NWU®

Faculty of Engineering Undergraduate

Fakulteit Ingenieurswese Voorgraads

2022 YEARBOOK

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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 at: http://www.nwu.ac.za/yearbooks.

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.

Rig alle korrespondensie aan:
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U UNIVERSITEITSNOMMER MOET ASSEBLIEF IN ALLE KORRESPONDENSIE VERMELD WORD.
Die Algemene Akademiese Reëls van die Universiteit, waaraan alle studente hulle moet onderwerp en wat op al die kwalifikasies wat die Universiteit aanbied, van toepassing is, verskyn in 'n afsonderlike bundel op die web by: http://www.nwu.ac.za/yearbooks.

***Let Wel:** Ofskoon die inligting wat in hierdie Jaarboek opgeneem is so noukeurig moontlik saamgestel is, aanvaar die Raad en die Senaat van die Universiteit hoegenaamd geen aanspreeklikheid vir onjuisthede wat hierin mag voorkom nie. In die besonder bly dit elke student se verantwoordelikheid om hom/haar deeglik te vergewis van die klasrooster en moontlike roosterbotsings voordat hy/sy finaal oor die keuse van modules besluit. Indien daar 'n botsing by 'n student se voorgenome keuse voorkom, is die betrokke kombinasie van modules ontoelaatbaar.*

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Vice-Chancellor / *Vise-Kanselier*
Prof ND Kgwadi

Vice-Principal / *Vise-Prinsipaal*
Prof LA du Plessis

Deputy Vice-Chancellor: Assigned functions and Potchefstroom campus operations / *Adjunk Vise-Kanselier: Toegewysde funksies en Potchefstroomkampusbedryf*
Prof DM Balia

Deputy Vice-Chancellor: Planning and Vaal Triangle campus operations / *Adjunk Vise-Kanselier: Beplanning en Vaaldriehoekkampusbedryf*
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Dr N Morei

Faculty of Natural and Agricultural Sciences / *Fakulteit Natuur- en Landbouwetenskappe*
Prof DM Modise

Faculty of Theology / Fakulteit Teologie
Dr H Goede

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Vacant
Dr F Moyo
Prof SK Ntwampe
Prof P van Vuuren

Junior Lecturers
Mr M Roopa
Mrs C du Plessis
Vacant

Research
NRF Rated Researcher

Student Representative
Chairperson Ingenium

Faculty Administrator
Mrs B Mackenzie

ENG.1 GENERAL / *ALGEMEEN*

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, postgraduate study and research in seven specialised fields in Engineering.

The spirit of the North-West University is reflected in the way we unlock the future for people and enable them to make their dreams come true.

This spirit runs across all our activities and operations, from our academic offerings and research to our student body, community engagement and sports achievements.

The NWU is committed to functioning as a unitary, integrated multi-campus university that will enable equity, redress and globally competitive teaching and research across all campuses.

The Faculty of Engineering of the North-West University continually strives to be a training hub for high-quality, versatile and innovative engineers. We pride ourselves on world-class teaching standards, a sound value system, innovative thinking and passion.

Engineers find ways to do things better, faster and more efficient. They make life easier by adding value to and optimising available resources. They reduce manufacturing costs by designing better processes.

Die Fakulteit Ingenieurswese van die NW-Universiteit het in 1982 amptelik tot stand gekom. In 1992 het die fakulteit van die Vaaldriehoek na Potchefstroom verskuif. Die Fakulteit bestaan uit vier skole wat opleiding, onderrig, nagraadse studie en navorsing in sewe gespesialiseerde rigtings in Ingenieurswese aanbied.

Die gees van die Noordwes-Universiteit word weerspieël in die manier waarop ons die toekoms vir mense ontsluit en hulle in staat stel om hul drome waar te maak.

Hierdie gees is teenwoordig in al ons aktiwiteite en werksaamhede, van ons akademiese aanbod en navorsing tot ons studentekorps, gemeenskapsbetrokkenheid en sportprestasies.

Die NWU is daartoe verbind om as ’n unitêre, geïntegreerde multikampusuniversiteit te funksioneer, wat billikheid, regstelling en internasionaal mededingende onderrig en navorsing oor al die kampusse heen sal bemoontlik.

Die Fakulteit Ingenieurswese streef voortdurend daarna om ’n opleidingsmiddelpunt vir hoë kwaliteit, veelsydige en innoverende ingenieurs te wees. Ons is trots op ons wêreldklas standaarde, gegronde waardesisteme, innoverende denke en passie.

Ingenieurs vind maniere om alledaagse dinge beter, vinniger en meer doeltreffend te doen. Hulle maak ons lewens makliker deur beskikbare bronne te optimaliseer en vervaardingingskostes te verminder deur beter prosesse te ontwerp.

For information regarding postgraduate study, you are referred to the Postgraduate Calendar.
Vir inligting oor nagraadse studie, word u verwys na die Nagraadse Jaarboek.

ENG.1.1 THE ENGINEERING PROFESSION / DIE INGENIEURSBEROEP

ENG.1.1.1 The Role of the Professional Engineer / Die Professionele Ingenieur se Rol

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 recognised as a “learned profession”.

With the impact of technology on our society engineering plays an increasingly important role concerning 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.

Ingenieurswese verwys na die praktyk van organisering van die ontwerp, konstruksie en bedryf van artefakte (produkte, prosesse of stelsels) wat die fisiese wêreld rondom ons transformeer ten einde sekere geïdentifiseerde behoeftes te bevredig. Ingenieurs bestudeer die wetenskap en pas dit toe om probleme van praktiese belang op te los, tipies deur ’n proses wat bekend staan as kreatiewe sintese of ontwerp.

Ingenieurs is lede van ’n professie en is verantwoordelik vir die oordeelkundige toepassing van hulle kennis vir die volhoubare ekonomiese vooruitgang en welsyn van die mensdom.

Alhoewel ingenieurswese as professie sy oorsprong in die vroegste ontwikkeling van die mensdom het, was dit eers in die middel van die negentiende eeu, toe daar die eerste keer begin is om wetenskaplike metodes sistematies toe te pas om ingenieursprobleme op te los en toe daar begin is met die stigting van ingenieurskole en -verenigings, dat dit erkenning begin geniet het as ’n “geleerde professie”.

Met die toenemende invloed van tegnologie op ons samelewing speel ingenieurs ’n al hoe belangriker rol ten opsigte van ekonomiese ontwikkeling. Uitstekende werksgeleenthede bestaan vir ingenieurs in feitlik alle sektore van die ekonomie, beide plaaslik sowel as in die buiteland.

Die BIng-graad het ten doel om studente met die nodige kennis toe te rus om as professionele ingenieurs te kan praktiseer.

ENG.1.1.2 Professional Ethics / *Professionele Etiek*

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 https://www.ecsa.co.za/default.aspx

As lede van 'n professie is ingenieurs onderworpe aan 'n gedragskode. In Suid-Afrika is die Suid-Afrikaanse Raad vir Ingenieurswese (ECSA) met statutêre magte beklee om standaarde vir opleiding voor te skryf en professionele ingenieurs te registreer. Registrasie as professionele ingenieur (PrIng) sertifiseer dat 'n persoon bevoeg is om as ingenieur te praktiseer. ECSA beskik ook oor die bevoegdheid om tugmaatreëls op ingenieurs wat hul aan wangedrag skuldig maak, toe te pas.

Danksy die hoë etiese standaarde wat in die ingenieursprofessie geld, is dit onwaarskynlik dat 'n persoon wat strafregtelik skuldig bevind word in 'n hof of teen wie dissiplinêr opgetree word weens optrede wat dui op oneerlikheid, nieteenstaande goeie akademiese prestasie, tot die professie toegelaat sal word of toegelaat sal word om as professionele ingenieur te registreer.

Verdere inligting aangaande die ingenieursberoep is beskikbaar op die webblad van die Ingenieursraad van Suid-Afrika (ECSA) by https://www.ecsa.co.za/default.aspx

ENG.1.1.3 Registration as Professional Engineer / Registrasie as Professionele Ingenieur

To register as a professional engineer, and to be able to use the title PrEng, a person must usually meet three requirements:

- The person must hold a BEng or BScEng degree as determined by the Engineering Profession Act 46 of 2000 and that has been accredited by ECSA for this purpose.
- Secondly, the person must have completed a period of in-service training that satisfies ECSA's requirements in terms of standard and duration (at least three years). This period may be reduced by one year after obtaining an advanced university degree.
- Lastly, the candidate must conduct an interview with registered peers to present experience gained during the in-service training period.

Om as 'n professionele ingenieur te registreer, en so die titel PrIng te gebruik, moet 'n persoon gewoonlik aan drie vereistes voldoen:

- *Die eerste vereiste is 'n universiteitsgraad in ingenieurswese (Bing of BScIng), soos bepaal deur die Wet op die Ingenieursweseprofessie van Suid-Afrika 46 van 2000 en geakkrediteer deur ECSA.*
- *Die tweede vereiste is 'n tydperk van indiensopleiding, wat volgens ECSA van aanvaarde standaard en duur is. Gewoonlik vereis die Raad indiensopleiding vir 'n tydperk van minstens drie jaar. Hierdie tydperk mag met een jaar verkort word, na die verwerwing van 'n gevorderde universiteitsgraad.*
- *Laastens word van die kandidaat verwag om deel te neem aan 'n onderhoud met eweknie ingenieurs met die doel om te bepaal of die ondervinding wat opgedoen is tydens die indiensopleiding tydperk genoegsaam is.*

ENG.1.2 PROFESSIONAL STATUS / PROFESSIONELE STATUS

ENG.1.2.1 ECSA Accreditation / *ECSA Akkreditasie*

The BEng programmes of the Faculty are formulated to meet the requirements of the Engineering Council of South Africa (ECSA) for accredited BEng programmes. This means that each of the programmes adheres to a minimum number of credits of 560, distributed between different knowledge areas according to the ECSA requirements, and that each graduate has proven to have obtained the prescribed eleven Graduate Attributes (GAs) listed by ECSA.

The bachelor's degree awarded in the Faculty of Engineering is recognised 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 46 of 2000.
- The following engineering societies for membership:
    i. South African Institution of Chemical Engineers (SAIChE)
    ii. South African Institute of Electrical Engineers (SAIEE)
    iii. The South African Institution of Mechanical Engineering (SAIMechE)
    iv. The Southern African Institute of Mining and Metallurgy (SAIMM)
    v. Southern African Institute for Industrial Engineering (SAIIE)
- Other local and foreign universities (that enable access to postgraduate study).

Die BIng-programme van die fakulteit, is so saamgestel, dat dit aan die vereistes van die Suid-Afrikaanse Raad vir Ingenieurswese (ECSA) vir akkreditasie, voldoen. Dit beteken dat elke program voldoen aan die minimum aantal krediete van 560 soos vereis word deur ECSA, end at elke graduandi voldoen aan die elf Graduandi-Eienskappe (GAs) wat deur ECSA bepaal word.

Die baccalaureusgrade wat in die fakulteit Ingenieurswese toegeken word, word erken deur:

- *Die Suid-Afrikaanse Raad vir Ingenieurswese (ECSA) as kwalifiserende grade vir registrasie as professionele ingenieur (PrIng) volgens die Wet op die Ingenieursweseprofessie van Suid-Afrika 46 van 2000.*
- *Die volgende ingenieursverenigings vir lidmaatskap, wat insluit:*
    i. SA Instituut van Chemiese Ingenieurs (SAIChI)
    ii. SA Instituut van Elektriese Ingenieurs (SAIEI)
    iii. SA Instituut vir Meganiese Ingenieurswese (SAIMI)
    iv. SA Instituut vir Mynbou en Metallurgie (SAIMM)
    v. SA Instituut vir Bedryfsingenieurswese (SAIBI)
- *Ander binnelandse en buitelandse universiteite (wat toegang verleen tot nagraadse studie).*

ENG.1.2.2 International Comparability / *Internasionale Erkenning*

International comparability of this qualification standard is ensured through the Washington Accord, an agreement for the mutual recognition of professionally oriented bachelor's degrees in engineering. The standards are comparable with the Washington Accord Graduate Attributes. Washington Accord signatories are Australia, Canada, Chinese Taipei, Hong Kong, China, India, Ireland, Japan, Republic of Korea, Malaysia, Russia, New Zealand, Singapore, South Africa, Sri Lanka, Turkey, the United Kingdom, and the United States of America. Comparability is audited on a six-yearly cycle by a visiting Washington Accord team.

