodynamics II**

Module objective: The main objective of this module is to help students develop fundamental skills and knowledge in the field of chemical thermodynamics, relevant to some basic operations in the chemical process industry.

Module outcomes:

After successful completion of this module, the student should be able to:

- confidently carry out complex thermodynamics calculations, concerning phase separation and chemical reaction;
- understand the importance of the Gibbs energy, and the chemical potential, in relation to equilibrium calculations;
- understand the concept of fugacity as a key-parameter in equilibrium calculations;
- be able to calculate the fugacity coefficient in gas, liquid or solid phase effectively;
- be able to calculate Vapour Liquid Equilibrium (VLE), Liquid Liquid Equilibrium (LLE), and see the importance in relation to various practical processes;
- co-operate effectively in group work;
- be punctual and act ethically sound in presenting results, findings, interpretations and personal views in problem solving activities;
- display appropriate communicative skills; and
- be open-minded and think entrepreneurially in all problem solving activities.

Credits: 16

Prerequisite: CEMI222 and CEMI224

Assessment modes: PC 3 hours 1:1

Module code: CEMI315	**Semester 1**	**NQF level: 7**

Name: **Biotechnology I**

Module objective: An introductory course in the basic fundamentals and applications of biotechnology. The aim of this module is to expose engineering students to the principles and concepts of biotechnology and how it relates to engineering problems.

Module outcomes:

After successful completion of this module, the student should have:

Knowledge

After completion of this Module the student will have a good knowledge of cell biology and the chemical composition of cells; the structure and function of bio molecules: carbohydrates, lipids, proteins and nucleic acids; introductory enzymology; the generation and utilization of energy by organisms; intermediary metabolism.

Skills

The students will be able to describe the basic structural properties of organisms and how they utilize substances to produce energy for survival and procreation. They will be able to design and execute simple biochemical experiments and to collect and process data.

Credits: 16

Prerequisite: none

Assessment modes: PC 3 hours 1:1

Module code: CEMI316	Semester 1	NQF level: 7
Name: **Particle Systems**		
Module objective: Teaching the fundamentals of particle systems and the design of processes to be able to handle particles.		
Module outcomes: After successful completion of this module students should have the following: Knowledge: Formal knowledge about the properties of particles, the handling of dry particles and the design of equipment to handle dry particles; properties of slurry systems and the design of equipment to handle slurries; acquire solid/liquid systems and the design of suitable equipment for the separation of these systems; the operation of ALL the above-mentioned systems and their integration. Skills: To analyse particles in terms of size and form; to generate and analyse size distribution data; to fit size distribution models and to design industrial equipment to separate particles in terms of size; to design and analyse equipment that stores and transports dry particles; to be able to describe slurries in terms of viscosity and to design equipment to mix and transport slurries; to be able to design equipment for the separation of solid/liquid systems; to use laboratory equipment to analyse and generate data particle systems. **Note:** Previously CEMI413		
Credits: 16		
Prerequisite: CEMI121		
Assessment modes: PC 3 hours 1:1		

Module code: CEMI321	Semester 2	NQF level: 7
Name: **Transport Phenomena II**		
Module objective: Teaching of the laws of transport principles and design of heat and mass transfer equipment on an advanced level, with the focus on engineering applications. The use of previously acquired knowledge of thermodynamics and momentum transfer, as well as skills with reference to problem solving. Skills that will be developed are aimed at the solution of heat and mass transfer problems generally encountered in the chemical engineering industry, as well as skill to design heat and mass transfer equipment. *Module outcomes:* After successful completion of this module, the student should have: Knowledge: Fourier's law, steady-state heat transfer by conduction, heat transfer with heat generation and steady-state heat transfer by fins, non-steady-state heat transfer, steady-state forced heat transfer by convection, steady-state natural convection transfer, heat exchanger design methods, Fick's law, steady-state mass transfer by diffusion, steady-state convective mass transfer and non-steady-state heat transfer. Skills: The solution of heat and mass transfer problems by applying analytical and numerical methods; the use of industrial design software for the design of a heat exchanger; the operation of a heat exchanger, as well as the measurement of certain experimental quantities and the processing of the measured results to be able to make meaningful deductions and reproduce them professionally in a practical report; the reading of an industrial heat exchanger design specification and the development of a design report that complies with industrial requirements.		
Credits: 16		
Prerequisite: CEMI311 and CEMI313		
Assessment modes: PC 3 hours 1:1		

Module code: CEMI322	Semester 2	NQF level: 7
Name: **Separation Processes I**		
Module objective: Development of skills for the conceptional design, modelling, optimization and selection of equilibrium-based separation processes, with specific reference to absorption, stripping, distillation and liquid extraction. Application of basic knowledge in the development of more complex processes.		
Module outcomes: After successful completion of this module, students should have the following: Knowledge: Formal knowledge about the appropriate equipment necessary in separation technology, the interpretation of separation process flow schemes, the use of thermodynamic models in equilibrium-based separation processes, calculations concerning flashing in multi-component processes, design of adsorption, stripping and distillation columns for binary and multi-component feed streams, as well as the optimization of separation processes. Skills: Effective interpretation of experimental data; work together in groups and, within the limited time, present the information in a report, as well as orally.		
Credits: 16		
Prerequisite: CEMI313		
Assessment modes: PC 3 hours 1:1		
Module code: CEMI323	**Semester 2**	**NQF level: 7**
Name: **Chemical Reactor Theory I**		
Module objective: Teaching of basic fundamentals about chemical reactor theory and the design of different types of reactors on an advanced level with the focus on suitable engineering problem solving. Use of all accumulated engineering knowledge and skills, especially mass and energy balances and thermodynamic laws applicable to problem solving. Skills that are developed are based on the utilization of the theory of the kinetics of homogeneous reactions for problem solving in reaction systems of industrial importance and catalytic reactions, with the focus on reactor design. *Module outcomes:* After successful completion of this module, students should have the following: Knowledge: Formal knowledge of reaction kinetics and reaction rates for different reaction systems, operation and functioning of different reactor types, derivation of operations and design equations from first principles for a variety of reactor types, isothermal and non-isothermal operation and design, pressure drop across reactors, non-steady-state operation of reactors, recirculation reactors, membrane reactors, thermodynamic effects and multiple reactions. Skills: The solution of reaction and reactor problems using analytical and numerical methods; the use of different industrial design software for the design of a reactor and reaction systems; the operation of different reactors, as well as the measuring of certain experimental quantities and the processing of the measured results to meaningful deductions in order to reach certain conclusions, communicated professionally in a practical report.		
Credits: 16		
Prerequisite: CEMI313 and CEMI 224		
Assessment modes: PC 3 hours 1:1		
Module code: CEMI326	**Semester 2**	**NQF level: 7**
Name: **Process Modelling for Control**		
Module objective: To be able to dynamically model industrial processes with mathematical techniques and to be able to simulate the model on a computer, to be able to develop a simple P, PI or PID control circuit to control the process and to tune this control circuit with existing techniques		

Module outcomes:
After completion of module, the student should be able to demonstrate:

- A basic overview-knowledge of the discipline of chemical process control.
- The use of an integrated knowledge of mass-, energy- and component balances, as obtained in the Process Principles modules (CEMI121 and CEMI224), to model a chemical process in steady-state as well as dynamically.
- The use of mathematical skills to solve differential equations that describe chemical processes dynamically.
- The use of mathematical computer packages to solve differential equations that describe chemical processes dynamically.
- The use of mathematical skills to linearize non-linear process models as well as to determine the stability of linear (or linearized) processes.
- A thorough understanding of the behaviour of first- and higher-order processes through behaviour analyses techniques.
- Knowledge of the fundamental- and empirical approaches to modelling chemical processes as well as a combination of these approaches.
- Full responsibility for individual- as well as group activities during learning opportunities.

NOTA: *New module from 2015. Previous module was CEMI324.*

Credits: 16

Prerequisite: CEMI313; WISN222 and TWGN212

Assessment modes: PC 4 hours 1:1

Module code: CEMI328	**Semester 2**	**NQF level: 7**

Name: **Plant Design I**

Module objective: The module objectives are to teach the students to be able to implement a systematic approach in the conceptual design of a plant and to have insight in the management of a project.
Module outcomes:
After successful completion of this module, the student should have:
Knowledge: Advanced Aspen and HRTi simulations, as well as relevant theory to complete a mechanical design of pressure vessels.
Skills: Advanced Aspen and HTRi simulations; do a thermodynamic and mechanical design of heat exchangers; use relevant theory to complete a mechanical design of a pressure vessel.

Credits: 12

Prerequisite: CEMI121 and CEMI 222

Assessment modes: PC 3 hours 1:1

Module code: CEMI411	**Semester 1**	**NQF level: 8**

Name: **Separation Processes II**

Module objective: Teaching of applicable separation processes, as well as the development of skills in order to solve problems in this field using the necessary calculations

Module outcomes:
After successful completion of this module, students should have the following:
Knowledge: Students obtain formal knowledge of preparation methods, leaching techniques, precipitation, crystallisation, ion exchange, liquid liquid extraction, cementation, reduction and electro winning, as well as the necessary calculations. In addition the leaner obtains knowledge of water purification and membrane processes.
Skills:

- Construction of Pourbaix diagrams for different systems, as well as the setting up and description of leaching reactions and processes.
- Description of the mechanisms of bacterial and pressure leaching.
- Determination of resin loading capacity, limit and bed volumes in an ion exchange system by making use of the fundamentals of ion exchange mechanisms.

- Determine the number of stadia of a liquid liquid extraction system.
- Apply precipitation, reduction and cementation as metal recovery processes.
- Describe electro winning and do appropriate calculations.
- Do necessary calculations with respect to membrane technology and water purification processes.

Credits: 16

Prerequisite: CEMI313 and CEMI322

Assessment modes: PC 3 hours 1:1

Module code: CEMI414	**Semester 1**	**NQF level: 8**

Name: **Process Control**

Module objective: To investigate advanced control strategies and their implementation. Typical control of unit processes is investigated in which both simple (P, PI or PID) controllers can be applied, as well as advanced control strategies. Finally a strategy for plant wide control is treated.

Module outcomes:

On completion of this module the student should have:

Knowledge:

- Critically evaluate advanced control strategies and apply them to unit processes.
- By means of criteria determine which control strategy can be used with which unit process.
- Understand multivariable systems and apply techniques concerning control strategies of such systems.
- Critically evaluate plant wide control systems and know the difference between short term and long term control strategies.

Skills:

- Equip a unit process with the correct control strategy and tune the controller correctly for stable operation.
- Know different advanced control strategies and apply to unit processes.
- Apply techniques to compile control strategies for multivariable systems.
- Draw up a plant wide control strategy.

Credits: 16

Prerequisite: CEMI324

Assessment modes: PC 3 hours 1:1

Module code: CEMI415	**Semester 1**	**NQF level: 8**

Name: **Chemical Reactor Theory II**

Module objective: All chemical engineers must have a basic knowledge of reactors and their operation. The objective of this module is to teach students advanced concepts concerning the design of reactors. The skills acquired in this module build on the knowledge that the student has acquired in his/her third year.

Module outcomes:

After successful completion of this module, the student should have:

Knowledge:

- Knowledge and insight to use simple models for non-ideal flow to predict the conversion in a non-ideal reactor.
- Develop models to predict the flow patterns in a reactor.
- Design a reactor for a heterogeneous catalytic reaction with complex reaction kinetics.
- Design reactors for reactions with de-activating and poisoned catalysts.
- Design reactor-regenerator systems for de-activating catalysts.
- Design reactors for non-catalytic heterogeneous reactions.
- Design reaction tanks and towers for gas-liquid reactions with adsorption.
- Design multiphase reactors and analyse biochemical reactors.
- Analyse and design reactors.

Skills:

- Realise the importance of optimal chemical reactor design for the chemical industry.
- Predict non-ideal flow patterns and develop suitable models of the flow.
- Design reactors with heterogeneous catalytic reactions having complex kinetics.
- Consider deactivation of catalysts in a heterogeneous reaction.
- Design tanks and towers for gas/liquid reactions.
- Design multiphase reactors, as well as biochemical reactors.

Credits: 16

Prerequisite: CEMI224 and CEMI323

Assessment modes: PC 3 hours 1:1

Module code: CEMI418	**Semester 1**	**NQF level: 8**

Name: **Ore Dressing**

Module objective: Ore dressing comprises the first steps during the preparation and concentration of mined ore. In this module all these processes are studied in terms of the fundamental principles and their operation, simulation and design.

Module outcomes:

After successful completion of this module, the student should have:

Knowledge:

- The principles of the synthesis and design of mineral plants.
- The processes of liberation and concentration of important minerals.
- The types units in the above-mentioned processes and their operation.
- Coal processing and plants.

Skills:

- To integrate and apply to mineral processes the principles of separation equilibrium and kinetics.
- To simulate mineral plants and the associated process units with the help of available computer packages.
- To use the principles of ore crushing and the liberation of minerals to design crushing circuits.
- To use the principles of mineral separation to design concentration processes.
- To understand the coupling and the relationships between the process steps.
- To use laboratory equipment during practical's.
- To be able to function effectively in groups.
- To communicate scientifically in different mediums.