The current signatories and the Graduate Attributes are available at
https://www.ecsa.co.za/education/SitePages/International%20Recognition.aspx

ECSA is 'n ondertekenaar van die Washington Verdrag en daarom word die grade wat deur ECSA vir die opleiding van professionele ingenieurs geakkrediteer is, ook internasionaal deur ander ondertekenaars van dié Verdrag erken. Hierdie ooreenkoms verseker dus wedersydse erkenning van geakkrediteerde BIng-grade. Programme word elke ses jaar geoudit om volhoubare standaarde te verseker.

BIng-graduandi van die Noordwes-Universiteit se opleiding word dus erken vir registrasie as Professionele Ingenieur (of ekwivalente) in lande wat dié verdrag onderteken het.

Die Washington Verdrag ondertekenaars sluit lande in soos Australië, Kanada, Sjinese Taipei, Hong Kong, Sjina, Indië, Ierland, Japan, Suid-Korea, Maleisië, Rusland, Nieu-Seeland, Singapoer, Suid-Afrika, Sri Lanka, Turkye, die Verenigde Koninkryk en die Verenigde State van Amerika.

Dié lys van ondertekenaars kan gevind word by
https://www.ecsa.co.za/education/SitePages/International%20Recognition.aspx

ENG.2 FACULTY RULES

ENG.2.1 AUTHORITY OF THE GENERAL ACADEMIC RULES / GESAG VAN DIE ALGEMENE AKADEMIESE REËLS

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 Academic Rules of the University, as determined from time to time by the Council of the University as recommended by the Senate. The Faculty rules should, therefore, be read in conjunction with the General Academic Rules.

See the Rules on the web page at:
http://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2019.06.20_A-Rules_e.pdf

Die fakulteitsreëls, wat ten opsigte van die verskillende kwalifikasies, programme en kurrikulums van hierdie fakulteit geld en in hierdie fakulteitsjaarboek opgeneem is, is onderhewig aan die Algemene Reëls van die Universiteit, soos dit van tyd tot tyd deur die Raad van die Universiteit op aanbeveling van die Senaat vasgestel word, en die fakulteitsreëls moet dus met daardie Algemene Reëls saamgelees word.

Die Reëls is op die webbladsy by:
http://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2019.06.20_A-Rules_e.pdf

ENG.2.1.1 General Provisions / *Algemene Bepalings*

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 101 of 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 postgraduate studies within the framework of the provisions of these Rules that has the status of a binding policy document of the University to regulate matters relating to the preparation for, progress, guidance and completion of postgraduate studies.

Except where expressly provided for differently, 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 (General Academic Rules 1.1.3).

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 a duly mandated sub-committee of Senate, may at any time resolve to require the affected person or structure to report on the performance of the indicated function or the making of the decision, and Senate may, within the limits of reasonableness, taking into account the implications for those affected thereby, replace or revoke the relevant act or decision (General Academic Rules 1.1.6).

Kragtens die Algemene Akademiese Reëls van die Noordwes-Universiteit geld die volgende ten opsigte van toepassing en interpretasie:

Hierdie Reëls moet saam met en onderhewig aan die Wet op Hoër Onderwys 101 van 1997 en die Statuut van die Noordwes-Universiteit gelees en toegepas word, tesame met beleide soos bepaal deur die Senaat en die Raad, met inbegrip van die Toelatingsbeleid, die Beleid oor Erkenning van Vorige Leer en die Assesserings- en Modereringsbeleid, sowel as die skedule van betaalbare gelde soos jaarliks deur die Universiteit bepaal.

Die Senaat moet binne die raamwerk van die voorskrifte van hierdie Reëls 'n handleiding vir nagraadse studie opstel wat die status van 'n bindende beleidsdokument van die Universiteit het om die voorbereiding vir, verloop, begeleiding en afhandeling van nagraadse studie te reël.

Behalwe waar dit uitdruklik anders vermeld word, geld hierdie Reëls ten opsigte van alle kwalifikasieprogramme wat in die Noordwes-Universiteit se Program- en Kwalifikasiemengsel gelys word en wat deur die Universiteit aangebied word, en geniet dit voorrang bo fakulteitsreëls (Algemene Akademiese Reël 1.1.3).

In gevalle waar bepalings van 'n fakulteitsreël strydig is met hierdie Reëls, geniet laasgenoemde voorrang.

Waar daar in hierdie Reëls funksies en besluitnemingsgesag aan persone of strukture opgedra word, kan die Senaat of betrokke kampus se Senaatskomitee te eniger tyd besluit om verslagdoening oor die uitoefening van die betrokke funksie of die neem van 'n besluit van sodanige persoon of struktuur te vereis, en kan die Senaat of die betrokke kampus se Senaatskomitee die betrokke handeling of besluit met inagneming van die implikasies vir diegene wat daardeur geraak word, binne die perke van redelikheid herroep of vervang (Algemene Reëls 1.1.6).

ENG.2.2 ACADEMIC LITERACY / AKADEMIESE GELETTERDHEID

All undergraduate students who register at the North-West University for the first time are required to register for a module/modules in academic literacy. They have to pass this module/these modules before they can graduate.

a) Testing

Students have to write a compulsory proficiency test in academic literacy, at a time and place determined by the University, to determine their ability to function within the academic environment. The purpose of this test is to identify students who, due to inadequate academic literacy skills, may not complete their study programme within the stipulated period in order to empower them with the necessary knowledge and skills.

Engineering students have to write the compulsory skills test in English (TALL). 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 check and verify his/her result within 14 days of writing the test and to register for the correct module in the correct semester (see below).

b) Module(s)

Academic Literacy Development (ALDE111)
Students who are identified as at-risk by the test, must register for the module ALDE111.

i. Level and credits

This module is on NQF level 5 and worth 12 credits (additional credits).

ii. Composition of module and calculation of module marks

ALDE111 comprises one component only, which includes two periods per week. Class attendance is compulsory. The module is only presented in Semester 1.

A system of continuous assessment is followed. The final module mark is calculated as follows: Exam mark = 40% and Participation mark = 60%. For admission to the exam in ALDE111, a participation mark of 40% is required.

Note that for conditional admission to ALDE122, a student who is required to follow ALDE111 should obtain a module mark of 40% minimum for ALDE111.

iii. Important additional information

Specific Faculty rules in terms of termination of studies might apply if a student fails ALDE111.

Students who have already successfully completed a module similar to ALDE111 at another tertiary institution and can provide proof of this, may apply in writing, on the prescribed form, for formal recognition for the module. This application should be submitted to the subject chair responsible for Academic Literacy. Recognition is only granted in cases where the modules are on the same NQF level (NQF5), where the credit values are of the same value (12), and where content is comparable.

iv. Language and mode of delivery

ALDE111 is presented in English. The module is presented in both contact and open distance learning mode. Note that only students who are formally registered for open distance learning may follow the module in this mode. All modules in open distance learning mode are presented in English only.

v. Outcomes

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

- bridge the divide between secondary school and university education;
- access academic information effectively in order to understand academic texts;
- process academic information successfully; and
- produce academic information responsibly and appropriately.

Academic Literacy Development (ALDE112 or ALDE122)

All students, regardless of the result obtained for the compulsory proficiency test in academic literacy, must register for the module ALDE112 [English] or ALDE122 [English]. Students who do not need to complete ALDE111, register for ALDE112 in Semester 1. Students who are required to enrol for ALDE111, register for ALDE122 in Semester 2. Note that ALDE112 and ALDE122 refer to exactly the same module presented in both semesters. The module codes, however, differ in order to distinguish between the semesters.

i. Level and credits

This module is on NQF level 5 and worth 12 credits. Note that it is calculated in terms of programme credits. It thus carries a weight of 12 credits in the first-year programme.

ii. Composition of module and calculation of module marks

For admission to the module ALDE122 [Semester 2], a student must first pass ALDE111 if he/she is required to take the module. In all other cases students have immediate access to ALDE112 [Semester 1].

Students who did not pass the module ALDE111 but were conditionally allowed to take ALDE122 and passed the module, may have their result for ALDE111 condoned to a pass by the entity concerned with Academic Literacy. This is subject to the Faculty rules of the Faculty of Humanities.

The modules ALDE112 and ALDE122 comprise two compulsory components: an Academic Literacy component and a Computer and Information Literacy component. For the academic literacy component, class attendance of two periods per week is compulsory. Computer and Information Literacy requires that students learn autonomously, but they will have access to contact sessions if they wish to make use of them. A student must pass both components to pass the module.

A system of continuous assessment is followed. The final module mark is calculated as follows: Exam mark = 40% and Participation mark = 60%. For admission to the exam in ALDE112 or ALDE 122, a participation mark of 40% is required.

iii. Important additional information

Specific faculty rules in terms of termination of studies might apply if a student fails ALDE 112 or ALDE122.

Students who have already successfully completed a similar module to ALDE 112 or ALDE122 at another institution and can provide proof of this, may apply in writing on the prescribed form for formal recognition of the module. This application should be submitted to the subject chair responsible for Academic Literacy. Recognition is only granted in cases where the modules are on the same NQF level (NQF5), where the credit values are the same value (12), and where content is comparable.

iv. Language and mode of delivery

ALDE112 or ALDE122 is presented in English. The module is presented in both contact and open distance learning mode. Note that only students who are formally registered for open distance learning may follow the module in this mode. Open distance learning is also presented in English.

v. Outcomes

On completion of this module students should be able to:

- successfully become part of the academic learning community and participate in this community;
- access information in a responsible and ethical way in order to write an academic text;
- process information strategically in order to write an academic text;
- produce an academic text;
- read at an acceptable speed and with an acceptable level of understanding; and
- demonstrate a fundamental level of computer and information literacy.

Alle voorgraadse studente wat vir die eerste keer aan die Noordwes-Universiteit registreer, is verplig om vir 'n module/modules in akademiese geletterdheid te registreer. Hulle moet dit slaag, alvorens hulle kan gradueer.

a) Toetsing

Studente moet 'n verpligte vaardigheidstoets in akademiese geletterdheid skryf op 'n gegewe tyd en plek, soos deur die Universiteit bepaal. Die doel van die toets is om studente te identifiseer wat a.g.v. onvoldoende vaardighede in akademiese geletterdheid die risiko loop om hulle studieprogram nie suksesvol te voltooi binne die toegelate tydperk nie, sodat hulle met die nodige kennis en vaardighede bemagtig kan word.

Ingenieursstudente moet die verpligte vaardigheidstoets in Engels (TALL) aflê. Met die uitsondering van studente wat deur die toets as grensgevalle uitgewys word, kry elke student slegs een geleentheid om die toets af te lê. Studente wat as grensgevalle beskou word, kry 'n tweede geleentheid. Dit is die student se verantwoordelikheid om hom-/haarself binne 14 dae na aflegging van die toets van sy/haar uitslag te vergewis en vir die korrekte module in die korrekte semester te registreer (sien hieronder).

b) Module(s)

Academic Literacy Development (ALDE111)

Studente wat deur die toets as risikogevalle geïdentifiseer word, moet vir die module ALDE111 [Engels] registreer.

i. Vlak en krediete

Hierdie module is op NKR-vlak 5 en het 'n waarde van 12 krediete (addisionele krediete).

ii. Samestelling van module en punteberekening

ALDE111 bestaan uit slegs een komponent wat minstens twee periodes per week behels en klasbywoning is verpligtend. Die module word slegs in Semester 1 aangebied.

'n Stelsel van deurlopende assessering word gebruik. Die finale modulepunt word soos volg bereken: Eksamenpunt = 40% en Deelnamepunt = 60%. Vir toelating tot die eksamen in ALDE111 word 'n deelnamepunt van 40% vereis.

Let wel: Vir voorwaardelike toelating tot die module ALDE122 moet 'n student wat verplig is om eers ALDE111 te volg, 'n modulepunt van minstens 40% in ALDE111 verwerf.

iii. Belangrike addisionele inligting

Spesifieke fakulteitsreëls t.o.v. terminering van studies kan van toepassing wees indien 'n student ALDE111 nie slaag nie.