Credits: 16

Prerequisite: none

Assessment modes: PC 3 hours 1:1

Module code: CEMI419	**Semester 1**	**NQF level: 8**

Name: **Pyrometallurgy**

Module objective: To give the student basic knowledge and insight of selected aspects of pyrometallurgical processes, including thermodynamic principles, refractories, furnaces and pyrometry. To understand high temperature separation techniques and to apply these in industrial applications.

Module outcomes:

After successful completion of this module, the student should have

Knowledge:

- Understand metallurgical thermodynamic principles used in pyrometallurgical processes.
- Refractories.
- Furnaces and their construction.

Skills:

- Able to use the Laws of Thermodynamics on relevant pyrometallurgical problems.

- Able to use Ellingham-diagrams to make predictions on pyrometallurgical plant operations.
- Distinguish between oxide/ non-oxide and acid/basic/neutral refractories and construct simple phase diagrams for the most important refractories,
- Determine from the phase diagrams plant conditions of the refractories.
- Discuss the classification principles of refractories.
- Perform combustion calculations used in pyrometallurgical processes.
- Distinguish between chemical and physical preparation processes.
- Understand direct reduction of hematite and solve relevant problems.
- Understand copper metallurgy and conduct relevant discussions and solve problems.
- Describe the reduction of solid oxide ores and perform calculations.
- Discuss the carbothermic reduction of ferro alloys.
- Describe the reduction of alumina.
- Determine chemical equations and solve problems.
- Give a short description of refining processes.
- Perform a research project on a relevant pyrometallurgical process.

Credits: 16

Prerequisite: None

Assessment modes: PC 3 hours 1:1

Module code: CEMI471	**Year module**	**NQF level: 8**

Name: **Vacation Training seniors**

This is a compulsory attendance module for a period of six weeks during the vacation.

Module objective: During vacation training students are exposed to the daily operation of an appropriate plant, installation or laboratory. Typical engineering problems which are connected with the work place concerned must be investigated under the guidance of an engineer in charge.

Module outcomes:

After successful completion of the module the student should have a better understanding of the skills a professional engineer needs, the process of engineering and problem solving. The student should be able to take his/her place in industry and apply safety requirements in the work place.

An occupational safety course (NOSA) will be completed during the second year of study at the University before, the start of the vacation training in industry.

Credits: 8

Prerequisite: Must have completed third year

Assessment modes: Attendance (Industry: report)

Module code: CEMI477	**Semester 2**	**NQF level: 8**

Name: **Plant Design II**

Module objective: To give the student basic knowledge and insight of selected aspects of a conceptual plant design and thereby facilitating the application of these skills in problem solving and plant design. To integrate and apply all previous knowledge and skills, together with innovation and creativity to conceptualise and design a process to create a valuable commodity from raw materials, that is technically and economically viable and at the same time responsible with regard to its impact on people and the environment.

Module outcomes:

After successful completion of this module, students should have:

Knowledge:

- Design aspects of well-known plants.
- Scope of a complete plant design project.
- Economic evaluation of a plant.
- The concept of optimized heat integration.

- All all prior knowledge gathered in preceding modules is integrated.

Skills:

- Capable of using modern information sources.
- Implement a hierarchical method of plant design and the ability to analyse any plant design.
- Communication skills (orally, written, individually or in groups).
- Perform heat integration analyses according to pinch techniques for heat exchangers, distillation columns and heat pumps.
- Perform a Hazop analysis for a conceptual design.
- To carry out creative procedural and non-procedural design and synthesis of components systems, operations, products or processes. (ECSA ELO 3).
- To communicate effectively in writing and orally with the engineering, as well as the wider community. (ECSA ELO 6).
- To develop a critical awareness of the impact of engineering activities on the social, industrial and physical environment. (ECSA ELO 7).
- To work effectively as an individual in teams and in multidisciplinary environments. (ECSA ELO 8).

Note: Previously CEMI416 + CEMI427

Credits:	32
Prerequisite:	A student must have completed all previous modules for this programme and must be able to graduate after successful completion of this module

Assessment modes: A final presentation (20%) and comprehensive design report (80%) that will be assessed by a panel of internal and external examiners. The assessment will be done in group context and the evaluation will be adapted for individuals by means of an acceptable technique.

Module code: CEMI479	**Year course**	**NQF level: 8**

Name: **Project**

Module objective: Student must have completed all preceding modules in this programme and must be able to graduate after successful completion of this module.

Module outcomes:

After successful completion of this module, students should have:

Knowledge:

- Planning methods of engineering projects.
- Methodology of literature searches.
- Knowledge about the specific research topic.
- Methods of data acquisition, processing, interpretation and presentation.
- Use and operation of laboratory and analytical apparatus.
- Laboratory safety.

Skills:

- To conceptualise and formulate research problems.
- To undertake a literature study.
- To formulate a hypothesis.
- To plan a research project according to acceptable methodology.
- To obtain or design and build the necessary apparatus.
- To operate laboratory apparatus.
- To do interim and final reporting by means of posters, oral presentations and written reports.

Note: Year module from 2012 (previously CEMI429).

Credits: 28

Prerequisite:	A student must have completed all previous modules for this programme and must be able to graduate after successful completion of this module.

Assessment modes: A poster (5%), presentation (20%) and comprehensive report (75%) that will be assessed by a panel of internal and external examiners.

Module code: CHEM111	Semester 1	NQF level: 5

Name: **Introductory Inorganic and Physical Chemistry**

Module outcomes:

On completing the module the student should be able:

- to demonstrate fundamental knowledge and insight into the properties of matter and compounds, molecular interaction, aqueous solutions, chemical equilibriums, acids and bases, formation of precipitates and electron transfer reactions and to apply this knowledge to write and name chemical formulae;
- to balance reaction equations, to use stoichiometric and other calculations to determine an unknown quantity, and to explain tendencies and relationships according to the Periodic Table (main groups);
- to demonstrate skills in applying laboratory and safety regulations;
- to be competent to explain observed chemical phenomena, do calculations relating to these, communicate results scientifically and to understand applications of these in industry and the environment better.

Module code: CHEM121	Semester 2	NQF level: 5

Name: **Introductory Organic Chemistry**

Module outcomes:

On completing the module the student should be able:

- to demonstrate knowledge and insight to classify and name organic compounds;
- to know the physical properties and chemical reactions of unsaturated carbohydrates, alkyl halides, alcohols, carbonyl compounds, carboxylic acids and their derivatives, as well as a few aromatic compounds;
- and to describe the mechanism of selected organic reactions.

Module code: CHEN211	Semester 1	NQF level: 6

Name: **Analytical Methods II**

Module outcomes:

At the end of this module the learner will have acquired knowledge and insight to describe analysis as a process (sampling, sample preparation, separation, quantifying, evaluating) to evaluate analytical data, to do analytical calculations and to describe gravimetric methods, volumetric methods (acid-base, complexiometric), atomic spectrometric methods (atomic absorption and emission spectroscopy, inductively coupled plasma), surface characterising methods (microscopy) and separation methods (extraction, column and thin-layer chromatography). The student will also have become familiar with general laboratory techniques and chemical analytical techniques with a view to quality control and control laboratories, and have developed the ability to learn 'classical' analytical methods him-/herself, to conduct chemical analyses in a responsible way and to evaluate analytical results.

Module code: CHEN223	Semester 2	NQF level: 6

Name: **Organic Chemistry II**

Module outcomes:

Knowledge

At the end of this module the student will be familiar with:

- the basic principles and rules of aromaticity;
- drawing resonance and chemical structures;
- identifying permanent and temporary effects and applying them to predict the sequel of reactions;
- the principles of electrophilic and nucleophilic aromatic substitution reactions with

special reference to orientation, reactivity and mechanism;
- illustrating general and name reactions of aromatic and heterocyclic compounds with appropriate examples and mechanisms;
- suggesting synthesis routes for preparing specific aromatic compounds.

Skills

At the end of this module the student will be familiar with:
- setting up appropriate glass apparatus;
- the correct and safe handling of chemicals;
- the dangers of chemicals;
- making scientific observations during experiments and noting these down in the correct way;
- obtaining pure compounds at the end of a synthesis;
- the theoretical background of the experiments;
- laboratory techniques and skills;
- doing appropriate scientific calculations and completing an experimental report.

Module code: EEII321	**Semester 2**	**NQF level: 7**

Name: **Power Systems I**

Module objective: To obtain a thorough understanding of the basic principles governing single-phase and three-phase power systems and the analytical techniques required for modelling and analysis of power systems under steady state conditions.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she
- has mastered the basic principles of single frequency power definitions for both single- and three-phase power systems, application of the admittance matrix, transformer principles and modelling, the per unit system, symmetrical components, steady state transmission line operation and modelling; and
- can analyse power systems under steady state conditions.

Credits: 16

Prerequisite: EERI221 and EERI311

Assessment modes: PC 3 hours 1:1

Module code: EEII327	**Semester 2**	**NQF level: 7**

Name: **Electrical Design**

Module objective: To secure the principles of systems/product development and design processes. An additional aim is to facilitate and test the practical implementation of knowledge. This course thus evaluates the student's ability to integrate all her/his previous knowledge by using analysis and synthesis.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she
- understands and can apply general project and acquisition management techniques, manage product life cycles, complete a conceptual and preliminary design, elements of detail design and manage design resources and techniques;
- can successfully work as an individual and in groups;
- can apply design guidelines and constraints; and
- can interpret a development specification and the allocation of requirements.

Credits: 16

Prerequisite: Student must be able to complete third year BEng

Assessment modes: PC 3 hours 1:1

Module code: EEII411	Semester 1	NQF level: 8
Name: **Power Systems II**		
Module objective: The student acquires the knowledge and skills to analyse power flow in a power system, fault currents and transient stability and how to economically dispatch energy within the power system. *Module outcomes:* To successfully complete this module, the student should demonstrate that he/she • understands the principles and requirements to operate a power system safely and economically within stable limits; • can solve power flow problems with Jacobi, Gauss-Seidel and Newton methods; • can perform symmetrical and asymmetrical fault current analysis; • can use the swing equation and equal area technique to test the stability of the network; • can use the principles of generator voltage control, load frequency control and economic dispatch to meet the system requirements; and • can calculate wave propagation in transmission systems.		
Credits: 16		
Prerequisite: EEII321		
Assessment modes: PC 3 hours 1:1		
Module code: EEII421	**Semester 2**	**NQF level: 8**
Name: **Power Electronics**		
Module objective: In this module the student is exposed to the different types of power electronic switches and converter topologies. Armed with this knowledge and skills acquired in this and previous modules the student will be able to analyse, design, construct and test power converter circuits for various applications and topologies. *Module outcomes:* To successfully complete this module, the student should demonstrate that he/she • has mastered the functioning of various power electronic switches, including diodes, transistors, MOSFETs, thyristors and IGBTs, and of various converter topologies; • understands the physics and switching transients of different switches; • can calculate the losses associated with different switches; • can apply switches in various converter topologies; and • successfully build a converter to control a electrical machine.		
Credits: 16		
Prerequisite: EERI311 and EERI321		
Assessment modes: PC 3 hours 1:1		
Module code: EERI112	**Semester 1**	**NQF level: 5**
Name: **Computer Engineering I**		
Module outcomes: To successfully complete this module, the student should demonstrate that he/she • has acquired thorough knowledge of binary and octal number systems, logic gates, Boolean algebra and simplification, Karnaugh map simplification, gates and their time relationships, as well as knowledge of various combinational circuits, e.g. decoding and encoding and mathematical circuits, synchronous circuits, flip-flop circuits and their time characteristics, random circuit adder designs, time division multiplexing, A/D, D/A converters and coupling, memory systems and microcomputer structures, buses and time signals, codes, e.g. ASCII, Grey, EBCDIC; and • is conversant with the theory of analysis, evaluation, simulation, design, synthesis and troubleshooting of logical circuits and systems of circuits.		
Credits: 16		
Prerequisite: none		

Assessment modes: PC 3 hours 1:1

Module code: EERI123	Semester 2	NQF level: 5

Name: **Computer Engineering II**

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has acquired thorough knowledge to identify and evaluate the difference between embedded microprocessors and general microprocessors as in the Intel 80x86 family, as well as the difference between von Neumann and Harvard architectures. Furthermore, the student should have the ability to specify and design embedded hardware for a given task and to design and codify software for a given task in assembly language or C++;
- can make use of IN and OUT interfaces on the level of specification, design and programming and can develop software for both polled and interrupt driven systems;
- can use address space optimally taking into consideration space and speed criteria in microprocessors; and
- is conversant with the theory of analysis, evaluation, simulation, design, synthesis and troubleshooting of microprocessors on a systems level.