Studente wat reeds 'n module soortgelyk aan ALDE111 suksesvol aan 'n ander tersiêre instelling voltooi het en bewys daarvan kan lewer, kan skriftelik op die voorgeskrewe vorm by die betrokke entiteit verantwoordelik vir Akademiese Geletterdheid om erkenning aansoek doen. Erkenning word slegs toegestaan in gevalle waar die modules op dieselfde NKR-vlak is (NKR5), die kredietwaarde minstens dieselfde is (12) en die inhoude vergelykbaar is.

iv. Taal en modus van aanbieding

ALDE111 word in Engels aangebied. Die module word in beide kontak- en afstandsmodusse aangebied, maar let daarop dat slegs studente wat formeel vir afstandsonderrig geregistreer is, dit in die afstandsmodus mag volg. Alle afstandsmodules word slegs in Engels aangebied.

v. Uitkomste

By afhandeling van hierdie module behoort die student in staat te wees om:

- *die gaping tussen hoërskool en universiteit te oorbrug;*
- *op effektiewe wyse toegang tot akademiese inligting te verkry met die doel om akademiese tekste te verstaan;*
- *akademiese inligting suksesvol te prosesseer; en*
- *akademiese inligting gepas en verantwoordelik te produseer.*

Academic Literacy Development (ALDE112 or ALDE122)

Alle studente, ongeag die uitslag van die verpligte vaardigheidstoets in akademiese geletterdheid, moet die module ALDE112 [Engels] of ALDE122 [Engels] neem. Studente wat nie ALDE111 hoef te volg nie, registreer vir ALDE112 in Semester 1. Studente wat ALDE111 moes volg, registreer vir ALDE122 in Semester 2. Let daarop dat dit dieselfde module is wat in beide semesters aangebied word, maar waarvan die modulekode verskil om die onderskeid in semester te tref.

I. Vlak en krediete

Hierdie module is op NKR-vlak 5 en het 'n waarde van 12 krediete. Let daarop dat dit wel vir kredietdoeleindes van die kurrikulum in berekening gebring word. Krediete hiermee verdien, dra dus 'n gewig van 12 krediete in die eerstejaarskurrikulum.

II. Samestelling van module en punteberekening

Vir toelating tot die module ALDE122 [Semester 2] moet 'n student wat verplig is om eers ALDE111 te volg, laasgenoemde slaag. In alle ander gevalle het studente onmiddellik toegang tot ALDE112 [Semester 1].

Studente wat nie die module ALDE111 geslaag het nie, maar wel voorwaardelik tot ALDE122 toegelaat is en die module geslaag het, se uitslag van ALDE111 kan deur die betrokke entiteit verantwoordelik vir Akademiese Geletterdheid tot 'n slaagpunt gekondoneer word. Dit is onderhewig aan die Fakulteit Geesteswetenskappe se Fakulteitsreëls.

Die module ALDE112 of ALDE122 bestaan uit twee verpligte komponente: Akademiese Geletterdheid en Rekenaar- en Inligtingsvaardighede. Akademiese Geletterdheid behels twee lesings per week en klasbywoning is verpligtend. Rekenaar- en Inligtingsvaardighede word op outonome wyse bemeester, maar daar is ook verskeie geleenthede vir kontaksessies tot studente se beskikking indien hul daarvan gebruik wil maak. Altwee die komponente moet geslaag word om die module te kan slaag.

'n Stelsel van deurlopende assessering word gebruik. Die finale modulepunt word soos volg bereken: Eksamenpunt = 40% en Deelnamepunt = 60%. Vir toelating tot die eksamen in ALDE112 of ALDE122 word 'n deelnamepunt van 40% vereis. Die eksamen bestaan uit twee vraestelle, naamlik Akademiese Geletterdheid en Rekenaar- en Inligtingsvaardighede. Die sub-minimum wat vir eersgenoemde komponent behaal moet word om die module te kan slaag, is 40%. Die sub-minimum wat vir laasgenoemde komponent behaal moet word om die module te kan slaag, is 50%. Hierdie twee komponente word in 'n 80:20-verhouding hanteer vir die berekening van die finale punt – 80% vir die eerste komponent (Akademiese Geletterdheid) en 20% vir die tweede komponent (Rekenaar- en Inligtingsvaardighede).

III. Belangrike addisionele inligting

Spesifieke fakulteitsreëls t.o.v. terminering van studies kan van toepassing wees indien 'n student ALDE112 of ALDE122 nie slaag nie.

Studente wat reeds 'n module soortgelyk aan ALDE112 of ALDE122 suksesvol aan 'n ander tersiêre instelling voltooi het en bewys daarvan kan lewer, kan skriftelik op die voorgeskrewe vorm by die betrokke entiteit verantwoordelik vir Akademiese Geletterdheid om erkenning aansoek doen. Erkenning word slegs toegestaan in gevalle waar die modules op dieselfde NKR-vlak is (NKR5), die kredietwaarde minstens dieselfde is (12) en die inhoude vergelykbaar is.

IV. Taal en modus van aanbieding

ALDE112 of ALDE122 word in Engels aangebied. Die module word in beide kontak- en afstandsmodusse aangebied, maar let daarop dat slegs studente wat formeel vir afstandsonderrig geregistreer is, dit in die afstandsmodus mag volg. Alle afstandsmodules word slegs in Engels aangebied.

V. Uitkomste

By afhandeling van hierdie module behoort die student in staat te wees om:

- *suksesvol in te skakel by die akademiese leeromgewing en daaraan deel te neem;*
- *op eties-verantwoordelike wyse te soek vir inligting wat nodig is vir die skryf van 'n akademiese teks;*
- *inligting op 'n strategiese manier te verwerk met die doel om 'n akademiese teks te kanskryf;*
- *'n akademiese teks te produseer; en*
- *'n fundamentele vlak van rekenaar- en inligtingsgeletterdheid te demonstreer.*

ENG.2.3 WARNING AGAINST PLAGIARISM / WAARSKUWING TEEN PLAGIAAT

Assignments are individual tasks and not group activities (unless explicitly indicated as group activities). For further details see:
http://www.nwu.ac.za/content/policy_rules

Werkstukke is individuele take en nie groepsaktiwiteite nie (tensy dit uitdruklik aangedui word as 'n groepsaktiwiteit). Vir meer besonderhede gaan na:
http://www.nwu.ac.za/content/policy_rules

ENG.2.4 CAPACITY STIPULATION / KAPASITEITSBEPALINGS

Please take cognisance 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 courses.

Neem asseblief kennis dat die Universiteit as gevolg van spesifieke kapasiteitsbepalings hom die reg voorbehou om kandidate vir toelating tot bepaalde studierigtings te keur. Dit beteken dat voornemende studente wat aan die minimum toelatingsvereistes voldoen, nie noodwendig tot die betrokke kursus toegelaat sal word nie.

ENG.2.5 PROTECTION OF PERSONAL AND EDUCATION-RELATED INFORMATION / BESKERMING VAN PERSOONLIKE EN OPVOEDKUNDIG-VERWANTE INLIGTING

General Academic Rule 1.11 stipulates the following:

In the course of the registration process, the extent to which the student's personal or education-related information may be disclosed to a third party is determined, but the student may withdraw or amend permission granted to disclose such information by means of a request in writing submitted to the Registrar. The university may disclose personal or education-related information regarding a student to a third party only after the law applicable to the protection of and access to information has duly been complied with.

Algemene Akademiese Reël 1.11 bepaal die volgende:

In die loop van die registrasieproses word die mate waarin die student se persoonlike of opvoedingsverwante inligting aan 'n derde party openbaar gemaak mag word bepaal, maar die student mag toestemming onttrek of wysig om sodanige inligting bekend te maak deur middel van 'n skriftelike versoek aan die registrateur. Die universiteit kan slegs persoonlike of opvoedingsverwante inligting rakende 'n student aan 'n derde party bekend maak nadat die wet wat op die beskerming van en toegang tot inligting van toepassing is, behoorlik nagekom is.

ENG.2.6 ADMISSION REQUIREMENTS FOR THE QUALIFICATION AND FACULTY / KWALIFIKASIE EN FAKULTEIT-SPESIFIEKE TOELATINGSVEREISTES

ENG.2.6.1 General / Algemeen

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

For admission to BEng degree studies the following apply:

Full Matriculation exemption, with an APS count of at least 34, Mathematics level 6 (70%-79%), and Physical Sciences level 6 (70%-79%).

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.

Consult the requirements for undergraduate studies and the calculation of the APS score, as well as for application purposes: http://engineering.nwu.ac.za/engineering/applications

Additional entry route: students with 50% in both Mathematics AND Physical Sciences, and an APS of 31, may have the opportunity to write a test as additional point of entry or enrol for the Xcel bridging program.

General Enquiries:
018 299 4026.
Booking for the test: 018 299 1318.
More information: http://engineering.nwu.ac.za/node/21112

Die aantal studente wat per skool toegelaat word, mag beperk word.

Vir toelating tot BIng-studie geld die volgende:

Matrikulasievrystelling, met 'n minimum APS-telling van 34, Wiskunde vlak 6 (70%-79%) en Fisiese Wetenskap (Skeinat) vlak 6 (70%-79%).

Taalvereiste nl. 'n slaagsyfer van 50%-59% (vlak 4) in die taal van leer en onderrig of huistaal- of eerste addisionele taalvlak.

Raadpleeg die toelatingsvereistes vir voorgraadse studie vir die wyse waarop die APS-telling bepaal word by: http://engineering.nwu.ac.za/engineering/applications

Addisionele toegangsroete: studente met 50% in beide Wiskunde EN Fisiese Wetenskappe en `n APS van 31 kan 'n geleentheid kry om 'n toets te skryf as addisionele toegangspunt of inskryf vir die Xcel-oorbruggingsprogram.

ENG.2.6.2 Admission from BSc to BEng / *Toelating vanaf BSc na BIng*

Prospective students who do not comply with the admission requirements for BEng programmes offered by the Faculty, and who have registered on year level 1 of a BSc programme in the Faculty of Natural and Agricultural Sciences, may in year 1 of their studies reapply for admission to the Faculty of Engineering.

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 requires that all the first-year modules must be passed at a minimum of 60%. The applicant must also write the Engineering Test.

By virtue of General Academic Rule 1.7.4 a student who desires to change to another curriculum must 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.

Voornemende studente, wat nie aan die toelatingsvereistes van 'n program wat deur die Fakulteit Ingenieurswese aangebied word, voldoen nie, kan aansoek doen vir registrasie op Jaarvlak 1 van 'n toepaslike BSc-program by die Fakulteit Natuur- en Landbouwetenskappe, met die oog op moontlike keuring aan die einde van 'n suksesvolle eerste jaar. Toelating tot FNAS is onderhewig aan daardie program se toelatingsvereistes asook kapasiteit.

Aan die einde van sy/haar eerste jaar kan 'n student weer aansoek doen vir keuring vir toelating tot 'n program wat deur die Fakulteit Ingenieurswese aangebied word. Toelating is onderhewig aan prestasie en die slaag van al die modules van die eerste jaar. Die Ingenieurstoets moet ook afgelê word met die oog op finale keuring.

Kragtens Algemene Akademiese Reël 1.7.4 kan 'n student wat van kurrikulum wil verwissel, skriftelik by die betrokke Fakulteit aansoek doen om erkenning van modules wat hy/sy reeds geslaag het en wat deel uitmaak van die kurrikulum waarna hy/sy wil oorskakel.

ENG.2.6.3 Joining from another university / *Toelating vanaf 'n ander universiteit*

a) Students who started their studies in Engineering at another university and who desire 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-year 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 Executive Dean before the beginning of the academic year.

f) Students who started their studies in Engineering at another university and who desire 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.

Enquiries:
Admissions Office
Building F20
(018) 299 2624

a) *Studente, wat hulle studie in ingenieurswese by ’n ander universiteit begin het en wat hul studie aan hierdie universiteit wil voortsit, se aansoek sal oorweeg word slegs indien die eerste jaar, binne een jaar, suksesvol by die vorige universiteit voltooi is. ’n Aansoek om by die tweede jaargang van die BIng-programme hier aan te sluit, sal oorweeg word.*

b) *Studente wat ingenieurswese aan ’n ander universiteit gestudeer het is aan keuring onderworpe. ’n Gedragsertifikaat moet ook getoon word. Aansoeke om toelating tot die BIng- program sal met inagneming van vorige leer ad hoc hanteer word.*

c) *Studente wat in die ingenieurswese aan ’n ander universiteit studeer en nie toegelaat word om hulle studie in ingenieurswese aan daardie betrokke universiteit voort te sit nie, sal nie toegelaat word om by die BIng-programme van die NWU aan te sluit nie.*

d) *Aansoeke om aansluiting by die BIng-program vir ’n gegewe jaar sluit op 31 Julie van die voorafgaande jaar en aansoeke om erkenning van modules op grond van ooreenstemmende modules wat aan ’n ander universiteit geslaag is, moet voor die begin van die akademiese jaar, skriftelik aan die betrokke Uitvoerende Dekaan gerig word.*

e) *Studente wat in die ingenieurswese by ’n ander universiteit studeer en hulle studies aan hierdie universiteit wil voortsit, moes by die aanvang van hulle studie by die ander universiteit reeds voldoen het aan die toelatingsvereistes van die Fakulteit Ingenieurswese van die NWU.*

Navrae:
Toelatingskantoor
Gebou F20
(018) 299 4154

ENG.2.7 RECOGNITION OF PRIOR LEARNING / ERKENNING VAN VORIGE LEER

The requirements regarding recognition of prior learning are stipulated in General Academic Rule 1.7.

Die vereiste ten opsigte van erkenning van vorige leer vir hierdie kwalifikasie, word in Algemene Akademiese Reël 1.7 vervat.

ENG.2.7.1 Amendment of curriculum and/or qualification / Wysiging van kurrikulum en/of kwalifikasie

Converting from one curriculum to another (including amendment of qualification or programme) requires the submission of a student request form. The full transcript of the student, along with the maximum period of the study, will be considered. Admission is subject to the approval of the Executive Dean.

Oorskakeling van een kurrikulum na ’n ander (insluitend wysiging van kwalifikasie of program) geskied deur die indiening van ’n studenteversoekvorm. Die volledige akademiese rekord van die student tesame met die toegelate maksimum duur van die studie, word in ag geneem. Toelating is onderhewig aan die goedkeuring van die Uitvoerende Dekaan.

ENG.2.8 REGISTRATION / REGISTRASIE

i. **Annual registration / *Jaarlikse registrasie***

The following apply for annual registration (General Academic Rules 1.10.1): /
Ingevolge Algemene Reëls 1.10.1 geld die volgende:

Every returning student must register annually in their personal capacity, either by means of a paper-based or an electronic registration process, for the learning components that are prescribed for the specific study year, in accordance with the Faculty rules applicable to the relevant qualification, programme and module(s) (General Academic Rules 1.10.1.1).

A student is personally responsible to:

- ensure compliance with all the programme and module registration requirements and the completion and submission of the formal documents required for registration as specified in Faculty rules (General Academic Rules 1.10.1.2.1); and

- determine that there are no clashes in contact timetables or scheduled assessment opportunities of the modules for which the student registers (General Academic Rules 1.10.1.2.2).

The university reserves the right to refuse or cancel the registration of a student where an applicant provides false, incorrect or incomplete information or documentation to register as a student, or where any other condition provided for in these rules is not satisfied (General Academic Rules 1.10.1.3).

Faculty rules provide for the requirements for active participation of students in specific programmes and students may not register for modules in which they are unable to or do not intend to actively participate (General Academic Rules 1.10.1.4).

In order to receive credits for a specific module a student must be registered for such module and pass it (General Academic Rules 1.10.1.5).

Two registration periods for the various levels and modes of study are determined annually in the university calendar, the second of which is reserved exclusively for registration of students in such distance programmes as may be identified annually by the responsible Executive Dean (General Academic Rules 1.10.1.6).

A student who was registered during the second registration period of the previous year must in the subsequent academic years report for registration during the first annual registration period (General Academic Rules 1.10.1.7).

In order to be registered, a student or the entity that has granted the student a bursary, must pay the prescribed registration and minimum tuition fees prescribed by the university (General Academic Rules 1.10.1.8).

A student who registers through the paper-based process for registration must complete and sign the relevant registration form, acquire the necessary approval from the relevant Faculty, and submit the signed form to the appropriate section within the Department of the Chief Director Student Academic Lifecycle Administration, upon which an official proof of registration is issued to the student (General Academic Rules 1.10.1.9).

A student who registers electronically must complete and sign the registration form electronically. After approval of the registration by the relevant Faculty, an official proof of registration is issued electronically (General Academic Rules 1.10.1.10).

A registered student must promptly submit all relevant changes to personal details on the prescribed form to the Chief Director Student Academic Lifecycle Administration for the purposes of official communication by the university with the student (General Academic Rules 1.10.1.11).

Official correspondence with students may be addressed by the university to the postal addresses, e-mail addresses and cell phone numbers supplied during registration, or as changed in accordance with General Academic Rule 1.10.1.11 (General Academic Rules 1.10.1.12).

ii. Module acceptances and exemptions

General Academic Rules 1.7 apply.

iii. Exemptions for a period and specific modules / *Vrystellings t.o.v. tydperk en spesifieke modules*

Faculty rules may stipulate that recognition or exemption of modules will apply for a specific period or that the Executive Dean may grant exemption or recognition of only certain modules.

A Faculty rule stipulates that recognition or exemption of modules will apply for three years. Applications for the recognition of only specific modules or exemption of modules longer than the prescribed period will be evaluated on merit by the Executive Dean in consultation with the School Director.

Fakulteitsreëls kan bepaal dat die verlenging van erkenning of vrystelling van modules vir 'n beperkte tyd sal geld of dat erkenning of vrystelling slegs vir bepaalde modules deur die Uitvoerende Dekaan goedgekeur kan word.

'n Fakulteitsreël geld dat die erkenning of vrystelling van spesifieke modules vir 'n beperkte tydperk van drie jaar geld. Versoeke om module-erkennings/-vrystellings langer as die genoemde tydperk of vir betrokke modules sal op grond van meriete deur die Uitvoerende Dekaan in konsultasie met die Skooldirekteur oorweeg word.

iv. Registration according to timetable/ *Inskrywing volgens rooster*

General Academic Rule 1.10.1.2.2 applies to engineering:

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

If a module must be repeated, the student must register for the relevant module in its entirety again and a new participation mark will have to be generated. No exemption from class attendance will be granted.

Before finally deciding on the choice of modules, students must take full cognisance of the class timetable. If the intended choice leads to a clash, the relevant choice will not be granted.

In such a case, the School Director in the School and the Faculty Administrator should be consulted.

Algemene Akademiese Reël 1.10.1.2.2 geld vir ingenieurswese:

'n Student word nie toegelaat om vir 'n module in te skryf indien daar ooreenkomstig die lesing-, toets- en eksamenrooster 'n roosterbotsing ten opsigte van 'n ander module waarvoor die student ingeskryf is, voorkom.

Indien 'n module herhaal word moet die student vir daardie betrokke module weer in sy geheel registreer sodat 'n nuwe deelnamepunt gegeneer kan word. Geen klasvrystellings word toegestaan nie.

Voordat daar finaal oor die keuse van modules besluit word, moet studente hulle deeglik vergewis van die klasrooster. Indien daar 'n botsing by 'n student se voorgenome keuse voorkom, sal registrasie daarvoor nie toegelaat word nie.

In so 'n geval moet die Skooldirekteur en Fakulteit Administrateur geraadpleeg word.

v. Simultaneous registration at more than one institution / *Gelyktydige registrasie by meer as een instelling*

A student registered at the university may not register concurrently for a qualification at another university except with the approval of the relevant Executive Dean, who may grant such approval only if the student has met the minimum residence requirements of both universities (General Academic Rule 1.10.5).

'n Student mag nie gelyktydig by die universiteit en 'n ander universiteit registreer sonder die toestemming van die betrokke Uitvoerende Dekaan nie wie so 'n instemming mag verleen indien die student aan die minimum vereistes van beide universiteite voldoen (Algemene Akademiese Reël 1.10.5).

vi. Simultaneous registration for more than one qualification / *Gelyktydige registrasie vir meer as een kwalifikasie*

The relevant Executive Dean may in writing grant a student permission, subject to compliance to the limitation on credit load provided for in General Academic Rule 1.9, to register simultaneously for more than one qualification at the university (General Academic Rule 1.10.6).

Die Uitvoerende Dekaan mag, op voorwaarde dat die student aan die bepaling aangaande kredietlading soos vervat in Algemene Akademiese Reël 1.9 voldoen, skriftelik aan 'n student toestemming verleen om gelyktydig vir meer as een kwalifikasie aan die universiteit te registreer (Algemene Akademiese Reël 1.10.6).

vii. Registration for additional modules / *Registrasie vir bykomende modules*

Apart from the required modules of the relevant curriculum, a student may register for additional modules in terms of the provisions of General Academic Rule 2.3.

Subject to provisions in Faculty rules, a student who registers for the first-year level of an undergraduate programme may be allowed to register for one additional module per semester (either an elective from the same programme or a module from another programme), provided that no timetable clashes are brought about thereby.

Subject to provisions in Faculty rules, a student who registers for the second, third or fourth year level of an undergraduate programme, and who has already passed all the required preceding modules of the relevant programme, may be allowed to register for a maximum of two additional modules per semester or two additional year modules, or one semester and one year module, provided that the student has ascertained that no class or examination timetable clashes are brought about thereby, and subject to the maximum number of credits for which a student may register in a given academic year as provided for in General Academic Rule 1.9.

An Executive Dean may grant permission to a student who wishes to register for more additional modules than provided for in General Academic Rules 2.3.1 and 2.3.2 to register for additional modules subject to the limitations provided for in General Academic Rule 1.9.

A student who failed modules that form part of the formal curriculum of a programme, may not, in the following year of study, register for additional modules not required for the curriculum of the programme before the failed modules have been passed.

Kragtens Algemene Akademiese Reël 2.3 geld die volgende vir die registrasie van bykomende modules:

Onderhewig aan fakulteitsreëls, kan 'n student wat vir die eerstejaarvlak van 'n voorgraadse program registreer, slegs toegelaat word om vir één module per semester (hetsy 'n keusemodule uit dieselfde program of 'n module uit 'n ander program) te registreer, indien geen roosterbotsings daardeur veroorsaak word nie.

Onderhewig aan die fakulteitsreëls, kan 'n student wat vir die tweede-, derde- of vierdejaarsvlak van 'n voorgraadse program geregistreer het, en wie reeds aan al die nodige voorvereistes van die modules of betrokke program voldoen, vir 'n maksimum van twee addisionele modules per semester of twee addisionele jaarmodules, of een semester en een jaarmodule registreer, op voorwaarde dat die student kan verseker dat daar geen klas-, toets- of eksamenroosterbotsings daardeur veroorsaak word nie en onderhewig aan die maksimum hoeveelheid krediete waarvoor 'n student gedurende 'n gegewe akademiese jaar mag registreer soos uiteengesit in Algemene Akademiese Reël 1.9.

Die Uitvoerende Dekaan kan, vir 'n student wat vir meer addisionele modules as waarvoor daar in Algemene Reëls 2.3.1 en 2.3.2 voorsiening gemaak word wil registreer, toestemming gee mits voldoen word aan die beperkinge van Algemene Akademiese Reël 1.9.

'n Student wat modules gedruip het wat deel uitmaak van die formele kurrikulum van 'n program, kan nie vir addisionele modules registreer wat nie deel uitmaak van die kurrikulum van die program alvorens die modules nie geslaag word nie.

ENG.2.9 ASSESSMENT / ASSESSERING

The rules concerning the assessment of undergraduate modules are stipulated in General Academic Rule 1.13 as well as General Academic Rule 2.5.

Die reëls met betrekking tot voorgraadse assessering word in Algemene Akademiese Reël 1.13 sowel as Algemene Akademiese Reël 2.5 vervat.

i. Participation mark / *Deelnamepunt*

The participation mark for a module is calculated from tests, assignments, practical work and research assignments.

The ratio between theory and practical work for the calculation of the participation mark is set out in the study guides of the various modules.

In case of continuous assessment, no participation mark will be calculated, and the module mark wil be the weighted average of the different assessments as indicated in the study guide.

Die deelnamepunt vir ’n module word saamgestel op grond van die punte wat behaal word vir toetse, opdragte, praktiese- en/of navorsingsopdragte.

Die verhouding tussen teorie en praktiese werk vir die berekening van die deelnamepunt vir ’n module word in die betrokke studiegids uiteengesit.

Vir kontinue assessering word geen deelnamepunt verwerf nie, en is die modulepunt die geweegde gemiddeld van die verskillende assesserings soos uiteengesit in die studiegids.

ii. **Examination opportunities / *Eksamengeleenthede***

The number of examination opportunities is in accordance with General Academic Rule 1.13.4.