Credits: 16

Prerequisite: EERI112 and ITRW115

Assessment modes: PC 3 hours 1:1

Module code: EERI212	Semester 1	NQF level: 6

Name: **Electrotechnics**

Module objective: This course is an introduction to the electrical and electronic engineering. The student should develop basic knowledge with regard to electrical quantities and signals, networks, solution of networks, ac theory and power.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has acquired thorough knowledge of electrical quantities and components, signals and understands the basic techniques governing circuit analysis;
- understands the most common network elements and their properties, as well as the application and functioning of these elements in dc and ac networks;
- has developed technical skills to analyse electrical networks in steady state dc and ac conditions using different techniques, phasors and to do power calculations; and
- has developed skills to perform simulations of electrical networks with circuit analysis software.

NOTE: This module is taken by Chemical, Minerals processing and Mechanical students.

Credits: 16

Prerequisite: FSKS111; FSKS121; WISN111 and WISN121

Assessment modes: PC 3 hours 1:1

Module code: EERI213	Semester 1	NQF level: 6

Name: **Electrotechnics II**

Module objective: This course is an introduction to the electrical and electronic engineering. The student should develop basic knowledge with regard to electrical quantities and signals, networks, solution of networks, ac theory and power.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has acquired thorough knowledge of electrical quantities and components, signals and understands the basic techniques governing circuit analysis;
- understands the most common network elements and their properties, as well as the application and functioning of these elements in dc and ac networks;
- has developed technical skills to analyse electrical networks in steady state dc and ac conditions using different techniques, phasors and to do power calculations; and

- has developed skills to perform simulations of electrical networks with circuit analysis software.

Note: New module from 2011 for Electrical, Electronic and Computer engineering students

Credits: 16

Prerequisite: FSKS111; FSKS121; WISN111 en WISN121

Assessment modes: PC 3 hours 1:1

Module code: EERI214	**Semester 1**	**NQF level: 6**

Name: **Engineering Programming I**

Module outcomes:

On successful completion of this module, students should be able to:

- demonstrate in-depth knowledge and understanding of mathematical modelling and the ability to simulate mathematical models by using a programming language;
- demonstrate knowledge and understanding of data structures (including vectors, matrices, switched lists, stacks and queues);
- use methods to create abstract data types for the above mentioned data structures;
- demonstrate the ability to construct complex algorithms by setting up and manipulating the above data structures;
- solve different engineering problems by using the above techniques.

Note: New module from 2015 for Electrical, Electronic and Computer engineering students

Credits: 8

Prerequisite: ITRW115; WISN111; WISN121; TGWN121; TGWN212; WISN221 en WISN212

Assessment modes: PC 3 hours 1:1

Module code: EERI221	**Semester 2**	**NQF level: 6**

Name: **Electrical Systems I**

Module objective: This course serves as an introduction to electrical engineering. The laws of electro-mechanics are applied in the derivation of models for direct current machines. The focus lies on steady state conditions. The student is able to represent 3-phase power, is knowledgeable in power principles and equipped to use phasor diagrams.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has acquired a thorough knowledge of basic units and derived units, the per unit system of measurement and the fundamental principles of electricity and mechanics, electrical network principles and active, reactive and complex power in single- and three-phase linear networks in the steady state;
- has skills to use per unit values to do calculations, and
- can use electrical network theory and circuit laws to analyse the operation of machines under steady state conditions and derive mathematical models for them. The student should also be able to analyse the steady state operation of single- and three-phase networks mathematically.

Credits: 16

Prerequisite: EERI213

Assessment modes: PC 3 hours 1:1

Module code: EERI222	**Semester 2**	**NQF level: 6**

Name: **Signal Theory I**

Module objective:

To introduce the student to the fundamentals of modelling and characteristics of continuous time, linear and time invariant systems. The student should become confidant with the mathematics and analysis of continuous time signals in both the time and frequency domain.

Module outcomes:
To successfully complete this module, the student should demonstrate that he/she

- has acquired a thorough knowledge of basic properties and behaviour of continuous time and linear time invariant systems;
- know the properties and limitations of the Fourier series and the Fourier transform;
- can describe basic signals with mathematical equations and will also be able to analyse these signals using Fourier series and the Fourier transform;
- can analyse linear time invariant systems in both the time and frequency domain to obtain knowledge on the behaviour and to compute the response of the system on arbitrary input signals; and
- will be able to design lower order passive Butterworth filters in both the high pass and low pass format.

Credits: 16

Prerequisite: EERI213, TGWN211, TGWN212, WISN211 and WISN212

Co-required: WISN221

Assessment modes: PC 3 hours 1:1

Module code: EERI223	**Semester 2**	**NQF level: 6**

Name: **Electronics I**

Module objective: To gain knowledge in the analysis and design of analogue electronic circuits.

Module outcomes:
To successfully complete this module, the student should demonstrate that he/she

- has acquired a thorough knowledge of elementary semiconductor physics, pn levels, application, analysis and design of diode circuits, dc and ac operation of bipolar and field-effect transistors, amplifier configurations, modelling, application, design and analysis of analogue amplifiers, basic properties and behaviour of continuous time, linear time invariant systems; and
- has developed the ability to use models of diodes and transistors in the analysis of such circuits during the application and design of analogue electronic circuits.

Credits: 16

Prerequisite: EERI213

Assessment modes: PC 3 hours 1:1

Module code: EERI224	**Semester 2**	**NQF level: 6**

Name: **Linear Systems**

Module objective: The purpose of the Linear Systems module is to solve analogue circuits by using Laplace transform techniques. This module therefore introduces the basics to be used in the Signal Theory II module.

Module outcomes:
To successfully complete this module, the student should demonstrate that he/she

- has acquired a commanding ability to analyse analogue circuits by using the Laplace transform technique, the convolution integral and to determine the transfer function of analogue circuits;
- has acquired an ability to analyse analogue circuits by applying principles from physics.
- can determine the characteristics of different approximation functions for filter designs and apply techniques to practically implement the approximation functions;
- has the ability to design active analogue filters using different methods and implement the designs in different ways using Bode diagrams and other techniques.

Note: *New module from 2015 prevoiuly EERI229*

Credits: 12

Prerequisite: EERI213 and WISN212.

Co-required: WISN222

Assessment modes: PC 3 hours 1:1

Module code: EERI228	Semester 2	NQF level: 6
Name: **Measure and Control**		
Module objective: To acquaint mechanical engineering students with basic instrumentation and control systems and electrical drive systems.		
Module outcomes: After completion of this module the student should be able to • demonstrate a thorough knowledge of the design and building of basic instrumentation and control systems for process control; • analyse the behaviour of induction motors; • specify motors for mechanical applications; • demonstrate skills in the designing and building of basic instrumentation and control systems; and • demonstrate skills in problem solving, teamwork and communication.		
Credits: 16		
Prerequisite: EERI212 or EERI213		
Assessment modes: PC 3 hours 1:1		
Module code: EERI311	**Semester 1**	**NQF level: 7**
Name: **Electrical Systems II**		
Module objective: In this module the student is introduced to ac machines and transformers. Armed with this knowledge and skills acquired in this and previous modules, the student should be able to analyse the performance of these electromagnetic converters. *Module outcomes:* To successfully complete this module, the student should be able to demonstrate that he/she • has acquired a commanding ability to analyse the performance of electromagnetic converters, i.e. transformers, induction motors and synchronous machines; and • understands and can apply the physics and theory of transformers, induction motors and synchronous machines in practical applications using complex algebra.		
Credits: 16		
Prerequisite: EERI213, EERI221		
Assessment modes: PC 3 hours 1:1		
Module code: EERI313	**Semester 1**	**NQF level: 7**
Name**: Electromagnetics II**		
Module objective: After successful completion of this module the student should be able to apply the principles of transmission and reflection of electromagnetic waves in waveguide applications, to model transmission lines and waveguides as electrical components, to calculate the radiation patterns of antennas and to calculate the electrical and magnetic fields in various applications. The student should further be able to set up and solve electromagnetic problems numerically, thus being able to use computer packages to solve electromagnetic problems. *Module outcomes:* To successfully complete this module, the student should demonstrate that he/she • has a thorough knowledge of the principles of transmission and reflection of electromagnetic waves, waveguides, the modelling of transmission lines and waveguides as electrical components, the radiation patterns of antennas and the electrical and magnetic fields in various applications; • can use the acquired knowledge to model and analyse waveguides, radiation patterns of antennas, and to calculate the electrical and magnetic fields in various applications; and • can set up and solve electromagnetic problems numerically, thus being able to use computer packages to solve these problems.		
Credits: 16		

Prerequisite: FSKS211

Assessment modes: PC 3 hours 1:1

Module code: EERI315	Semester 1	NQF level: 7

Name: **Signal Theory II**

Module objective: The purpose of this module is to teach the student to analyse, design and implement active filters. To reach this goal the student must first learn to perform network analysis on passive and active RLC circuits.

Module outcomes:

- To successfully complete this module, the student should demonstrate that he/she
- understands the principles, benefits and application areas of digital signal processing;
- has acquired and understanding of the characteristics of signals and signal processing;
- understands and is able to handle discrete-time systems;
- is able to handle discrete-time signals in the time domain, including correlation and convolution;
- is able to handle discrete-time signals in the frequency domain;
- understands and is able to handle finite-length discrete transforms.

Credits: 16

Prerequisite: EERI312

Assessment modes: PC 3 hours 1:1

Module code: EERI316	Semester 1	NQF level: 7

Name: **Engineering Programming II**

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- Understands the difference between classical and object oriented software engineering;
- Mastered the principles of object oriented programming, namely objects, classes, inheritance and polymorphism;
- be acquainted with programming methods applicable in certain problem-solving techniques, e.g. simulation and modelling, by the development of object oriented programmes; Understands and is able to apply the principles of graphical user interfaces and event driven programming;
- Is able to design and develop object oriented computer programs to solve engineering problems;
- Is able to develop software according to best programming practice;
- understands various phases in software engineering: requirements and analysis, specification, design, implementation, integration and maintenance,
- understands and can use planning and estimating, project management, life cycle models, teamwork, documentation and testing of software theoretically as well as with case studies.

Credits: 16

Prerequisite: ITRW115; EERI112 and EERI122/EERI123

Assessment modes: PC 3 hours 1:1

Module code: EERI321	Semester 2	NQF level: 7

Name: **Control Theory I**

Module objective: Control Theory I is the basic course in control theory where the student integrates knowledge gained in previous subjects to analyse, design and simulate system behaviour in the continuous time domain.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has mastered the main elements of modern analogue control system theory, i.e. model control system components, determine steady state errors and dynamic response, perform stability analyses, frequency response representations, controller design and

simulate, state space modelling of systems;
- can set up block diagrams of systems, model systems, determine steady state errors and dynamic responses; and
- can perform stability analyses with Routh-Hurwitz and root-locus methods, perform frequency response representations using Bode diagrams and others, verify system response through simulation, model systems through state space representation.

Credits: 16

Prerequisite: TGWN121; EERI212/213; TGWN212 and WISN212

Assessment modes: PC 3 hours 1:1

Module code: EERI322	**Semester 2**	**NQF level: 7**

Name: **Electronics II**

Module objective: The student should be able to demonstrate a thorough knowledge of electronic hardware after the successful completion of EERI322. The student should also be able to use these obtained skills in creating effective, purpose-driven designs. In addition the student should be able to approach all practice-aimed applications in a problem-solving and analytical manner and cooperate in finding solutions successfully in groups and professional relations, and communicate them orally and in writing.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- knows advanced standard configurations of active components;
- is capable of analysing and designing feedback, multistage and power amplifiers as integrated circuits;
- has the capability to determine the frequency and time response of electronic circuits;
- can manipulate signal descriptions in an orthogonal space, with specific reference to signals in the frequency domain; and
- can use modulation techniques for the design and analysis of information channels for transfer of analogue or digital information.

Credits: 16

Prerequisite: EERI223

Assessment modes: PC 3 hours 1:1

Module code: EERI412	**Semester 1**	**NQF level: 8**

Name: **Electronics III**

Module objective: The aim of this module is to enable the student to analyse and design radio frequency analogue electronic circuits. This module also serves as a study of radio frequency electronic amplifiers, and the stability and noise that accompanies circuits.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- understands basics of microstrip waveguides at radio frequencies;
- can use different methods to analyse and design stable analogue radio frequency amplifiers (specifically linear, quasi-linear and nonlinear amplifiers) and lossless impedance matching networks with the aid of the Smith chart;
- can analyse stability and noise in radio frequency amplifiers;
- understands orthogonality, amplitude modulation, frequency modulation, phase modulation, pulse amplitude modulation, pulse width modulation, pulse position modulation and the influence of noise in analogue communication systems; and
- understands digital communication, e.g. ASK, PSK, QAM with reference to the influence of noise and the necessity of error correction.

Credits: 16

Prerequisite: EERI322

Assessment modes: PC 3 hours 1:1

Module code: EERI413	Semester 1	NQF level: 8

Name: **Signal Theory III**

Module objective: The purpose of the Signal Theory III module is to teach the student to handle signal theory principles in the digital world. The differences between analogue signal theory and digital signal theory are discussed in detail and the advantages and disadvantages of digital signal theory are pointed out.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- understands the principles, benefits and application areas of digital signal processing;
- understands fundamental principles of audio applications of digital signal processing;
- understands fundamental principles of telecommunication applications of digital signal processing;
- can design analogue input/output interfaces for digital signal processing systems
- can use discrete transforms, e.g. the z-transform and its applications in digital signal processing, and correlation and convolution.

Credits: 16

Prerequisite: EERI312

Assessment modes: PC 3 hours 1:1

Module code: EERI418	Semester 1	NQF level: 8

Name: **Control Theory II**

Module objective: This module is a specialist module that follows on the basic level of the third year of study. The focus of the module is on time discrete systems. After successful completion of the module, the student should be able to analyse, design and simulate basic time discrete systems. A short overview of artificial neural networks and fuzzy logic systems is also given.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she can

- design state variable feedback systems, set up mathematical models of simple linear systems;
- apply the z-transform and inverse z-transform, apply and describe sampling and reconstruction;
- determine the pulse transfer functions for open-loop and closed-loop systems;
- determine the time-response characteristics of open-loop and closed-loop systems;
- determine the stability of digital systems;
- describe the operation and application of artificial neural networks and fuzzy logic systems;
- design digital controllers according to predetermined criteria;
- analyse the impact of engineering activities on the community and the environment; and
- complete tasks or projects in group context.

Credits: 16

Prerequisite: EERI321

Assessment modes: PC 3 hours 1:1

Module code: EERI419	Semester 1	NQF level: 8

Name: **Project**

Module outcomes:

After successful completion of this module the student should have mastered the following:

- Engineering design and synthesis, i.e. engineering problem solving, the application of fundamental and specialist knowledge, investigations, experiments and data analysis, engineering methods, tools and information technology.
- Professional and general communication in both written and oral form and be able to effectively communicate with engineering - and non technical audiences.

- Work effectively as an individual or as a team in multi-disciplinary groups.
- Demonstrate desire to learn continuously, i.e. the extension of knowledge within own area of specialisation and other engineering disciplines.
- Act ethically and professionally, i.e. act responsibly in society and the environment.

Credits: 8

Prerequisite: Student must be able to complete his/her final academic year.

Co-required: INGM472

Assessment modes: Successful demonstration concept and review of concept report

Module code: EERI423	**Semester 2**	**NQF level: 8**

Name: **Telecommunication systems**

Module objective: To provide the student with an overview of the most important aspects of modern speech and data communication systems. Radio and optical communication networks must be defined, designed, analysed, and evaluated from a systems perspective.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- understands the basic principles on which radio and optical communication systems operate; is able to compare and evaluate different radio and optical communication systems;
- is able to characterise, analyse, and design radio-based communication systems, including cellular systems, receivers and transmitters, mixers, phase-locked loops and frequency synthesizers; and
- able to analyse optical networks.

Credits: 16

Prerequisite: EERI313

Assessment modes: PC 3 hours 1:1

Module code: EERI429	**Semester 2**	**NQF level: 8**

Name: **Project**

Module outcomes:

After successful completion of this module the student should have mastered the following:

- Engineering design and synthesis, i.e. engineering problem solving, the application of fundamental and specialist knowledge, investigations, experiments and data analysis, engineering methods, tools and information technology.
- Professional and general communication in both written and oral form and be able to effectively communicate with engineering - and non technical audiences.
- Work effectively as an individual or as a team in multi-disciplinary groups.
- Demonstrate desire to learn continuously, i.e. the extension of knowledge within own area of specialisation and other engineering disciplines.
- Act ethically and professionally, i.e. act responsibly in society and the environment.

Credits: 16

Prerequisite: Student must be able to complete his/her final academic year.

Co-required: INGM472

Assessment modes: Successful reporting on an engineering project, in the form of a written report, an oral presentation and a poster presentation.

Module code: EERI471	**Semester 2**	**NQF level: 8**

Name: **Vacation training seniors**

Module objective: This is a compulsory attendance module requiring vacation training for a period of six weeks during the University vacation. During this training period students are exposed to the day to day operation of an acceptable plant, installation or laboratory. Typical engineering problems arising from the activities of the workplace concerned have to be investigated by the student, under the supervision of the engineer in charge.

Module outcomes:
After successful completion of this module, the students should have insight in the skills required of professional engineers, better understand the process of engineering and problem solving, pull their weight in industry and be able to apply safety measures in the work environment.

Credits: 8

Prerequisite: Must have completed third year

Assessment modes: Participation (industries, report)

Module code: EERI472	**Year module**	**NQF level: 8**

Name: **Introduction to Project Management**

Module objective: To equip students with knowledge and practical project management skills for application in a technical environment.

Module outcomes:
After successful completion of this module, the student should be able to

- have fundamental knowledge of project management activities for all project management functions during each life cycle phase; and
- be able to execute activities of project management in the management of his/her own final year project by using techniques which include development and updating of applicable documentation, as well as using applicable software.

NOTE: *New code for Electrical, Electronic and Computer Engineering programmes*

Credits: 8

Prerequisite: None

Co-required: EERI429

Assessment modes: PC 3 hours 1:1

Module code: FIAP172	**Year module**	**NQF level: 5**

Name: **Professional Practice I**

Module outcomes:
On successful completion of this module a student must be able:

Knowledge:

- to demonstrate fundamental knowledge of the work engineers perform in the various disciplines, as well as the curriculum to be followed;
- to demonstrate fundamental knowledge and the application of :
  a) the principles and theory of project management;
  b) the principles and theory of systems engineering;
  c) computer programmes such as Word, Excel and Power Point;
  d) learning, listening, reading and writing strategies; as well as
  e) the academic language register and the reading and writing of academic texts in the field of engineering.

Skills:

- The student must demonstrate the ability to apply, as a member of a multi-disciplinary team, the engineering process of determination of need, analysis, design, manufacture and evaluation to a simple engineering problem or project; to effectively and verbally communicate the engineering process in an ethically responsible way within the academic milieu and to demonstrate the ability to source scientific information within the field of engineering, to analyze texts, interpret them, synthesize, evaluate and to communicate solutions in a creative manner in the applicable academic genres by using linguistic and mathematical conventions as applicable to the field of engineering.

Credits: 24

Prerequisite: None

Method of delivery: full time year course

Assessment modes: Group portfolios and individual portfolio.

Module code: FIAP271	Year module	NQF level: 6
Name: **Professional Practice II**		
Module outcomes: On successful completion of the module the student must be able: **Knowledge:** • to demonstrate thorough knowledge of the elements of project management and economic and financial accountancy and to apply this knowledge to determine cost estimates, mark analysis, risk analysis and the evaluation of economic feasibility and profitability of non-complex projects to be undertaken in the field of engineering. **Skills:** • to demonstrate skills to identify, analyse and evaluate entrepreneurial opportunities and the sustainability thereof; to plan, implement, develop and manage a simulated organisation, with due regard to economic, social, ethical and environmental responsibilities; • to demonstrate the ability as an individual and member of a team, to apply organisational managerial elements in the form of a comprehensive management plan and to communicate the development and execution thereof verbally and in writing to stakeholders by way of relevant IT.		
Credits: 24		
Prerequisite: FIAP172		
Method of delivery: full time year course		
Assessment modes: Group portfolios and individual portfolio.		
Module code: FSKS111	**Semester 1**	**NQF level: 5**
Name: **Mechanics, Oscillations, Waves and Theory of Heat**		
Module outcomes: **Knowledge:** At the end of this module, students will have formal mathematical knowledge of fundamental concepts like force, work, energy and momentum, elasticity, simple harmonic motion, waves, hydrostatics, hydrodynamics and theory of heat. **Skills:** For the first time, students are introduced to differential and integral calculus in natural science problems, and using these, they will have the skills at the end of the module to describe certain sections of the theory and to solve a variety of problems of the above-mentioned topics. In the accompanying practical sessions, students develop skills in measuring, processing and reporting natural science processes selected from an area wider than Physics only.		
Module code: FSKS121	**Semester 2**	**NQF level: 5**
Name: **Electricity, Magnetism, Optics, Atomic and Nuclear Physics**		
Module outcomes: **Knowledge:** Learners acquire a formal mathematical knowledge of electricity and magnetism, optics and topics from atomic and nuclear physics, such as introductory quantum theory, quantum theory of radiation, atomic spectra, X-rays, de Broglie waves and radioactivity. **Skills:** Learners develop skills to describe physical processes and natural science problems by means of differential and integral calculus and to solve a variety of problems of the above-mentioned topics. In the accompanying practical sessions, they develop their skills in measuring, processing and reporting on natural science processes.		

Module code: FSKS211	Semester 1	NQF level: 6
Name: **Electricity and Magnetism**		
Module outcomes: **Knowledge:** At the end of this module, the students have been introduced comprehensively to the experimental laws of electrostatics and magneto statics in vacuum and matter, and to introductory electrodynamics. **Skills:** Students learn to apply the laws to a variety of problems by calculating electrostatic potentials and fields and magneto static fields. In the practical sessions, they apply new knowledge to measure some of these phenomena, to investigate the laws governing them and to analyse and present their results and reports by means of computer methods.		
Module code: GENL311	**Semester 1**	**NQF level: 7**
Name: **Mineralogy and Petrology**		
Module outcomes: On completion of this module the student will have the knowledge to • describe the relation between the basic principles of crystallography, crystal chemistry and structure and properties of minerals and artificial materials; • give an indication of the geological occurrence and uses of economic minerals; • relate aspects of the textual and mineralogical characteristics of rocks with the beneficiation of economic deposits; • indicate the most important South African economic deposits and their contribution to the South African economy; and • explain the origin of coal, relate aspects e.g. coal analysis, beneficiation and use with one another and be aware of its impact on the environment.		
Credits: 16		
Prerequisite: None		
Assessment modes: PC 3 hours 1:1		
Module code: INGB121	**Semester 2**	**NQF level: 5**
Name: **Process Drawings**		
Module objective: The objective of this module is the equip the student to execute the first step of process optimization. *Module outcomes:* After successful completion of this module the student should be able to • describe any process in terms of process inputs, process transformation, and process outputs; • interpret, create and communicate through specialised process drawings; • use work measurement techniques to determine standard process times; • appreciate the role of process drawings and work measurement in practical process and systems design and in further analysis design modules.		
Credits: 12		
Prerequisite: INGM111 (40%)		
Assessment modes: PC 3 hours 1:1		
Module code: INGM111	**Semester 1**	**NQF level: 5**
Name: **Engineering Graphics I**		
Module objective: To equip the student to communicate with basic engineering graphics and to create drawings by means of hand sketching and computer aided design software. The student should have an understanding of the role of engineering graphics in further design modules and in practical design processes.		

Module outcomes:
After successful completion of this module, the student should be able to
- make use of basic geometric forms to create and communicate design solutions;
- create technical design solutions by using sketching and CAD; and
- communicate in e-format.

Credits: 12

Prerequisite: none

Assessment modes: PC 3 hours 1:1

Module code: INGM121	**Semester 2**	**NQF level: 5**

Name: **Engineering Graphics II**

Module objective: To equip the student to communicate through advanced mechanical engineering graphics and to create specialised mechanical drawings. The student should have an understanding of the role of engineering graphics in practical design analysis and in further design modules. The student should acquire the skills to operate in a group by solving design problems and perform project administration in e-format.

Module outcomes:
After successful completion of this module, the student should be able to
- create 3D models of parts and assemblies and create manufacturing and assembly drawings;
- work in groups to solve engineering designs; and
- communicate in e-format.

Credits: 12

Prerequisite: INGM111 (40%)

Assessment modes: PC 3 hours 1:1

Module code: INGM122	**Semester 2**	**NQF level: 5**

Name: **Materials Science I**

Module objective: To equip the student with basic knowledge about the composition, structure, properties and applications of engineering materials. This module forms the basis for later modules in materials selection, techniques for manufacturing, strength of materials and design.

Module outcomes:
After successful completion of this module, the student should be able to
- evaluate the suitability of some important engineering materials for certain applications, based on their properties; and
- analyse and interpret experimental data in the laboratory.

Credits: 16

Prerequisite: none

Assessment modes: PC 3 hours 1:1

Module code: INGM211	**Semester 1**	**NQF level: 6**

Name: **Strength of Materials I**

Module objective: The objective of this module is to give the students a basic knowledge of strength of materials and give them a basic understanding of the analysis and design of mechanical structures. This module forms the basis for Strength of Materials and Mechanical Design in the 3rd year.

Module outcomes:
After successful completion of this module, the student should be able to
- use the knowledge gained to define and solve structural problems;
- solve design problems;
- communicate technical information by means of a design report; and
- analyse and interpret observed data.