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 provided 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 available examination opportunities, has passed all modules but one required for a qualification, may apply to the relevant Executive Dean 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 (General Academic Rule 1.13.6).

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

Die aantal eksamengeleenthede word gereël deur Algemene Akademiese Reël 1.13.4

Vir voorgraadse eksamens is daar twee eksamengeleenthede per module, waarvan een of albei deur die student benut kan word.

’n Student wat van die tweede eksamengeleentheid gebruik maak, moet die voorgeskrewe bedrag betaal.

Indien die student van albei geleenthede gebruik maak, word die modulepunt bereken op grond van die deelnamepunt wat toelating tot die eerste eksamengeleentheid verleen het en die punt wat in die tweede eksamen verwerf word.

Fakulteitsreëls kan bepaalde modules van die moontlikheid van ’n tweede eksamengeleentheid uitsluit. (Vir Ingenieurswesemodules word daar in die betrokke studiegids aangedui indien ’n tweede eksamengeleentheid nie van toepassing is nie).

'n Student wat ná benutting van alle beskikbare eksamengeleenthede alle modules wat vir 'n kwalifikasie vereis word, behalwe een, geslaag het, kan by die Uitvoerende Dekaan aansoek doen om 'n finale assesseringsgeleentheid in die uitstaande module, met dien verstande dat die student in daardie akademiese jaar vir die betrokke module geregistreer was en 'n deelnamepunt behaal het wat hom/haar tot die eksamen toegelaat het (Algemene Akademiese Reël 1.13.6).

Die deelnamebewys van die student wat vir 'n module verwerf is vir die eerste eksamengeleentheid, word oorgedra na die tweede eksamengeleentheid.

iii. Medical certificates for absence / *Siektebriewe vir afwesigheid*

No medical certificate is required for missed examinations: students must avail themselves for 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 student's inability to write the test, must be submitted to the School Director within five working days of the consultation with the doctor, or the date of the test, whichever comes first.

Vir eksamen geld geen siektebriewe nie. Die eerste en/of tweede geleentheid word benut.
Wat afwesigheid weens siekte van 'n semestertoets betref, moet 'n geldige mediese sertifikaat by die Skooldirekeur ingehandig word, waarin die onvermoë om die toets af te lê bevestig word. Hierdie sertifikaat moet binne vyf werksdae vanaf die besoek aan die dokter, of die datum van die toets, welke ookal eerste was, ingedien word.

Prosedures word in die Kwaliteitshandleiding uiteengesit.

iv. Use of pocket calculators during examinations / *Gebruik van sakrekenaars tydens eksamens*

The following policy with respect to calculators has been approved:

a) Prescribed calculators may be used but are not supplied.

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:

In exceptional cases, permission for the use of non-standard calculators may be given. An application with motivation to this effect must 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 must then sign a statement to this effect.

Die volgende beleid ten opsigte van sakrekenaars is goedgekeur:

a) *Voorgeskrewe sakrekenaars mag gebruik word, maar word nie voorsien nie.*

b) *Indien die sakrekenaars ter sprake nie akkuraat genoeg beskryf kan word nie moet die eksaminator persoonlik teenwoordig wees om die sakrekenaars te kontroleer.*

c) *Die hooftoesighouer moet by die aanvang van elke eksamensessie/toets die kandidate se aandag pertinent daarop vestig dat slegs sakrekenaars aanvaar word soos op die vraestel vermeld.*

d) *Geen student mag gedurende 'n eksamen en/of toetssessie 'n sakrekenaar by 'n ander student leen nie.*

e) *Enige afwyking van hierdie voorskrifte sal 'n oortreding van die eksamen- en toetsregulasies wees.*

f) *Wat die gebruik van nie-standaard sakrekenaars tydens die eksamen betref, geld die volgende:*

Toestemming sal in uitsonderlike gevalle verleen word om nie-standaard sakrekenaars te gebruik. Aansoek met motivering moet twee weke voor die aanvang van die eksamen ingedien word. In elke geval moet maatreëls in plek geplaas word om die geheue van die rekenaar skoon te maak, voordat dit in die eksamenlokaal ingeneem mag word. Daar moet op elke eksamenvraestel aangedui word of 'n sakrekenaar met geheue, gebruik mag word en dit moet bevestig word dat die geheue skoongemaak is. Die student en toesighouer moet dit ook verifieer en 'n verklaring teken.

v. Admission to examination / *Toelating tot die eksamen*

The requirements regarding undergraduate examination are stipulated in General Academic Rule 1.13.2.

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

"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 (General Academic Rule 1.13.2.1).

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 (General Academic Rule 1.13.1.1).

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.

Die vereistes ten opsigte van toelating tot eksamen, word vervat in Algemene Akademiese Reël 1.13.2.

'n "Deelnamebewys" is 'n bevestiging van die dosent in 'n bepaalde module dat 'n student ooreenkomstig die toepaslike kurrikulumvoorskrifte bevredigend aan onderrig-leeraktiwiteite en die uitvoering van onderrig-leeropdragte deelgeneem het, waardeur die student tot 'n finale assessering in die betrokke module of onderdeel daarvan toegelaat word.

In die Fakulteit Ingenieurswese moet 'n minimum deelnamepunt van 40% behaal word vir toelating tot die eksamen (Algemene Akademiese Reël 1.13.2.1).

Die deelnamepunt vir 'n module word saamgestel uit toetse, werkstukke en praktiese werk. Vir elke onderrigleeropdrag (klastoetse, werkstukke, opgawes, ensovoorts) wat by wyse van formatiewe assessering in 'n module uitgevoer word, word 'n punt toegeken. 'n Student se deelnamepunt is die geweegde gemiddelde van hierdie punte (Algemene Akademiese Reël 1.13.1.1).

Toelating tot die eksamen in enige module geskied dus deur die verwerwing van 'n deelnamebewys en 'n deelnamebewys/-punt sal slegs aan 'n student uitgereik word indien hy/sy:

a) Voldoen het aan die spesifieke vereistes daarvoor wat in die studiegids vir die betrokke module uiteengesit is;

b) Waar van toepassing, die praktiese werk wat vir 'n module vereis word, voltooi het; en

c) 'n Deelnamepunt van minstens 40% behaal het.

Die verhouding tussen teorie en praktiese werk vir die berekening van die deelnamepunt vir 'n module word in die betrokke studiegids uiteengesit.

Die deelnamebewys van die student wat vir 'n module verwerf is vir die eerste eksamengeleentheid, word oorgedra na afloop van die tweede eksamen geleentheid.

vi. Relationship between credits, teaching periods and examination papers / *Verhouding tussen kredietpunte, onderrigperiodes en eksamenvraestelle*

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). 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.

The duration for an examination paper for a 12-credit module should normally (but not limited to) be two hours and for 16, 24 or 32 credit modules, three hours.

Modules is volgens vlakke van gevorderdheid ingedeel, wat ook verband kan hou met die studiejaar waarin die modules in 'n bepaalde program geneem word, indien die program in die minimum studietydperk voltooi word.

Die kurrikulums van ingenieurswese is saamgestel vir die minimum studietydperk van vier jaar (BIng-kwalifikasie). 'n Student kan aansoek doen om die modules van 'n program ook oor 'n langer tydperk te versprei. Oorskryding van die maksimum studietydperk van 'n program, omdat die student nie na wense gevorder het nie, sal slegs in uitsonderlike gevalle toegelaat word.

Die volgorde waarin modules in 'n program geneem moet word, is nie willekeurig nie, maar ontwerp om te verseker dat volgende leer altyd op vorige leer voortbou. In elke betrokke studiegids word volledige inligting oor 'n spesifieke module gegee.

Die eksamenvraestel vir 'n 12-kredietpunt module duur gewoonlik (maar nie beperk nie) twee ure en die eksamenvraestelle van modules wat 16, 24 of 32 kredietpunte tel, duur gewoonlik drie ure.

vii. Moderating of modules, examination papers and answer papers / *Moderering van modules, vraestelle en antwoordstelle*

General Academic Rules 2.5.1 is applicable as well as Faculty rules where the requirements of Statutory Councils are stated.

Algemene Reëls 2.5.1 is van toepassing asook fakulteitsreëls waar Statutêre Rade se vereistes gestel is.

viii. Calculation of module mark / *Berekening van modulepunt*

The module mark (General Academic Rule, glossary) is calculated by using the ratio between the participation mark and the examination mark as set out in the study guide.

Die modulepunt (Algemene Reël, verklarende woordlys) word bereken volgens die verhouding tussen die deelnamepunt en die eksamenpunt soos uiteengesit in die studiegidse.

Module mark refers to the final mark awarded to a student for a particular module. It is calculated according to a formula which is determined by Faculty rules, based on a combination of particular weightings for the participation mark and the summative assessment mark awarded to a student in a module; the weight of the participation mark in the above-mentioned formula may not be less than 30% or more than 70%. In the case of continuous assessment, the module mark is calculated according to a weighted average of all assessments as indicated in the study guide.

Die modulepunt verwys na die finale punt wat 'n student verwerf het vir 'n module. Dit word bereken volgens die fakulteitreëls wat gebaseer is op 'n geweegde gemiddeld tussen die deelnamepunt en die summatiewe assesseringspunt behaal deur die student. Die deelnamepunt se bydrae moet tussen 30% en 70% van die modulepunt wees. Vir kontinue assessering word die modulepunt bepaal deur 'n geweegde gemiddeld van al die assesserings soos aangedui in die studiegids.

ix. Pass requirements / *Slaagvereistes van 'n module*

Under General Academic Rule 1.13.3 the following applies for the Faculty of Engineering:
A final assessment mark in a module will be considered a pass 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 relevant School Director may allocate a pass mark of 50% to the student (General Academic Rule 2.5.2).

The final module mark is composed, 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 or study guide (General Academic Rule 1.13.3).

When ECSA Graduate Attributes are assessed at exit level, the student is required to prove satisfactory achievement of the GA in parallel to passing the module. Failure of either one will lead to the student having to repeat the module.

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 Academic Rule 1.13.3 must be applied.

For continuous assessment, the student is deemed to have passed the module when the final module mark, calculated from the weighted average of all assessments, is above 50%, and when the student has adhered to all sub-minimum requirements set for specific assessments.

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

Kragtens Algemene Akademiese Reël 1.13.3 geld die volgende reëls vir die Fakulteit Ingenieurswese:
'n Finale assesseringspunt word as 'n slaagpunt beskou as die student tot assessering toegelaat is, en die vereiste modulepunt van minstens 50% in die assessering behaal het, met dien verstande dat ten minste 40% in die eksamen behaal moet word.

Waar 'n bona fide-eerste-inskrywingstudent in enige eerstevlakmodule van die eerste semester gedruip het, kan die Skooldirekteur nogtans 'n slaagpunt van 50% daarvoor toeken, mits 'n eksamenpunt van minstens 50% in daardie module behaal is (Algemene Akademiese Reël 2.5.2). Dit kan vir Ingenieurswese in uitsonderlike gevalle oorweeg word, waar 'n enkele module uitstaande is om die semester te slaag.

Die modulepunt word ooreenkomstig met die fakulteitsreëls saamgestel uit die punt wat 'n student in die eksamen vir 'n module verwerf het en die deelnamepunt ten opsigte van die module, met dien verstande dat die deelnamepunt se gewig in die berekening van die modulepunt nie minder as 30% en nie meer as 70% mag bedra nie (Algemene Akademiese Reël 1.13.3).

Wanneer ECSA Graduandi-eienskappe (GAs) op uittreevlak geassesseer word, moet die student kan bewys dat hierdie eienskap bemeester is, parallel tot die punt verkry vir die module. As of die GA of die modulepunt nie suksesvol behaal is nie, sal die module gedruip word en moet die student die module herhaal.

Die modulepunt vir elke module word dus bereken deur die gemiddeld van die deelnamepunt en die eksamenpunt te bereken. Afhangende van die spesifieke vereistes van verskillende modules moet die berekening van die deelnamepunt asook modulepunt in die betrokke studiegids duidelik uitgespel word, indien dit van b.g. verskil en Algemene Akademiese Reël 1.13.3 moet in sodanige gevalle toegepas word.

Alle modules wat ekstern of intern gemodereer word se punt word eers as finaal beskou nadat die moderering afgehandel en die verslag van die moderator ontvang is.

x. **Access to marked examination work / *Toegang tot gemerkte eksamenwerk***

With reference to General Academic Rule 1.13.7 a student can officially apply to the School Director for access to marked examination work as well as the memoranda. The internal process is fully described in the Quality Manual, Reassessment of Scripts.