Credits: 12

Prerequisite: WISN121 and TGWN121

Assessment modes: PC 3 hours 1:1

Module code: INGM212	Semester 1	NQF level: 6

Name: **Engineering Materials**

Module objective: Provision of learning opportunities in order to acquire an understanding of the influence of chemical composition and strengthening mechanisms and strengthening techniques/methods on strength, ductility, toughness, and formability of ferrous- and non-ferrous alloys, relevant specifications and the use and potential application of these materials in mechanical design.

Module outcomes: After successful completion of this module, the student should be able to demonstrate that he/she has

- a fundamental knowledge of the engineering properties of materials and their basic testing, as well as the typical application in mechanical design of these materials;
- knowledge of the principles and methods that are available to improve engineering properties of ferrous and non-ferrous alloys;
- a fundamental knowledge of modern methods of material selection and specification; and
- the ability to specify materials for simple mechanical designs, taking cognizance of requirements relating to failure, corrosion and impact on the environment.

Credits: 12

Prerequisite: None

Assessment modes: PC 2 hours 1:1

Module code: INGM222	Semester 2	NQF level: 6

Name: **Thermodynamics I**

Module objective: To lead the students to a thorough understanding of the concepts and principles of thermodynamics and lead them to a confident application thereof. The concepts mastered in this module form an integral part of the energy and thermal-fluid modules in subsequent years.

Module outcomes:

After the completion of the module the student should be able to

- calculate the value of any property, given the values of two independent properties;
- apply the First Law to open and closed systems;
- use the principle of reversibility to analyse open and closed systems; and
- analyse real open and closed systems.

Credits: 12

Prerequisite: WISN11

Co-required: WISN121

Assessment modes: PC 3 hours 1:1

Module code: INGM224	Semester 2	NQF level: 6

Name: **Computer Methods**

Module objective: In industry, engineers work with a variety of computer software that enable them to solve engineering problems. The software can be divided into two main groups, namely thermal flow analysis and strength of materials analysis packages.

The object of this module is to expose the student to both types of computer packages that he/she will come across in modules in following years of study, and eventually in industry itself. This module also provides a support function for modules in the third and fourth years of study, where this knowledge and these skills will be required.

Module outcomes:

After successful completion of this module, the student should be able to

- identify and interpret thermal flow and strength of materials problems;
- plan and develop simulations and analysis to solve problems;

- write, solve and analyse basic thermal flow programmes using Engineering Equation Solver (EES);
- design and analyse piping networks using Flownex; and
- design and solve basic structural problems using NASTRAN.

Credits: 8

Prerequisite: INGM211

Co-required: INGM222

Assessment modes: PC 3 hours 1:1

Module code: INGM271	**Year module**	**NQF level: 6**

Name: **Workshop Training**

Module objective: The purpose of this module is to provide learners instruction in workshop practice and the safe use of tools.

Module outcomes:

After successfully completing this module the student will have mastered the practical use of basic hand tools and manufacturing equipment, e.g. welding machines and various machine tools The student will acquire basic knowledge of safety requirements in the workshop and the skills to fabricate small articles, involving plate metal work, turning, welding, electronics, etc. The student will acquires knowledge about electrical circuits and electrical equipment. The module is completed at approved institutions during two weeks in the winter recess in the first year, or after completion of the first academic year, A report has to be handed in one week after the start of the next semester.

Note: *This is the new code for Mechanical students for the module MEGI271 from 2010.*

Credits: 8

Prerequisite: none

Method of delivery: vacation training

Assessment modes: Participating (Industry: report)

Module code: INGM311	**Semester 1**	**NQF level: 7**

Name: **Thermodynamics II**

Module objective: To develop and apply the concepts and principles from the first module in thermodynamics in different applications. This module follows on the first module in thermodynamics and develops it further. It forms part of the foundation of modules such as air conditioning and thermal machines.

Module outcomes:

After successful completion of the module the student should be able to:

- analyse power and refrigeration cycles;
- do an exergy analysis on open and closed systems;
- use variables such as: dry bulb temperature, relative humidity and specific humidity in analysing processes performed on air;
- apply the First Law on processes performed on air;
- use the Psychrometric Chart in the calculation and analysis of processes performed in the conditioning of air;
- given the off-gas analysis, fuel composition, air-fuel ratio or other standard specifications, balance the combustion reaction and calculate the energy released (work or power) in combustion reactions; and
- use thermodynamic relations to calculate the value of internal energy, enthalpy and entropy for components used in thermodynamic systems.

Credits: 12

Prerequisite: INGM222 (40%)

Assessment modes: PC 3 hours 1:1

Module code: INGM312	Semester 1	NQF level: 7
Name: **Fluid Mechanics**		
Module objective: To provide the student with the basic knowledge of fluid mechanics including the conservation laws for systems and control volumes with the emphasis on incompressible flow in pipes and ducts. This is a first module in fluid mechanics that forms part of the basis for the follow-on module MEGI321 Fluid Mechanics II as well as for the modules in Thermal Flow,. System Design and Project. *Module outcomes:* • After successful completion of this module, the student should be able to • apply the mathematical formulations for velocity, acceleration, mass flow rate and forces to describe the properties of flow fields; • apply the equations for the conservation of mass, linear momentum and angular momentum in both integral and differential form to describe and solve practical problems in fluid mechanics; • apply dimensional analysis techniques to derive scaling laws for simple experimental studies of fluid mechanical phenomena; and • calculate the losses that are present in steady-state incompressible flow in pipes and ducts and apply it to the solution of practical pipe network problems and the design of simple pipe systems.		
Credits: 12		
Prerequisite: none		
Assessment modes: PC 3 hours 1:1		
Module code: INGM313	**Semester 1**	**NQF level: 7**
Name: **Strength of Materials II**		
Module objective: To equip the student with basic knowledge of the determination of stresses and displacements for the analysis and design of structural components. This module follows on MEGI211 and serves s further preparation for the modules on structural analysis fluid machines and mechanical design. *Module outcomes:* After successful completion of this module, the student should be able to: • apply fundamental knowledge of stresses, strains and displacements along with specialist knowledge of strength of materials, to solve strength of materials problems; and • analyse basic structural components through structured and unstructured synthesis of knowledge of strength of materials; and • interpret and analyse observed additional data that must be obtained with reference to the practical's.		
Credits: 12		
Prerequisite: INGM211		
Assessment modes: PC 3 hours 1:1		
Module code: INGM321	**Semester 2**	**NQF level: 7**
Name: **Fluid mechanics**		
Module objective: To equip the student with the basic knowledge of compressible flow, boundary layer flow, potential flow and measuring techniques in fluid mechanics. This module follows on MEGI 312 Fluid Mechanics I and serves as further preparation for the modules in Heat Transfer and Thermal Fluid System Design.		
Module outcomes: After successful completion of this module, the student should be able to • apply the basic knowledge and principles of compressible flow, potential flow and boundary layer theory to solve problems; • use the applicable engineering tools such as the software package EES, and the		

specialist flow network solver Flownex to solve problems; and
- use the observed results of practical work to analyse and interpret data.

Credits: 8

Prerequisites: INGM312 and INGM222 (40%)

Assessment modes: PC 3 hours 1:1

Module code: INGM322	**Semester 2**	**NQF level: 7**

Name: **Structural Analysis**

Module objective: To equip the student with basic knowledge of the flexibility, stiffness and finite element methods. This module follows on MEGI313 and serves as support and further preparation for the modules on mechanical design.

Module outcomes:

After successful completion of this module, the student should be able to
- identify, formulate and to solve structural problems;
- apply specialist knowledge of the flexibility, stiffness and finite element methods to analyse and solve engineering problems; and
- use the appropriate engineering tools such as EES and a finite element code to simulate engineering problems.

Credits: 12

Prerequisite: INGM313 and TGWN222
Co-required: INGM327

Assessment modes: PC 3 hours 1:1

Module code: INGM323	**Semester 2**	**NQF level: 7**

Name: **Machine Design**

Module objective: The goal of this module is to give the students the basic knowledge of machine design and a basic understanding of the analysis and design of simple machine components. This module covers some of the basic aspects needed for Mechanical Design.

Module outcomes:

After successful completion of this module, the student should be able to
- use the knowledge of this module to analyse and design the different machine components; and
- be able to analyse and interpret observed data.

Credits: 12

Prerequisite: TGWN211

Assessment modes: PC 3 hours 1:1

Module code: INGM327	**Semester 2**	**NQF level: 7**

Name: **Mechanical Design**

Module objective: To teach the student the basic engineering knowledge for the analysis and design of some basic mechanical components. The mechanical components include fasteners, bearings, gears, clutches, brakes, fly wheels, shafts and axles. This is a comprehensive module in design of mechanical components that is based on the modules in Drafting for Engineers, Engineering Materials and Strength of Materials.

Module outcomes:

After successful completion of this module, the student should be able to
- analyse existing designs of basic machine elements;
- design basic machine elements; and
- communicate in writing with technical audiences through sketches, drawings and a formal engineering design report.

Credits: 16

Prerequisite: INGM313

Assessment modes:

The final module mark is dependent on: a comprehensive design report, semester test marks; class test marks; and marks gained for assignments. The ratio that each of these

assessment methods contributes to the final module mark is given in the study guide. The main outcome is a final, comprehensive design report, submitted on the last scheduled day of classes. This report is assessed both internally and externally. The report has a sub-minimum (requirement) of 50% on all Level 3 exit level outcomes (ELOs).

Module code: INGM411	**Semester 1**	**NQF level: 8**

Name: **Thermal Machines**

Module objective: This module will equip the student with fundamentals in engineering science and applied knowledge of gas turbines and reciprocating internal combustion engines. Design, solution and optimization criteria of ideal and practical thermodynamic cycles will form the basis of analysis and synthesis in operational performance. The module builds on the knowledge gained in thermodynamics, fluid dynamics, heat transfer and computer methods, and forms part of the basis for the final year Project and the Thermo-Fluid System Design module to follow.

Module outcomes:

After successful completion of this module, the student should be able to

- apply the fundamental knowledge of gas turbine and internal combustion engine theory, together with specialised knowledge of thermodynamics and cycles, fluid dynamics, heat transfer and computer programming to solve thermo machine problems;
- design a basic thermal machine cycle by means of convergent and divergent synthesis of existing knowledge;
- generate and optimize a typical gas turbine cycle, using programming in Engineering Equation Solver (EES); and
- analyse and interpret experimental data measured during practical sessions.

Credits: 16

Prerequisite: INGM311 and INGM321

Co-required: INGM412

Assessment modes:

The final module mark is dependent on: a comprehensive design report, semester test marks; class test marks; and marks gained for assignments. The ratio that each of these assessment methods contributes to the final module mark is given in the study guide. The main outcome is a final, comprehensive design report, submitted on the last scheduled day of classes. This report is assessed both internally and externally. The report has a sub-minimum (requirement) of 50% on all Level 3 exit level outcomes (ELOs).

Module code: INGM412	**Semester 1**	**NQF level: 8**

Name: **Heat Transfer**

Module objective: To provide the student with the basic knowledge of conduction, convection and thermal radiation. Furthermore develop the necessary skills to solve problems that are generally found in heat transfer processes. This module follows on Fluid Mechanics and is necessary for successfully completing Thermal Fluid System Design.

Module outcomes:

After successful completion of this module, the student should be able to

- apply basic knowledge and concepts of heat transfer, including conduction, external flow, flow inside pipes and thermal radiation to solve practical problems;
- design a basic heat exchanger by integrating the knowledge gained on different heat transfer methods into a solution strategy;
- use engineering software tools like Excel and EES to solve heat transfer problems; and
- analyse and interpret results obtained from practical experiments.

Credits: 12

Prerequisite: INGM321

Assessment modes: PC 3 hours 1:1

Module code: INGM413	Semester 1	NQF level: 8
Name: **Fluid Machines**		
Module objective: At the end of this module the student should have in-depth knowledge of the concepts and theory of fluid machines and be able to select the right fluid machine for different applications and predict the performance of fluid machines individually, as well as in flow networks. *Module outcomes:* After successful completion of this module, the student should be able to have in-depth knowledge on the concepts and theory of fluid machines and be able to • choose the right fluid machine for the right application; • predict the performance of a fluid machine given the performance of a scale model; • predict the performance of a fluid machine, given the geometry of the machine, as well as the flow conditions before and after the machine; and • predict the performance of fluid machines in flow networks.		
Credits: 12		
Prerequisite: INGM321		
Assessment modes: PC 3 hours 1:1		
Module code: INGM414	**Semester 1**	**NQF level: 8**
Name: **Air conditioning and Refrigeration**		
Module objective: After completion of this module the student should be able to solve air conditioning and refrigeration problems and design a refrigeration system (by combining a synthesis of knowledge with additional self-obtained information). It includes the use of tools such as Excel, as well as specialist programs such as EES. The student should be able to understand the impact of the air conditioning and refrigeration industry, as a result of the use of harmful refrigeration media and emissions, on the environment and should be able to stay abreast with the latest technology available on the market.		
Module outcomes: After successful completion of this module, the student should be able to • understand the psychrometric chart and do basic calculation for various actual processes; • understand and calculate the heating load for a building; • understand and solve a compression thermodynamic cycle for air-conditioning system with applicable equipment sizing; • understand and solve air distribution system for a building; • using engineering software tools like Excel and EES and Design Builder to solve problems; and • analyse and interpret results obtained from assignments and practical experiments.		
Credits: 16		
Prerequisite: INGM311 and INGM321		
Assessment modes: PC 3 hours 1:1		
Module code: INGM415	**Semester 1**	**NQF level: 8**
Name: **Failure of Materials**		
Module objective: Engineers of all disciplines need to have a basic and applied knowledge of the degradation and possible failure mechanisms of structural materials. The module aims to introduce students to failure mechanisms associated with metal alloys, ceramics and polymeric engineering materials with reference to those properties that influence integrity. The module is presented against the background of specific applications and observed failures of materials under typical service conditions.		