Students may still make use of the second opportunity examinations after access was allowed to marked examination scripts of the first examination opportunity.

Met verwysing na Algemene Akademiese Reël 1.13.7 mag 'n student by die Skooldirekteur aansoek doen om insae in sy/haar antwoordstel asook die memorandum vir 'n spesifieke vraestel te verkry.

Die interne prosedure word volledig uiteengesit in die Kwaliteitshandleiding, Reassessment of Scripts.

Die student mag steeds van die tweede eksamengeleentheid gebruik maak, al is toegang tot gemerkte eksamenwerk na 'n eerste eksamengeleentheid verleen.

xi. Repeating of modules / *Herhaling van 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 in its entirety and a new participation mark accumulated. Class exemption is not granted.

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.

Indien 'n student nie tydens een van die twee eksamengeleenthede wat volg op die verwerwing van 'n deelnamepunt vir 'n bepaalde module, in die eksamen slaag nie, moet die module herhaal word en 'n nuwe deelnamepunt saamgestel word. Klasvrystelling word nie toegelaat nie.

Verder geld die veronderstelling dat indien 'n module na die semestertoets eers gestaak word, dit tel asof die module daardie semester geneem is.

ENG.2.10 ATTAINMENT OF AN UNDERGRADUATE QUALIFICATION / VERWERWING VAN VOORGRAADSE KWALIFIKASIE

ENG.2.10.1 Satisfaction of requirements / *Voldoening aan die vereistes*

By virtue of General Academic Rules 1.3.3, 1.14, 1.17 and 1.19.3, an undergraduate qualification is obtained when final verification and audit confirmation are given that a student has successfully completed all the modules prescribed in the applicable Faculty rules for the programme of the qualification concerned (General Academic Rule 2.6.1).

Kragtens Algemene Reëls 1.3.3, 1.14, 1.17 en 1.19.3, word 'n voorgraadse kwalifikasie verwerf, wanneer finale verifikasie en oudit bevestig dat 'n student aan al die vereistes en uitkomstes van die spesifieke program waarvoor geregistreer is, voldoen het.

Al die voorgeskrewe modules, soos in die betrokke programdokument en fakulteitsreëls vervat, moet suksesvol voltooi word, alvorens 'n graad toegeken word (Algemene Akademiese Reël 2.6.1).

ENG.2.10.2 Awarding of a qualification with distinction / *Toekenning van graad met lof*

In order to receive the degree of Bachelor of Engineering with distinction, a student must complete the degree in the minimum period of four years (unless medically interrupted as stated by A-Rule 2.6.2.2 for which the student has to apply for recognition at the office of the Director of the CEE after which a decision will be taken by the Executive Dean, the Director of the CEE and the School Director) and must have achieved a weighted average of 75% for all core modules of the degree over the four years of study. The weighted average is calculated by firstly determining the weighted average mark for each year based on the credit load per core module for that year. From there, the weighted average per year will be calculated by taking year one as 10%, year two as 20%, year three as 30% and year four as 40 % of the final average mark.

Ten einde vir die toekenning van die graad Baccalaureus in Ingenieurswese met lof te kwalifiseer, moet 'n student die graad in die minimum tydperk van vier jaar voltooi (tensy die studies onderbreek was as gevolg van mediese redes soos uiteengesit in Algemene Akademiese Reël 2.6.2.2, waarna die student moet aansoek doen vir herkenning by die kantoor van die Direkteur van die Sentrum vir Ingenieursonderrig, en waarna 'n besluit geneem sal word deur die Uitvoerende Dekaan, die Sentrum Direkteur en die betrokke Skool Direkteur) en 'n geweegde gemiddeld van 75% vir al die kernmodules van die graad oor die vier jaar van studie behaal.

In die berekening word die kredietwaarde van modules ook in ag geneem. Verder tel jaargang een 10%, jaargang twee 20%, jaargang drie 30% en jaargang vier 40 % van die gemiddelde totaal.

ENG.2.11 ASSUMED LEARNING-BASED PROGRESS IN A CURRICULUM / VORDERING IN 'N PROGRAM GEBASEER OP VERONDERSTELDE LEER

General Academic Rule 1.8 explains the principles of linked and concurrent modules.
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 comfortably complete the prescribed modules for a specific semester of a curriculum, has been acquired in the preceding semesters.

A student, who has failed one or more modules in a preceding semester, will probably not be adequately equipped to take the modules of the following semester. Such students are advised to consult the School Director beforehand to find out for which modules of the relevant semester they may register with a reasonable expectation of success.

The rules aim to ensure that a student in any semester will only register for those modules for which he/she has at least the minimum prior knowledge.

When students change from one programme to another, the entrance level for the new programme will have to be determined in consultation with the School Director under which the relevant curriculum falls. A module in any curriculum may only be registered for if it conforms to the requirements regarding assumed learning, as indicated in the study guide/list of modules.

Algemene Akademiese Reël 1.8 vervat die beginsels van verwante en veronderstelde leer ten opsigte van modules.

By die saamstel van elke program is verseker dat veronderstelde leer, dit wil sê die nodige voorkennis en algemene vlak van insig en ervaring wat nodig is om die modules wat in 'n bepaalde semester van 'n program voorgeskryf is met gemak te kan volg, reeds in die voorafgaande semesters verwerf is.

'n Student wat een of meer modules in die voorafgaande semesters gedruip het, sal waarskynlik nie voldoende toegerus wees om die modules van die volgende semester te neem nie. Sulke studente word aangeraai om die Skooldirekteur vooraf te raadpleeg om vas te stel vir watter modules van die betrokke semester hulle wel met 'n redelike verwagting op sukses kan registreer.

Die reëls in hierdie verband het ten doel om te verseker dat 'n student in enige semester slegs vir daardie modules registreer waarvoor hy/sy wel oor die minimum voorkennis beskik.

Studente wat van een program na 'n ander program omskakel se intreevlak in die nuwe program sal in oorleg met die Skooldirekteur waarbinne die betrokke program ressorteer, bepaal word.

Registrasie van 'n module uit enige program kan slegs geskied indien aan die eise ten opsigte van veronderstelde leer, soos in die studiegids/modulelys van 'n betrokke module aangedui is, voldoen is.

ENG.2.11.1 Requirements with respect to assumed prior learning for BEng programmes / Vorderingsvereistes ten opsigte van veronderstelde leer vir BIng-programme

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% must be achieved in that prerequisite module, before the following module may be taken.

b) An auxiliary module must be taken in the same semester as the module on which it has 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 Academic Rule 2.4).

Wat vereistes ten opsigte van veronderstelde leer van Ingenieurswese modules betref, geld die volgende:

a) Waar 'n eerste semestermodule in 'n bepaalde jaarvlak 'n voorvereiste ten opsigte van veronderstelde leer vir 'n tweede semestermodule is, of 'n module uit een jaarvlak, 'n voorvereiste ten opsigte van veronderstelde leer vir 'n module van die volgende jaarvlak is, moet 'n slaagpunt

(modulepunt) van minstens 50% in daardie voorvereiste module behaal word, voordat die opvolgmodule geneem mag word.

b) *Wat 'n newe-vereiste module betref word dit in dieselfde semester gevolg as die module waarop dit betrekking het.*

c) *Aangesien BIng as 'n professionele graad beskou word wat tot professionele registrasie lei, mag 'n student kragtens Algemene Akademiese Reël 2.4 slegs vir finalejaarsmodules registreer indien al die voorafgaande modules geslaag is.*

ENG.2.12 MONITORING OF ACADEMIC PERFORMANCE / MONITERING VAN AKADEMIESE VORDERING

General Academic Rules 1.15 and 1.16 apply.

A student is deemed not to have made satisfactory academic progress if, in a semester, the student achieves less than half the credits required for the applicable programme as prescribed in die Faculty rules applicable to the mode of delivery and attendance mode (General Academic Rule 1.15.1).

Subject to additional arrangements provided for in Faculty rules, a student whose academic performance is unsatisfactory may be given a written warning by the relevant Executive Dean, alerting the student to the implications of unsatisfactory academic progress for the completion of the study programme, and providing a basis for the applicable lecturer or programme leader to review the unsatisfactory progress with the student and refer the student for appropriate support, including academic advice, supplemental instruction and study counselling (General Academic Rule 1.15.2).

Every school must monitor the academic progress of students who have received warning letters (General Academic Rule 1.15.3).

Algemene Akademiese Reël 1.15 asook 1.16 is van toepassing:

'n Student wat nie goeie akademiese vordering toon nie word beskou as 'n student wat gedurende 'n semester minder as die helfte van die verwagte krediete vir die betrokke program behaal het, soos bepaal in die fakulteitsreëls vir die afleweringsmetode en of dit 'n kontak- of afstandsprogram is (Algemene Akademiese Reël 1.15.1).

Onderhewig aan bykomende maatreëls in die fakulteit, kan 'n geskrewe waarskuwing aan 'n student wie swak akademiese vordering toon deur die Uitvoerende Dekaan uitgereik word, wat die student se aandag op die gevolge van swak akademiese vordering vir die afhandeling van die program vestig, en wat die betrokke dosent of programbestuurder in staat sal stel om die swak vordering met die student te bespreek en hom/haar te verwys vir gepaste ondersteuning, insluitend akademiese advies, aanvullende onderrig en studie berading (Algemene Akademiese Reël 1.15.2).

Elke skool moet die akademiese vordering van studente wat waarskuwingsbriewe ontvang het monitor (Algemene Akademiese Reël 1.15.3).

ENG.2.13 PROGRESSION REQUIREMENTS (GENERAL ACADEMIC RULE 1.16) / VORDERINGSVEREISTES (ALGEMENE AKADEMIESE REËL 1.16)

In order to ensure that a sufficient percentage of the credit load of the programme for which the student is registered is completed within the maximum duration allowed for the study –

a) a contact student must obtain at least 66% of the total credits that are required for the programme up to the historic year level for which the student is registered; and

b) a distance student must obtain at least 66% of the total credits that are required for the curriculum up to the historic year level for which the student is registered.

A student who fails to comply with the progression requirements provided for in General Academic Rule 1.16.1 does not automatically qualify to continue study in the applicable programme.

After every examination period the responsible Executive Dean must, in consultation with the Faculty Management Committee or other applicable Faculty structure, review the academic records of all students to determine the students' compliance with the progression requirements.

Should the responsible Executive Dean decide to terminate a student's registration due to failure to comply with the progression requirements, the student may, within ten days of the date of such decision, submit to the Faculty manager a motivated request in the prescribed form to be readmitted to the study.

The Executive Dean's decision to grant or refuse a request for readmission submitted in terms of General Academic Rule 1.16.4 is final.

The Executive Dean reports all the decisions taken in terms of this rule to the Registrar.

Om te verseker dat 'n student die voldoende persentasie kredietlading van die program waarvoor hy/sy geregistreer is binne die maksimum duur van die studie voltooi –

a) moet 'n kontakstudent ten minste 66% van die totale krediete van die program tot en met die historiese jaarvlak waarvoor die student geregistreer is verwerf; en

b) 'n afstandstudent moet ten minste 66% van die totale krediete van die program tot en met die historiese jaarvlak waarvoor die student geregistreer is verwerf.

'n Student wat nie aan die vorderingsvereistes soos vervat in Algemene Akademiese Reël 1.16.1 voldoen nie, kwalifiseer nie vanselfsprekend om met sy/haar studies in daardie program voort te gaan nie.

Na afloop van elke eksamentydperk, moet die Uitvoerende Dekaan, in raadpleging met die Fakulteitsbestuurskomitee of ander toepaslike fakulteitstrukture, die akademiese vorderingsverslae van alle studente nagaan om studente se voldoening aan vorderingsvereistes te bepaal.

Indien die belanghebbende Uitvoerende Dekaan besluit om 'n student se studies te termineer omdat die student nie aan die verwagte vorderingsvereistes voldoen nie, mag die student binne 10 dae vandat die besluit geneem is, 'n gemotiveerde versoek om studies voort te sit, deur middel van die voorgeskrewe vorm, by die Fakulteitsadministrateur indien.

Die Uitvoerende Dekaan kan volgens Algemene Akademiese Reël 1.16.4 die besluit vir hertoelating toestaan of afkeur en daardie besluit is finaal.

Die Uitvoerende Dekaan lewer verslag aangaande alle besluite wat volgens hierdie reël geneem is, aan die Registrateur.