Module outcomes:
After successful completion of this module, the student should
- be familiar with the most important material properties that influence failure of engineering materials; and
- have adequate knowledge of materials and materials science to efficiently gather information to identify failure-related problems and specify precautionary and rectifying actions of sub-system design and operational practice.

Credits: 16

Prerequisite: INGM212

Assessment modes: PC 3 hours 1:1

Module code: INGM416	**Semester 1**	**NQF level: 8**

Name: **Aircraft Design**

Module objective: The objective of the module is to prepare the student for further in depth study of aerodynamics and aircraft design and give an introduction to the fundamentals of aeronautical engineering.

Module outcomes:
After successful completion of this module, the student should be able to
Knowledge:
- Understand the fundamentals of fluid mechanics, lift, drag, thrust, aircraft performance, stability and control.

Skills:
- Use Xfoil (2D computer software for designing airfoils) to design and optimize airfoils;
- Integrate knowledge and skills of this and other modules to investigate and manage information, analyse and use data, and design an aircraft according to given specifications;
- Develop and communicate orally and/or in writing, his/her ideas and opinions in well formulated arguments using appropriate academic discourse.

Credits: 16

Prerequisite: INGM321

Assessment modes: PC 3 hours 40:60

Module code: INGM417	**Semester 1**	**NQF level: 8**

Name: **Systems Engineering**

Module objective: To teach the student the basic knowledge of systems engineering and the ability to apply it in the design of practical systems. This is the capstone in the application of the underlying training in engineering drawings, materials, strength of materials and mechanical design. This module develops the design skills of the students and exposes them to group work.

Module outcomes:
After successful completion of this module, the student should be able to
- define a user requirement in engineering terms, do a functional analysis of the system and creatively generate system concepts and evaluate it;
- break a system down into sub-systems and components, assign applicable technical performance measures to it, and design according to the specifications;
- communicate in writing with technical audiences by means of reports; and
- work in a group.

Credits: 12

Prerequisite: None Co-required: INGM479 or NUCI479

Assessment modes: PC 3 hours 1:1

Module code: INGM421	Semester 2	NQF level: 8
Name: **Machine Dynamics**		
Module objective: To equip the student with basic knowledge of machine dynamics, vibration and condition monitoring. The module builds on the knowledge gained in dynamics and serves as a basis to identify and understand typical problems found in practice *Module outcomes:* After successful completion of this module, the student should be able to • apply the fundamental knowledge of machine dynamic theory including laws of motion, natural and forced vibrations, as well as specialized knowledge to solve vibration problems; • understand the use of different measuring equipment to gather data on vibration problems; • apply knowledge to the diagnoses of vibrating systems for condition monitoring and preventive maintenance of equipment; • analyse and interpret experimental data measured during practical.		
Credits: 16		
Prerequisite: TGWN312		
Assessment modes: PC 3 hours 1:1		
Module code: INGM423	**Semester 2**	**NQF level: 8**
Name: **Manufacturing Technology**		
Module objective: The objective of this module is firstly to introduce the student to the different manufacturing technologies available, and to enable the student to specify the correct or applicable manufacturing processes for any mechanical design. The second objective is to enable the student to design for manufacturing i.e. so that the designed component or product can be manufactured as effectively, simple and inexpensive as possible. *Module outcomes:* At the end of the module the student should have a good background knowledge on the different manufacturing processes. This includes • logical and systematic solution of engineering problems with respect to manufacturing of products on the grounds of effectiveness, time, cost, quality and finish; • applying knowledge with respect to material properties and manufacturing processes and technology to solve industrial orientated problems regarding material forming, manufacturing and value adding; and • basic designs for manufacturing by evaluation of critical components and the optimisation of the manufacturing process. • The student must know and understand the applications and limitations of the different manufacturing processes and be able to apply them successfully to engineering problems related to manufacturing. • The student must understand the economic aspects related to manufacturing, as well as the impact it has on the design process.		
Credits: 12		
Prerequisite: INGM212		
Assessment modes: PC 3 hours 1:1		
Module code: INGM427	**Semester 2**	**NQF level: 8**
Name: **Thermal Fluid System Design**		
Module objective: This module will equip the student with fundamentals in engineering science and applied knowledge of steam turbines and boilers with the emphasis on coal plant and combustion. Design, solution and optimization criteria of ideal and practical Rankine cycles will form the		

basis of analysis and synthesis in operational performance. The module builds on the knowledge gathered in thermodynamics, fluid dynamics, heat transfer and computer methods, and forms part of the basis for the final year Project.

Module outcomes:

After successful completion of this module, the student should be able to

- apply the fundamental knowledge of steam turbine theory and auxiliary plant applications together with specialised knowledge of thermodynamics and cycles, fluid dynamics, heat transfer and computer programming to solve fluid machine problems;
- design a basic Rankine cycle by means of convergent and divergent synthesis of existing knowledge, with emphasis on feed pumping combinations and regenerative feed water heating options;
- generate and optimizing a typical Rankine cycle using programming in Engineering Equation Solver (EES);
- optimize Steam boiler auxiliary plant combustion and airflow with coal quality impact factors;
- evaluate safety precautions, air pollution and impact on society;
- know combined cycle principles; and
- handle boiler operational problems, control system philosophy, clinker formation and soot blowing philosophies.

Credits: 16

Prerequisite: INGM411 and INGM412

Assessment modes:

The final module mark is dependent on: a comprehensive design report, semester test marks; class test marks; and marks gained for assignments. The ratio that each of these assessment methods contributes to the final module mark is given in the study guide. The main outcome is a final, comprehensive design report, submitted on the last scheduled day of classes. This report is assessed both internally and externally. The report has a sub-minimum (requirement) of 50% on all Level 3 exit level outcomes (ELOs).

Module code: INGM471	**Year module**	**NQF level: 8**

Name: **Vacation Training seniors**

This is a compulsory attendance module for a period of six weeks during the vacation.

Module objective: During vacation training students are exposed to the daily operation of an appropriate plant, installation or laboratory. Typical engineering problems which are connected with the work place concerned must be investigated under the guidance of an engineer in charge.

Module outcomes:

After successful completion of the module the student should have a better understanding of the skills a professional engineer needs, the process of engineering and problem solving. The student should be able to take his/her place in industry and apply safety requirements in the work place. An occupational safety course (NOSA) will be completed during the second year of study at the University before, the start of the vacation training in industry.

Credits: 8

Prerequisite: Must have completed third year

Assessment modes: Attendance (Industry: report)

Module code: INGM472	**Year module**	**NQF level: 8**

Name: **Introduction to Project Management**

Module objective: To equip students with knowledge and practical project management skills for application in a technical environment.

Module outcomes:

After successful completion of this module, the student should be able to

- have fundamental knowledge of project management activities for all project management functions during each life cycle phase; and

- be able to execute activities of project management in the management of his/her own final year project by using techniques which include development and updating of applicable documentation, as well as using applicable software.

Credits: 8

Prerequisite: None

Co-required: INGM479 or NUCI479

Assessment modes: PC 3 hours 1:1

Module code: INGM479	**Year module**	**NQF level: 8**

Name: **Project**

Module objective: To teach the student to execute a project with help from a study leader and to report it both orally and in writing. The project has both a theoretical and practical component ,e.g. design and testing. The student is given an opportunity to integrate his/her knowledge and skills in various engineering subjects into one comprehensive project.

Module outcomes:

After successful completion of this module, the student should be able to

- define the problem and divide it into smaller problems;
- synthesize, analyse and evaluate the possible solutions;
- document the design or experimental procedures;
- fabricate the design or experimental hardware;
- test aspects of the design, evaluate the design or to do the experiments;
- collect information through the library and/or internet;
- report on the project both verbally and in writing; and
- use project management software to manage progress on the project.

Credits: 16

Prerequisite: INGM271;
Student must be able to complete his/her degree

Co-required: INGM471

Assessment modes: Successful reporting on an engineering project, in the form of a written report, an oral presentation and a poster presentation.

Module code: ITRW112	**Semester 1**	**NQF level: 5**

Name: **Introduction to Computers and Programming**

Module outcomes:

On completing this module, the students should be able to demonstrate fundamental knowledge of the different components of a computer and an information system, as well as programming languages and their uses. Furthermore, the student should be able to demonstrate the manipulation of spreadsheets by applying knowledge of tables, computations, transfer of data between different applications, functions and graphic presentations; to demonstrate the ability to solve problems by designing and implementing structured programming, by using data manipulation and data presentations and applying 'GUI' event-driven approaches in the development environment of a spreadsheet; to demonstrate insight into ethical issues related to the wider IT business and an awareness of the risks and dangers that threaten the business; to demonstrate the ability to communicate in writing by compiling a report after having completed a project.

Module code: ITRW115	**Semester 1**	**NQF level: 5**

Name: **Programming for Engineers I C++**

Module outcomes:

After successfully completing the module the student ought to have knowledge of and insight in the basic structure, data types, and functions, including structured problem solving and debugging, testing and execution of applications of the programming language C++.

The student will have to demonstrate that he/she can apply the acquired knowledge and insight to solve elementary problems in engineering, develop an algorithm to solve problems, codify the algorithm in C++, and to debug and test it on the computer.

Module code: ITRW126	Semester 2	NQF level: 5

Name: **Programming for Engineers (Visual Basic)**

Module outcomes:

On completing this module students should be able to

- demonstrate knowledge requiring the mastering of certain prior theoretical insights to write computer programs;
- solve simple problems by the application of prior theoretical knowledge;
- demonstrate that he/she has sufficient knowledge of and insight into the graphical interface environment to develop computerized systems in a visual object-oriented computer language;
- demonstrate the ability to understand and implement conditional, repetition and sequential structures; and
- have mastered aspects such as graphical interface design, event-driven programming, and procedural programming.

Assessment criteria:

The student demonstrates that the outcomes have been mastered if he/she

- can show that he/she can practically apply the theory of graphical interface programming by solving given problems; and
- can facilitate problem solving by the design and development of computer applications with emphasis on user-friendly interfaces.

Module code: MEGI271	Year module	NQF level: 6

Name: **Workshop Training**

Module objective: The purpose of this module is to provide learners instruction in workshop practice and the safe use of tools.

Module outcomes:

After successfully completing this module the student will have mastered the practical use of basic hand tools and manufacturing equipment, e.g. welding machines and various machine tools The student will acquire basic knowledge of safety requirements in the workshop and the skills to fabricate small articles, involving plate metal work, turning, welding, electronics, etc. The student will acquires knowledge about electrical circuits and electrical equipment.

The module is completed at approved institutions during two weeks in the winter recess in the second year or after completion of the second academic year. A report has to be handed in one week after the start of the next semester.

Note: This module code is for the programmes of Chemical, Minerals Processing, Electrical, Electronic and Computer engineering students. From 2010 the code for Mechanical students is INGM271

Credits: 8

Prerequisite: none

Method of delivery: vacation training

Assessment modes: Participating (Industry: report)

Module code: NUCI321	Semester 2	NQF level: 7

Name: **Nuclear Energy**

Module objective: Students are expected to develop knowledge and understanding of the opportunities and challenges facing the global nuclear energy industry and to gain basic technical knowledge of major types of nuclear reactors and nuclear fuel cycles, in order to be able to select the most applicable technical and economical options, in view of these global nuclear energy policy issues. The attainment of these general outcomes will be facilitated by setting the more specific outcomes listed here.

Module outcomes:

After successful completion of this module, the student should have mastered the following:

Knowledge:

Acquire integrated knowledge of issues pertaining to global trends in the field of nuclear energy production and the global consequences thereof with an ability to apply and evaluate the key terms, concepts, facts, principles, rules and theories of the field;
acquire a detailed knowledge of nuclear materials in the fuel cycle, and how this knowledge relates to other fields of energy supply;
develop an understanding of a range of methods of enquiry in the field of nuclear energy systems, and an ability to apply a range of methods to resolve problems or introduce change;
Skills:
Students are expected to:

- develop skill and ability to identify, analyse, critically reflect on and address complex problems, applying evidence-based solutions and theory-driven arguments;
- develop an ability to take decisions and act ethically and professionally, and the ability to justify these decisions and actions drawing on appropriate ethical values and approaches, within a simulated group-work class environment;
- develop appropriate processes of information gathering for current technical and economical issues relating to nuclear power in a global context; and an ability to independently validate the sources of information, and evaluate and manage the information;
- hone the ability to develop and communicate one's own ideas and opinions in well-formed arguments, using appropriate academic, professional, or occupational discourse;
- develop an ability to manage processes in unfamiliar and variable contexts, recognising that problem solving is context- and system bound, and does not occur in isolation;
- develop an ability to accurately identify, evaluate and address own learning needs in a self-directed manner, and facilitate collaborative learning processes; and
- to take full responsibility for own work, decision making and use of resources and limited accountability for the decisions and actions of others in varied or ill-defined contexts.

Credits: 12

Prerequisite: none

Assessment modes: PC 3 hours 1:1

Module code: NUCI326	**Semester 2**	**NQF level: 7**

Name: Nuclear Engineering I

Module outcomes:
After successful completion of this module, the student should be able to demonstrate an extensive and systematic knowledge of the thermo-hydraulic characteristics of power reactors, reactor heat generation, thermodynamics of nuclear energy conversion systems, the single-phase and two-phase flow mechanics and heat transfer of power reactors, as well as the single-phase and two-phase transport equations; demonstrate skills to do a thermal analysis of fuel elements and to use single-phase and two-phase transport equations to solve problems; and to demonstrate the ability as an individual and/or member of a group to solve, with the aid of thermal design principles, identify and analyse unknown and complex real problems in nuclear engineering and suggest ethically responsible solutions, based on proven principles and theories.

Credits: 12

Co-required: NUCI321

Assessment modes: PC 3 hours 1:1

Module code: NUCI421	Semester 2	NQF level: 8

Name: **Nuclear Engineering II**

Module objective: To guide students in rounding off their introductory knowledge of nuclear engineering, acquired in NUCI321 and NUCI326 on a mostly conceptual level, by adding the complementary mathematical and technical knowledge.

Module outcomes:

Knowledge

- Atomic and Nuclear Physics: Students must be able to derive the appropriate mathematical formulae and apply these to the necessary calculations regarding the nuclear reactions in a nuclear reactor.
- Interactions Between Radiation and Matter: Definition of the concepts, derivation and interpretation of the mathematical formulae and application of data, especially those concerning the interactions between neutrons and the various materials in the core of the reactor.
- Different Types of Nuclear Reactors: Mathematical description of the fuel cycle in terms of the conversion ratio, isotopic breeding, fuel burn up, etc. Students must also be able to explain the advantages and disadvantages of different reactor types in terms of the theory treated in this module.
- Neutron Diffusion and Moderation: To derive, apply and understand Fick's law and the relevant diffusion equations.
- Nuclear Reactor Theory: To understand and apply the one group reactor equation, to derive the bare slab reactor equation and to understand the other reactor shapes. To give qualitative theoretical explanations of the various aspects of reactor design, for instance reflectors and the lumping of fuel.
- Time Dependant Reactor Behaviour: To define and demonstrate insight into the mathematical concepts, without having to derive the mathematical formulae. To give detailed qualitative theoretical explanations of the mechanisms and effects of the temperature and void reactivity coefficients, also for different fuels.
- Radiation Protection: To explain the importance of radiation protection and to demonstrate elementary knowledge of radiation dissymmetry, statutory radiation limits and techniques for protecting against radiation.
- Reactor Safety and Licensing: To have elementary understanding of the most important radiation safety theories as well as of the licensing process.
- Nuclear Reactor Accidents: To understand and discuss the technical aspects of the accidents in terms of the above mentioned theoretical concepts.

Skills

The student will be capable of:

- synthesising lessons from the history of nuclear power to gain insight into how to best utilize nuclear power;
- revealing, applying and expanding basic knowledge in atomic and nuclear physics and in nuclear engineering fields;
- applying basic knowledge about nuclear physics and the interaction of radiation with matter to the elementary analysis of various nuclear power reactors and their fuel cycles;
- using his broad background knowledge regarding the various reactor types, to make recommendations about the most suitable reactor type for various needs;
- basic analytical calculation of neutron moderation and diffusion in nuclear reactors;
- introductory analysis of nuclear reactors and their time dependent behaviour;
- applying knowledge of heat production and transfer in nuclear reactors to basic analysis of their safety;
- communicating with the public about the benefits and potential risks associated with nuclear power; and

- applying all these skills towards creating elementary conceptual solutions for reactor design issues.

Credits: 16

Prerequisite: NUCI321 and NUCI326

Assessment modes: PC 3 hours 1:1

Module code: NUCI479	**Year module**	**NQF level: 8**

Name: **Project in Nuclear Engineering**

Module objective: To teach the student to execute a project with help from a study leader and to report it both orally and in writing. The project has both a theoretical and practical component ,e.g. design and testing. The student is given an opportunity to integrate his/her knowledge and skills in various engineering subjects into one comprehensive project.

Module outcomes:

After successful completion of this module, the student should be able to

- define the problem and divide it into smaller problems;
- synthesize, analyse and evaluate the possible solutions;
- document the design or experimental procedures;
- fabricate the design or experimental hardware;
- test aspects of the design, evaluate the design or to do the experiments;
- collect information through the library and/or internet;
- report on the project both verbally and in writing; and
- use project.

Credits: 16

Prerequisite: INGM271
Student has to be in final year and must be able to complete degree.

Co-required: INGM472

Assessment modes: Successful reporting on an engineering project, in the form of a written report, an oral presentation and a poster presentation.

Module code: REII221	**Semester 2**	**NQF level: 6**

Name: **Computer Engineering III**

Module objective: This course is built on EERI122 (Computer Engineering II) by dealing with more advanced processors and their architectures. Students should be able to analyse and design the computer systems and solve problems.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has fundamental knowledge of 16- and 32-bit processor architectures (Intel, ARM, MIPS, SoC, PSoC, and Soft Cores).
- Understands electrical requirements of these processors, PCB design and signal integrity issues to be aware of.
- Understands memory interfaces. Specifically various types of RAM, ROM, FLASH. Address decoding, and DMA is of importance.
- Understands common communication busses
- (I2C, I2S, RS232, RS485, USB, 1-Wire, SPI)
- Understands programming of complex embedded systems. Techniques for doing so, safety and security considerations pertaining to embedded systems.
- can apply his/her knowledge to solve engineering problems by direct programming of
- low-level microprocessors and high-level programming using the API;
- can use the BIOS and operating systems, interface theory and bus standards; and
- can design a basic microprocessor.

NOTE: The same as REII321. New module for year level 2 from 2015.

Credits: 16

Prerequisite: EERI112/123

Assessment modes: PC 3 hours 1:1

Module code: REII311	Semester 1	NQF level: 7

Name: **Computer Engineering IV**

Module objective: This course builds on REII321 (Computer Engineering III) to progress from single computers to networks of computers. Specific emphasis is placed on engineering aspects of data transmission and networks.

Module outcomes:

To successfully complete this module, the student should be able to demonstrate that he/she understands data communication and computer networks from the following perspectives:

- Historical: In terms of standards.
- The user: Information theory, signal coding and compression.
- Security: Cryptography and algorithms.
- Network: Topologies, switching, models and dimensioning, internet networks, components, protocols, quality of service.
- Link: Media access, error correction, protocols.
- Channel: Capacity, transmission media, line coding, modulation.
- Applications: GSM, VoIP.

Upon completion of the module, the student should be able to describe IP and the OSI 7 layer structure, be able to programme simple data compression and cryptography, to derive network models and apply same in dimensioning, to apply routing algorithms, implement error correction codes, characterise media, do engineering calculations and simulations on data rates, congestion in networks, optimal buffer sizes and influence of automatic resend.

Credits: 16

Prerequisite: EERI122, EERI122/123

Assessment modes: PC 3 hours 1:1

Module code: REII321	Semester 2	NQF level: 7

Name: **Computer Engineering III**

Module objective: This course is built on EERI122 (Computer Engineering II) by dealing with more advanced processors and their architectures. Students should be able to analyse and design the computer systems and solve problems.

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- has fundamental knowledge of 16- and 32-bit processor architectures (Intel, ARM, MIPS, SoC, PSoC, and Soft Cores).
- Understands electrical requirements of these processors, PCB design and signal integrity issues to be aware of.
- Understands memory interfaces. Specifically various types of RAM, ROM, FLASH. Address decoding, and DMA is of importance.
- Understands common communication busses
- (I2C, I2S, RS232, RS485, USB, 1-Wire, SPI)
- Understands programming of complex embedded systems. Techniques for doing so, safety and security considerations pertaining to embedded systems.
- can apply his/her knowledge to solve engineering problems by direct programming of
- low-level microprocessors and high-level programming using the API;
- can use the BIOS and operating systems, interface theory and bus standards; and
- can design a basic microprocessor.

NOTE: Discontinued December 2015

Credits: 16

Prerequisite: EERI112/123

Assessment modes: PC 3 hours 1:1

Module code: REII327	Semester 2	NQF level: 7
Name: **Computer Engineering Design**		
Module objective: To secure the principles of systems/product development and design processes. An additional aim is to facilitate and test the practical implementation of knowledge. This course thus evaluates the student's ability to integrate all her/his previous knowledge by using analysis and synthesis. *Module outcomes:* To successfully complete this module, the student should demonstrate that he/she • understands and can apply general project and acquisition management techniques, manage product life cycles, complete a conceptual and preliminary design, complete elements of detail design and manage design resources and techniques; • can successfully work as an individual and in groups; • can apply design guidelines and constraints; and • can interpret a development specification and the allocation of requirements.		
Credits: 16		
Prerequisite: Student must be able to complete year level three of BEng degree		
Assessment modes: PC 3 hours 1:1		
Module code: REII411	**Semester 1**	**NQF level: 8**
Name: **Computer Engineering IV**		
Module objective: This course builds on REII321 (Computer Engineering III) to progress from single computers to networks of computers. Specific emphasis is placed on engineering aspects of data transmission and networks. *Module outcomes:* To successfully complete this module, the student should be able to demonstrate that he/she understands data communication and computer networks from the following perspectives: • Historical: In terms of standards. • The user: Information theory, signal coding and compression. • Security: Cryptography and algorithms. • Network: Topologies, switching, models and dimensioning, internet networks, components, protocols, quality of service. • Link: Media access, error correction, protocols. • Channel: Capacity, transmission media, line coding, modulation. • Applications: GSM, VoIP. Upon completion of the module, the student should be able to describe IP and the OSI 7 layer structure, be able to programme simple data compression and cryptography, to derive network models and apply same in dimensioning, to apply routing algorithms, implement error correction codes, characterise media, do engineering calculations and simulations on data rates, congestion in networks, optimal buffer sizes and influence of automatic resend.		
Credits: 16		
Prerequisite: REII321		
Assessment modes: PC 3 hours 1:1		
Module code: REII413	**Semester 1**	**NQF level: 8**
Name: **Engineering Programming II**		
Module outcomes: To successfully complete this module, the student should demonstrate that he/she • understands database definitions and terms; • can design and implement databases, and store, alter and delete information in databases; • Use basic and advanced SQL to manipulate databases; • Identify problems associated with concurrent access and repair of databases after		

failure; and
- can implement interfaces to the database.

Credits: 16

Prerequisite: EERI314

Assessment modes: PC 3 hours 1:1

Module code: REII422	**Semester 2**	**NQF level: 8**

Name: **Software Engineering**

Module objective: This course builds on Engineering Programming I to ensure that software development follows a standardized process to deliver software which satisfies user requirements, which is delivered on time, within the set budget and with a minimum number of residual faults .

Module outcomes:

To successfully complete this module, the student should demonstrate that he/she

- understands various phases in software engineering: requirements and analysis, specification, design, implementation, integration and maintenance, whether according to classical or modern two-dimensional approaches;
- understands and can use planning and estimating, project management, life cycle models, teamwork, documentation and testing of software theoretically as well as with case studies;
- is able to implement and operate a software engineering process for a product;
- has mastered the classical as well as modern versions of the phases of software projects, including requirements, specification, design, implementation, integration and maintenance;
- has developed skills in software management in teams.

Credits: 16

Prerequisite: EERI314

Assessment modes: PC 3 hours 1:1

Module code: STTK312	**Semester 1**	**NQF level: 7**

Name: **Engineering Statistics**

Module outcomes:

After successful completion of this module, the student shall be able to:

- Demonstrate fundamental knowledge of the following statistical concepts: uncertainty and variation, a distribution, certain continuous and discrete distributions, numerical summary measures, bivariate and multivariate data and distributions, methods for obtaining data, probability and sampling distributions, quality and reliability , point estimation and statistical intervals, testing statistical hypotheses, the analysis of variance, experimental design and inferential methods in regression and correlation.
- Demonstrate his/her ability to interpret graphic illustrations of the data, explain the concept of a distribution, work with certain continuous and discrete distributions, calculate measures of centre, spread and variants thereof, making scatter plots, calculating correlation coefficients, fitting lines to data and working with multivariate data, explaining different sampling methods and measurement systems, explain basic concepts in probability theory and the description of sampling distributions, explain methods used in quality and reliability, calculating point and interval estimates, performing hypothesis testing procedures, performing analysis of variance calculations, propose an experimental design in specific cases and using inferential methods in regression and correlation.