ENG.2.14 TERMINATION OF STUDIES / BEËINDIGING VAN STUDIE

In terms of General Academic Rule 1.18 the Rules following below apply in the Faculty of Engineering:

Where a student has already received two warnings from the Executive Dean as referred to in 1.18.1.3 and fails for the third time to show satisfactory academic performance, or did not obtain permission as referred to in 1.18.1.6 to exceed the maximum duration of the study period, the Registrar may, on the advice of the responsible Executive Dean, terminate the student's studies.

A student whose studies have been terminated will not be 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 readmission the responsible Executive Dean has the discretionary authority to set reasonable conditions for such readmission and must report such conditions to the Registrar.

Kragtens Algemene Akademiese Reël 1.18 geld die volgende in die Fakulteit Ingenieurswese: Indien

'n student reeds twee waarskuwings van die Uitvoerende Dekaan ontvang het, soos bepaal in 1.18.1.3 en vir 'n derde keer onbevredigende akademiese prestasie lewer, of nie toestemming ontvang het om die maksimum voorgeskrewe duur van die studietydperk te oorskry nie (soos bepaal in 1.18.1.6), kan die Registrateur, op aanbeveling van die betrokke Uitvoerende Dekaan, die student se studie beëindig.

'n Student wie se studie beëindig is, word nie in die daaropvolgende akademiese jaar weer tot dieselfde studieprogram toegelaat nie.

'n Student wie se studie beëindig is, kan op die gewone wyse aansoek doen om toelating tot 'n ander studieprogram, maar moet ten tyde van die aansoek melding maak van die studiebeëindiging.

By 'n aansoek om hertoelating kan die betrokke Uitvoerende Dekaan na goeddunke redelike voorwaardes vir sodanige hertoelating stel. Sodanige voorwaardes moet aan die Registrateur gerapporteer word.

ENG.2.15 FACULTY RULES PERTAINING TO THE ISSUING OF WARNING LETTERS

In accordance with General Academic Rule 1.15.2 with regard to the monitoring of academic performance, a student in any BEng programme of the Faculty of Engineering's academic performance is considered to be unsatisfactory when:

1. After the first semester of the first year of first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed at least 50% of the module credits of the first semester for the particular programme.

2. After the second semester of the first year of first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has

not passed at least 50% of the module credits of the second semester for the particular programme.

3. After the first semester of the second year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all first-year, first-semester modules for that particular programme.

4. After the second semester of the second year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all first-year, second-semester modules for that particular programme.

5. After the first semester of the third year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all second-year, first-semester modules for that particular programme.

6. After the second semester of the third year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all second-year, second-semester modules for that particular programme.

7. After the first semester of the fourth year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all third year, first-semester modules for that particular programme.

8. After the second semester of the fourth year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all third year, second-semester modules for that particular programme.

9. After the first semester of the fifth year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all fourth-year, first-semester modules for that particular programme.

10. After the second semester of the fifth year after first registration for a module(s) (or accepted equivalent from the NWU or other university) which is part of the programme, the student has not passed all fourth-year, second-semester modules for that particular programme.

ENG.3 OTHER SPECIFIC FACULTY RULES / ANDER SPESIFIEKE FAKULTEITSREËLS

By virtue of General Academic Rule 1.3 the following is stipulated:

i. Every Faculty board makes, subject to these Rules, Faculty rules about the qualification programmes offered by the specific Faculty and submits those rules to the 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. Faculty rules are published in the calendar of the relevant Faculty.

v. 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.

Kragtens Algemene Akademiese Reël 1.3 geld die volgende algemene bepalings ten opsigte van Fakulteitsreëls:

i. Elke fakulteitsraad maak, onderhewig aan die Algemene Reëls, fakulteitsreëls met betrekking tot die kwalifikasieprogramme wat deur die betrokke fakulteit aangebied word en lê dit aan die Senaat voor vir goedkeuring.

ii. Fakulteitsreëls kan, waar toepaslik, benewens die gevalle waarvoor in hierdie Reëls voorsiening gemaak word, ook voorsiening maak vir reëlings wat nodig mag wees vir die akkommodasie van kwalifikasiespesifieke vereistes en fakulteitspesifieke prosedures en strukture.

iii. Die plek of plekke waar elke kwalifikasieprogram of -kurrikulum aangebied word, asook die metode van aflewering daarvan, word bepaal deur fakulteitsreëls binne die raamwerk van institusionele beleide.

iv. Fakulteitsreëls word in die jaarboek van die betrokke fakulteit gepubliseer.

v. Waar fakulteitsreëls gewysig word voordat die volgende weergawe van die jaarboek gepubliseer is, moet stappe geneem word wat redelikerwys nodig is om die wysigings onder die aandag te bring van studente wat daardeur geraak word.

ENG.3.1 MINIMUM AND MAXIMUM DURATION / MINIMUM EN MAKSIMUM DUUR

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 (General Academic Rule 1.14.1.4).

Die minimum voltydse studietydperk vir die graad is vier jaar en die maksimum tydsduur vir die voltooiing van die graad is ses jaar (Algemene Akademiese Reël 1.14.1.4).

ENG.3.2 MEDIUM OF INSTRUCTION / TAAL VAN ONDERRIG

The Faculty of Engineering supports the NWU language policy. The faculty language plan was set up to facilitate the education of engineers who will be professionally fluent in English (graduate attribute), taking cognisance of the fact that these students enter our educational system from multiple multilingual and multicultural contexts. Hence, implementing deliberate interventions at the education system entry points to optimise access and success. Please refer to the faculty language plan for detail on the implementation of language as the medium of instruction at various levels.

Die Fakulteit Ingenieurswse ondersteun die taalbeleid van die NWU. Die fakulteit se taalplan was so saamgestel dat dit die onderrig van ingenieurs bevorder wat op uittreevlak (graduandi-eienskap) bevoeg is om professioneel in Engels te kan kommunikeer. Daar is verder in ag geneem dat studente by die universteit aansluit vanuit verskilllende taal en kultuur agtergronde, en daarom is daar gepoog om spesifieke intervensies te plaas by die intreevlak om sukses te help bevorder. Raadpleeg asseblief die fakulteit se taalplan om 'n gedetaileerde uiteensetting van die onderrigtaal op verskillende vlakke te verkry.

ENG.3.3 PRACTICAL TRAINING IN INDUSTRY DURING STUDY PERIOD / PRAKTIESE OPLEIDING IN NYWERHEDE GEDURENDE STUDIETYDPERK

As part of their programme and training, engineering students must receive practical experience and undergo specified training in industry during vacations.

First-year students are required to do a module in workshop practice. The purpose of this module is to provide students with instruction in workshop practice and the safe use of tools. Students must master the practical use of basic hand tools and manufacturing equipment and acquire basic knowledge of safety requirements in the workshop and the skills to fabricate small articles. The eleven GAs (Graduate Attributes) of ECSA will also be introduced and discussed.

Senior students (at the end of year level 3) must perform discipline-appropriate vacation work for at least six weeks. It is expected of these students to complete a report on their vacation training, which must be handed in (together with an employer's report) at the University soon after completion of the training. The completion of a short course in occupational safety, presented at the University, is a precondition for this module.

As deel van hul program en opleiding, moet ingenieurstudente praktiese ervaring opdoen, en ondergaan dus gespesifiseerde opleiding in die nywerheid gedurende vakansies.

Van eerstejaarstudente word vereis om'n module in werkswinkelpraktyk te voltooi. Die doel van hierdie module is om studente te onderrig in werkswinkelpraktyk en die veilige gebruik van gereedskap. Studente moet die praktiese gebruik van basiese handgereedskap en vervaardigingstoerusting bemeester en basiese kennis van veiligheidsvereistes in die werkswinkel verkry, asook vaardighede verwerf om klein artikels te vervaardig. Die elf graduandi-eienskappe (GAs) van ECSA sal ook bekendgestel en bespreek word.

Senior studente (aan die einde van jaarvlak 3) moet dissipline-toepaslike vakansiewerk vir ten minste ses weke verrig. Daar word van hierdie studente verwag om 'n verslag oor hul vakansie-opleiding te voltooi, wat (saam met die werkgewer se verslag) kort na voltooiing van die opleiding by die Universiteit ingelewer moet word.

ENG.3.4 EQUIPMENT / TOERUSTING

A lecturer has the right, with the consent of the School 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 first year of study, every student must have a laptop. The laptop must be Windows compatible with a hard disk and colour monitor. All assignments in all modules in the Faculty must be completed using a word processing package.

'n Dosent het die reg om, met toestemming van die Skooldirekteur, van studente te verwag om sekere basiese apparaat, rekenaartoerusting, programmatuur, komponente of ander verbruikbare items aan te koop, waar die besit van sodanige toerusting of verbruiksitems die waarde van die module sal verhoog. By oorweging van die verhoging in waarde van die module, moet die dosent die omvang van die uitgawes streng in ag neem.

Daar word van elke student verwag om vanaf die eerste studiejaar 'n skootrekenaar te besit. Die skootrekenaar moet Windows aanpasbaar wees met 'n hardeskyf en kleurskerm. Alle werkstukke in alle modules in die Fakulteit moet voltooi word met behulp van 'n woordverwerkingspakket.

ENG.3.5 NETWORK SERVICES / NETWERKDIENSTE

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

Access to these services will be supplied by the LAN and WiFi 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 utilised 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.

Dit word van alle studente in die Fakulteit Ingenieurswese verwag om volle toegang tot internasionale e-pos, Internet en WWW-fasiliteite te hê ten einde hulle by te staan in die voltooiing van hulle studies.

Toegang tot hierdie dienste sal deur die Skole se LAN en WiFi via die Uninet verskaf word met die samewerking en onder die finale beheer van die afdeling Inligtingstegnologie Potchefstroomkampus.

Alle regulasies deur die Universiteit uitgereik en soos van tyd tot tyd gewysig ten opsigte van die gebruik van die Universiteit se rekenaarfasiliteite, sal ook op hierdie studente en die dienste deur hulle gebruik, van toepassing wees. Regulasies deur die Fakulteit Ingenieurswese uitgereik en van tyd tot tyd gewysig, sal ook betrekking hê. Enige oortreding van hierdie regulasies kan of sal tot dissiplinêre stappe lei.

ENG.4 SCHOOLS IN THE FACULTY OF ENGINEERING / SKOLE IN DIE FAKULTEIT

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

Die Fakulteit Ingenieurswese bestaan uit vier skole. Elke skool word deur 'n direkteur bestuur. In elke skool is daar verskillende programme met programleiers. Die skole is veral verantwoordelik vir die onderrig van voorgraadse en nagraadse programme.

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 Minerals Processing
School of Electrical, Electronic and Computer Engineering	• Electrical and Electronic Engineering • Computer and Electronic Engineering • Mechatronic Engineering
School of Mechanical Engineering	• Mechanical Engineering • Electromechanical Engineering
School of Industrial Engineering	• Industrial Engineering

Die onderskeie skole en programme (voorgraads) is die volgende:

Skool	***Programme***
Skool vir Chemiese en Mineraal Ingenieurswese	• *Chemiese Ingenieurswese* • *Chemiese Ingenieurswese met Mineraal-prosessering*
Skool vir Elektriese, Elektroniese en Rekenaar Ingenieurswese	• *Elektriese en Elektroniese Ingenieurswese* • *Rekenaar- en Elektroniese Ingenieurswese* • *Megatroniese Ingenieurswese*
Skool vir Meganiese Ingenieurswese	• *Meganiese Ingenieurswese* • *Elektromeganiese Ingenieurswese*
Skool vir Bedryfsingenieurswese	• *Bedryfsingenieurswese*

ENG.5 QUALIFICATIONS, PROGRAMMES AND CURRICULA / KWALIFIKASIES, PROGRAMME EN KURRIKULUMS

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

In die Fakulteit Ingenieurswese kan verskillende kwalifikasies (grade) verwerf word. 'n Bepaalde kwalifikasie (voorgraads) kan in een van agt rigtings verwerf word. In elke program word 'n vaste kurrikulum gevolg.

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

Inligting oor en die reëls vir die verskillende kwalifikasies, studierigtings/programme en kurrikulums, vir voorgraadse studie, word in hierdie jaarboek uiteengesit. Vir inligting oor nagraadse opleiding kan die nagraadse jaarboek geraadpleeg word.