Credits: 16

Prerequisite: WISN121

Assessment modes: PC 3 hours 1:1

Module code: TGWN121	Semester 2	NQF level: 5
Name: **Statics and Mathematical Modelling**		
Module outcomes: On completing this module, the students should be able to do the following: demonstrate fundamental knowledge of geometric vectors and their operational rules, vectors, forces, components, scalar and vector product, Cartesian forms, resultant of two- and three-dimensional systems of force through a point, the principle of propagation, moments, couples, reduction of systems of forces to a single force and a single couple, equilibrium in a plane and equilibrium in space, friction and moments rotating around axes, the modelling process, geometric similarity and proportionalities, dimensional analysis and the theorem of Buckingham; to demonstrate problem solving skills by analysing familiar and unfamiliar problems, by using knowledge of techniques to determine resultants of different types of systems of force, by solving equilibrium problems in two and three dimensions, by forming and solving models by means of proportionality relations and dimensional analysis, and by fitting models to data.		
Module code: TGWN211	**Semester 1**	**NQF level: 6**
Name: **Dynamics I**		
Module outcomes: On completing this module, students should be able to do the following: demonstrate fundamental knowledge of kinematics (square, normal, tangential and cylindrical coordinates) and kinetics of a single particle (force, acceleration, work, energy, momentum, impulse), a system of particles (force, acceleration, work, energy, momentum, impulse) and a rigid body (force, acceleration, work, energy, momentum, impulse, moment of inertia, angular impulse and angular momentum), all moving along a straight line or a curved trajectory; demonstrate problem solving skills by analysing familiar and unfamiliar problems and using knowledge of kinematics and kinetics to calculate time duration, displacements, velocities, accelerations, forces, word done, energy, momentum, impulse, moment of inertia, angular impulse and angular momentum.		
Module code: TGWN212	**Semester 1**	**NQF level: 6**
Name: **Differential Equations and Numerical Methods**		
Module outcomes: On completing this module students should be able to do the following: demonstrate fundamental knowledge of first-order ordinary differential equations, the Laplace transform and the methods of Euler, Heun and Runge-Kutta for solving a single and a set of differential equations numerically, demonstrate problem solving skills by solving familiar and unfamiliar first order ordinary differential equations through separation of variables and conversion to exact differential equations, and by using them to model real phenomena, solving linear differential equations with constant coefficients using the Laplace transform, and solving any type of ordinary initial value problem numerically by using computers, and amongst others utilizing the MATLAB computer software.		
Module code: TGWN221	**Semester 2**	**NQF level: 6**
Name**: Dynamics II**		
Module outcomes: On completing this module students should be able to do the following: demonstrate fundamental knowledge of the theory of flexible cables, internal forces and deformation of simple beams, and the motion of satellites and planets, demonstrate problem solving skills by solving familiar and unfamiliar problems involving deformations in beams and cables acted on by forces, and determining the orbits and positions of satellites.		

Module code: TGWN222	Semester 2	NQF level: 6
Name: **Numerical Analysis**		
Module outcomes: On completing this module the student should be able to do the following: demonstrate fundamental knowledge and insight into the theory of basic numerical methods for general occurring mathematical problems, amongst which are the solving of non-linear equations, determining interpolation polynomials and the numerical determining of definite integrals, demonstrate problem solving skills by solving non-linear equations through iteration techniques, determining the interpolation polynomials of Lagrange and Newton, determining definite integrals by means of the trapezium method, Simpson's rule, Romberg integration and Gauss quadrature, and the computer application of these techniques, show a fondness for this field of study and demonstrate insight into the relation between reality and abstraction, model and solution; reveal a Christian or alternative perspective on the subject.		
Module code: TGWN312	**Semester 1**	**NQF level: 7**
Name: **Partial Differential Equations (Numerical)**		
Module outcomes: On completing this module the learner should be able to do the following: demonstrate fundamental knowledge and insight into the discretisation of ordinary and partial differential equations, the special properties of tridiagonal matrices, calculation problems caused by ill-conditioned and sparse systems of linear equations, convergence properties of iterative methods of systems of linear equations, solving parabolic, elliptical and hyperbolic differential equations numerically, performing iterative methods with MATLAB on a computer; demonstrate problem solving skills in numerically solving two point boundary value problems, the heat equation, the potential equation and the wave equation with the finite difference methods and in implementing these by computer; show a fondness of this field of study and demonstrate insight into the relation between reality and abstraction, model and solution; reveal a Christian or alternative perspective on the subject.		
Module code: TGWN321	**Semester 2**	**NQF level: 7**
Name: **Dynamics III**		
Module outcomes: On completing this module the student should be able to do the following: demonstrate fundamental knowledge and insight into the kinematics and kinetics of a rigid body in space, the Lagrange formulation for dynamics and the basis of variation calculus; demonstrate skills in solving problems describing motion and the constraints on motion, modelling the three-dimensional motion of a rigid body, stationary curves for functionals formed through integrals; show a fondness of this field of study and demonstrate insight into the relation between reality and abstraction, model and solution; reveal a Christian or alternative perspective on the subject.		
Module code: WISN111	**Semester 1**	
Title: **Introductory Algebra and Analysis I**		
Module outcomes: On completing this module, students should be able to do the following: demonstrate fundamental knowledge of the concept of functions, polynomials in one variable with factor theorem, remainder theorem and synthetic division, rational functions and partial fractions, absolute value function, circle measure and inverse functions, trigonometric and inverse trigonometric functions, hyperbolic and inverse hyperbolic functions, exponential and logarithmic functions, limits, continuity, differentiability and indefinite integrals of all the above mentioned functions, complex numbers; demonstrate problem solving skills by analysing familiar and unfamiliar problems, using the knowledge of techniques to develop powers of first degree polynomials, calculating the limits, derivatives and indefinite integrals of all the above mentioned functions and performing simple operations with complex numbers.		

Module code: WISN121	Semester 2	
Title: **Introductory Algebra and Analysis II**		
Module outcomes: On completing this module, students should be able to do the following: demonstrate fundamental knowledge of logic, the system of real numbers, mathematical induction, permutations and combinations and the binomial theorem, De Moivre's theorem and its applications, L'Hospital's rule and its applications, the fundamental theorems of differential and integral calculus, the use of derivatives in optimisation and curve sketching, basic concepts of power series and the basic theorems on the converging of series, Taylor series, the basic properties and applications of the definite integral, applications of integration to surfaces, lengths and volumes; demonstrate problem solving skills by analysing familiar and unfamiliar problems, using knowledge of techniques by applying logic to systems of numbers, proving theorems with mathematical induction, determining the number of arrangements and selections from a set, performing operations with complex numbers, judging convergence of power series, calculating Taylor series, determining limits using L'Hospital's rule, sketching functions, formulating optimisation problems mathematically and using knowledge of derivatives to solve them, by determining definite integrals and calculating surfaces, lengths and volumes.		
Module code: WISN211	**Semester 1**	**NQF level: 6**
Name: **Analysis III**		
Module outcomes: On completing this module, students should be able to do the following: demonstrate a thorough knowledge and insight into all the aspects of the differential calculus of multivariate functions: partial and directional derivatives, the gradient function, optimisation problems, including Lagrange's method, the theory of multiple integrals to calculate partial derivatives, directional derivatives and gradients, and double and triple integrals; demonstrate problem solving skills by analysing familiar and unfamiliar problems, using knowledge of techniques to solve practical problems modelled with multivariate functions. Students should demonstrate the ability to use the geometric and physical meaning of the above-mentioned concepts to abstract the underlying mathematical structure of applied problems and to interpret the significance of the mathematical solution.		
Module code: WISN212	**Semester 1**	**NQF level: 6**
Name: **Linear Algebra I**		
Module outcomes: On completing this module students should be able to do the following: demonstrate a thorough knowledge and insight into the solvability of systems of linear equations; the basic properties of Euclidic spaces and linear transformations, interdependency of general vector space concepts; demonstrate the ability to determine Eigen values and Eigen vectors; demonstrate problem solving skills by analysing familiar and unfamiliar problems, using knowledge of techniques to solve systems of linear equations in the context of a vector space; to perform matrix operations; to determine bases for subspaces; to calculate Eigen values and Eigen vectors; to execute these matrix calculations and interpret the results.		
Module code: WISN221	**Semester 2**	**NQF level: 6**
Name: **Analysis IV**		
Module outcomes: On completing this module, students should be able to do the following: demonstrate a thorough knowledge and insight into line integrals of scalar valued and vector valued functions of two and three variable functions; the fundamental theorem and Green's theorem for line integrals and their applications; surface integrals of scalar valued and vector valued functions; the theorem of Stokes and the divergence theorem of Gauss and their applications; the theory of higher order linear differential equations and methods (of undetermined coefficients and the variation of parameters) to solve second order linear differential equations with constant coefficients; sequences and series of real numbers; tests		

for convergence (integral test, comparison test, limit comparison test) and tests for absolute convergence of series of real numbers (ratio and root tests); demonstrate problem solving skills by analysing familiar and unfamiliar problems; using knowledge of techniques to calculate line integrals of scalar valued and of vector valued functions and use them in solving practical problems (such as the calculation of surfaces and the calculation of word done by forces along curves); by calculating surface integrals of scalar valued and vector valued functions of two and three variables and use them to solve practical problems (such as calculating flow rates through surfaces); by using the Theorem of Stokes to calculate surface integrals by using line integrals along closed curves and vice versa; by using the theorem of Gauss to calculate surface integrals of vector fields over closed surfaces by evaluating triple integrals; by determining the solutions of homogeneous linear differential equations that have constant coefficients and by solving non-homogeneous linear equations using the methods of indeterminate coefficients and the variation of parameters; by using the different (relevant) tests for the convergence of series of real numbers to test for the convergence of these series.

Module code: WISN222	**Semester 2**	**NQF level: 6**

Name**: Linear Algebra II**

Module outcomes:

On completing this module, students should be able to do the following: demonstrate a thorough knowledge and insight into general vector spaces and bases; inner products; vector norms; linear transformations. The student acquires knowledge and insight into matrix and vector norms and stepwise orthogonal transformations on a matrix; learn to execute LU factorising and to calculate certain systems of differential equations; demonstrate problem-solving skills by analysing familiar and unfamiliar problems; by using knowledge of techniques to determine inner products, vector norms and linear transformations.

Module code: WVIS321	**Semester 2**	**NQF level: 7**

Name: **Science, Technology and Society**

Module objective: The objective of this module is to develop an elementary knowledge and understanding of the foundational issues and/or ethical problems in one or both main subjects of the study programme, as is envisaged by the Institutional Plan. It is especially important to bring home the notion that, due to different assumptions and perspectives on the nature of reality, different answers to these questions have been developed, which represent different "approaches" in the subject field.

Module outcomes:

After successful completion of this module, students should

- have a solid and systematic knowledge of the most important foundational issues in the relevant field of study and demonstrate a critical understanding of the meta-theoretical assumptions underscoring foundational issues;
- be able to demonstrate knowledge and a critical understanding of specific forms of ethics that apply to the field of study, such as a personalised code of conduct or the general human rights charter, and be able to apply such forms of ethics discriminately to analyse, evaluate and pose possible solutions to some current themes or issues salient to the field of study; and
- be able to demonstrate the ability to analyse, synthesise and critique the assumptions on which a chosen theme or issue is based, formulate a personal opinion about the theme or issue that gives evidence of a personal coherent world view, and communicate the findings in a presentation making use of applicable technology, as well as in an evidence-based report written in a typical academic format.

Credits: 12

Prerequisite: None

Assessment modes: PC 3 hours 1:1

Module code: WVTS211	Semester 1	NQF level: 6
Name: **Understanding the Technological World**		
Module objective: The objective of this module is to broaden and deepen the students' vision of reality by introducing them to a variety of contemporary world views and ideologies and to relevant international issues determined by them. Also to introduce them to the notion of the world as a coherent whole and to the interconnectedness and interdependence of natural and social systems. *Module outcomes:* After successful completion of this module, students should: • have a fundamental knowledge base of a selection of world views and ideologies and demonstrate their critical understanding through an ability to compare the nature and function, as well as different contemporary manifestations of these world views and ideologies; • have the ability to understand the interrelatedness of phenomena such as occur in natural and social systems, and from this vantage point, analyse and evaluate real life problems or case studies based on core issues of our time, such as poverty, constant change, human rights, HIV-AIDS, power abuse, corruption, racism, xenophobia, etc.; and • be able to articulate their personal world view and use it as a point of departure for arguing and communicating feasible solutions to core issues and problems of our time in a typical academic manner.		
Credits: 12		
Prerequisite: none		
Assessment modes: PC 3 hours 1:1		

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