FIRST BACHELOR'S DEGREES				
Qualification	**Curriculum code**	**Qualification Programme code**	**Method of Delivery**	**NQF Level**
Bachelor of Engineering in Chemical Engineering	I421P	7CG K01	Full-time	8
Bachelor of Engineering in Chemical Engineering with Minerals Processing	I422P	7CG K02	Full-time	8
Bachelor of Engineering in Electrical and Electronic Engineering	I423P	7CN K01	Full-time	8
Bachelor of Engineering in Computer and Electronic Engineering	I424P	7CH K01	Full-time	8
Bachelor of Engineering in Electromechanical Engineering	I425P	7CL K01	Full-time	8
Bachelor of Engineering in Mechatronics Engineering	I401P	7CR K01	Full-time	8
Bachelor of Engineering in Mechanical Engineering	I426P	7CJ K01	Full-time	8
Bachelor of Engineering in Industrial Engineering	I437P	7CK K01	Full-time	8

EERSTE BACCALAUREUSGRADE				
Kwalifikasie	***Kurrikulum kode***	***Kwalifikasie Programme kode***	***Metode van lewering***	***HOKR-vlak***
Baccalaureus Ingeneriae in Chemiese Ingenieurswese	*I421P*	*7CG K01*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Chemiese Ingenieurswese met Mineraalprosessering	*I422P*	*7CG K02*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Elektriese en Elektroniese Ingenieurswese	*I423P*	*7CN K01*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Rekenaar- en Elektroniese Ingenieurswese	*I424P*	*7CH K01*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Elektromeganiese Ingenieurswese	*I425P*	*7CL K01*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Megatroniese Ingenieurswese	*I401P*	*7CR K01*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Meganiese Ingenieurswese	*I426P*	*7CJ K01*	*Voltyds*	*8*
Baccalaureus Ingeneriae in Bedryfsingenieurswese	*I437P*	*7CK K01*	*Voltyds*	*8*

ENG.5.1 BACHELOR OF ENGINEERING (BENG) / BACCALAUREUS INGENERIAE (BING)

The BEng degree can be obtained in one of eight programmes:

- Chemical Engineering
- Chemical Engineering with Minerals Processing
- Electrical and Electronic Engineering
- Computer and Electronic Engineering
- Electromechanical Engineering
- Mechatronic Engineering
- Mechanical Engineering
- Industrial 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 and programme manager.

Die BIng-kwalifikasie kan in een van agt rigtings verwerf word:

- *Chemiese Ingenieurswese*
- *Chemiese Ingenieurswese met Mineraalprosessering*
- *Elektriese en Elektroniese Ingenieurswese*
- *Rekenaar- en Elektroniese Ingenieurswese*
- *Elektromeganiese Ingenieurswese*
- *Megatroniese Ingenieurswese*
- *Meganiese Ingenieurswese*
- *Bedryfsingenieurswese*

Die programme, wat hieronder in besonderhede beskryf word, kan slegs voltyds geneem word. Studente kan tydens hulle studie met die toestemming van die betrokke Skooldirekteur van program verander of die program waarvoor hulle ingeskryf is, wysig.

ENG.5.2 COMPOSITION OF THE CURRICULA / SAMESTELLING VAN KURRIKULUMS

Purpose of the qualification / *Doel van die kwalifikasie*

The purpose of the BEng qualification, as stipulated by ECSA, is to build the necessary knowledge, understanding, abilities and skills required for further learning towards becoming a competent practising engineer. The recognised purpose of this bachelor's degree in engineering, accredited as satisfying this standard is to provide graduates with:

1. Preparation for careers in engineering and related areas, for achieving technical leadership and to contribute to the economy and national development;

2. The educational requirement towards registration as a Professional Engineer with the Engineering Council of South Africa as well as to allow the graduate to make careers in engineering and related fields;

3. A thorough grounding in mathematics, natural sciences, engineering sciences, engineering modelling, engineering design and the abilities to enable applications in fields of emerging knowledge together with an appreciation for the world and society in which engineering is practised; and

4. For graduates with an appropriate level of achievement in the programme, the ability to proceed to postgraduate studies in both course-based and research-based masters programmes.

Die doel van die BIng-kwalifikasie, soos bepaal deur ECSA, is om die nodige kennis, begrip, vermoëns en vaardighede wat nodig is vir verdere leer oor te dra om 'n bevoegde praktiserende ingenieur te word. Die erkende doel van die baccalaureusgraad in ingenieurswese, geakkrediteer as bereiking van hierdie standaard, is om gegradueerdes te voorsien van:

1. *Voorbereiding vir loopbane in ingenieurswese en verwante gebiede, vir die bereiking van tegniese leierskap en om 'n bydrae tot die ekonomie en nasionale ontwikkeling te maak.*

2. *Die opvoedkundige vereiste vir registrasie as 'n Professionele Ingenieur by die Ingenieursraad van Suid-Afrika, sowel as om die gegradueerdes in staat te stel om loopbane in ingenieurswese en verwante dissiplines te maak.*

3. *'n Deeglike grondslag in wiskunde, natuurwetenskappe, ingenieurswese, ingenieursmodellering, ingenieursontwerp en die vermoë om toepassings in die velde van opkomende kennis te maak, tesame met 'n waardering vir die wêreld en die samelewing waarin ingenieurswese beoefen word.*

4. *Vir gegradueerdes met 'n toepaslike vlak van prestasie in die program, die vermoë om voort te gaan met nagraadse studie in beide kursus-gebaseerde en navorsing-gebaseerde magisterprogramme.*

Qualification outcomes / *Kwalifikasie uitkomste*

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.

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.

Die kurrikulum vir die eerste studiejaar bestaan hoofsaaklik uit die natuurwetenskapmodules, naamlik Chemie, Wiskunde, Toegepaste Wiskunde, Fisika en Rekenaarprogrammering. Sekere inleidende ingenieurswesemodules word ook aangebied in die eerste jaar.

In die tweede studiejaar word meer ingenieurswetenskapmodules aangebied, tesame met geselekteerde natuurwetenskapmodules, wat verskil vir die verskillende rigtings.

Die kurrikulums vir die derde en vierde studiejare bestaan hoofsaaklik uit ingenieurswetenskapmodules met 'n paar wetenskap- en bestuursmodules. In die finale jaar val die klem op ontwerp en sintese, met ontwerp- en projek-modules wat 'n belangrike deel uitmaak.

Terwyl formele modules in rekenaarwetenskap en inligtingstegnologie tot tweedejaarsvlak aangebied word, word groot klem regdeur die kurrikulum op rekenaartoepassings in ingenieurswese geplaas.

ENG.5.2.1 ECSA Graduate Attributes / ECSA *Graduandi-Eienskappe*

The curricula of all the undergraduate engineering programmes at the NWU are compiled in order to comply with the graduate attributes required by the Engineering Council of South Africa, namely:

Outcome 1: Engineering problem-solving;
Outcome 2: Application of scientific and engineering knowledge;
Outcome 3: Engineering design and synthesis;
Outcome 4: Investigations, experiments and data analysis;
Outcome 5: Engineering methods, skills and tools, including information technology;
Outcome 6: Professional and technical communication;
Outcome 7: Sustainability and impact of engineering activity;
Outcome 8: Individual, team and multidisciplinary working;
Outcome 9: Independent learning ability;
Outcome 10: Engineering professionalism; and
Outcome 11: Engineering management.

Die leerplanne van al die voorgraadse ingenieursweseprogramme by die NWU is saamgestel om te voldoen aan die graduandi-eienskappe soos vereis deur die Ingenieursraad van Suid-Afrika, naamlik:

Uitkoms 1: Ingenieursprobleemoplossing;
Uitkoms 2: Toepassing van wetenskaplike en ingenieurskennis;
Uitkoms 3: Ingenieursontwerp en sintese;
Uitkoms 4: Ondersoeke, eksperimente en data-analise;
Uitkoms 5: Ingenieursmetodes, vaardighede en gereedskap, insluitende inligtingstegnologie;
Uitkoms 6: Professionele en tegniese kommunikasie;
Uitkoms 7: Volhoubaarheid en impak van ingenieursaktiwiteite;
Uitkoms 8: Individuele, span- en multidissiplinêre samewerking;
Uitkoms 9: Onafhanklike leervermoë;
Uitkoms 10: Ingenieursprofessionalisme; en
Uitkoms 11: Ingenieursbestuur.

ENG.5.2.2 Articulation possibilities / *Artikulasiemoontlikhede*

The graduate attributes ensure that a graduate of a programme meeting these standards would meet requirements for entry to a number of programmes including:

- A candidacy programme toward registration as a Professional Engineer;
- Formal specialist study toward the Postgraduate Diplomas in Engineering;
- Research master's programmes leading to master's degrees in Engineering;
- With appropriate work experience, a Master of Business Administration or similar;
- In certain disciplines, progression toward the Government Certificate of Competency.

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

Die uittreevlakuitkomste verseker dat 'n gegradueerde van 'n program wat aan hierdie standaarde voldoen, sal voldoen aan die vereistes vir toelating tot 'n aantal programme, insluitend:

- *'n Kandidaatprogram met die oog op registrasie as 'n Professionele Ingenieur;*
- *Formele spesialis-studie vir Nagraadse Diplomas in Ingenieurswese;*
- *Navorsingsmeestersgraadsprogramme wat lei tot meestersgrade in Ingenieurswese;*
- *Met toepaslike werksondervinding, 'n Meestersgraad in Besigheidsadministrasie of soortgelyk; en*
- *In sekere dissiplines, studie met die oog op die Regeringsertifikaat van Bevoegdheid.*

Die basiese en toegepaste vaardighede wat die gegradueerdes met hierdie kwalifikasie verwerf in wiskundige, rekenaar- en basiese wetenskaplike dissiplines en ingenieurswese, sal hulle toerus om voort te gaan met studie in verskeie gespesialiseerde vakgebiede aan ander inrigtings.

ENG.5.2.3 Knowledge / *Kennis*

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.

Aan die einde van sy/haar suksesvolle studie sal die student oor wetenskaplike kennis en insig beskik wat oor een of meer vakgebiede strek. Dit sluit in feitekennis, maar veral ook kennis van en insig in begrippe, strukture, prosedures, modelle, teorieë, beginsels, navorsingsmetodes en die plek en grense van die wetenskap in die menslike lewe.

ENG.5.2.4 Skills / *Vaardighede*

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.

Na suksesvolle voltooiing van hierdie kwalifikasie sal die student die volgende vaardighede hê:

- *Die vermoë om konvergerende en divergerende ingenieursprobleme, kreatief en innoverend te identifiseer, te assesseer, te formuleer en op te los.*
- *Die vermoë om vanaf eerste beginsels wiskundige, basiese wetenskaplike en ingenieurswetenskaplike kennis aan te wend om ingenieursprobleme op te los.*
- *Die vermoë om prosedurele en nie-prosedurele ontwerp en sintese van komponente, sisteme, ingenieurswerke, produkte of prosesse kreatief uit te voer.*
- *Die vermoë om ondersoeke en eksperimente te ontwerp en om ondersoeke uit te voer.*
- *Die vermoë om toepaslike ingenieursmetodes, vaardighede en gereedskap, insluitende inligtingstegnologie, te gebruik.*
- *Die vermoë om, beide mondeling en skriftelik effektief te kommunikeer met ingenieursgehore en die breë gemeenskap.*

ENG.5.2.5 Values / *Waardes*

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.

Die volgende waardes word nagestreef:

Kritiese bewustheid van die impak van ingenieursaktiwiteite op die sosiale, industriële en fisiese omgewing.

Die vermoë om effektief as 'n individu, in spanne en in multidissiplinêre omgewings te werk.

Die vermoë om deur goedontwikkelde leervaardighede onafhanklike leer te onderneem.

Die vermoë om 'n kritiese bewustheid van die noodsaaklikheid om professioneel en eties op te tree te toon en om te beoordeel en verantwoordelikheid te aanvaar binne die grense van eie bevoegdheid.

ENG.5.3 PHASING IN AND OUT OF PROGRAMMES/CURRICULA / IN- EN UITFASEER VAN PROGRAMME/KURRIKULUMS

The directors of all applicable schools, in consultation with the subject chairs/programme managers, issue transitional rules where necessary in order to facilitate the transition from existing programmes to new programmes.

If the curriculum for which a student registered in the previous year was amended in this calendar, the student's curriculum will be adjusted to correspond with the version in this calendar. If at all possible, adjustments will be made in such a manner that a student's study load is not increased.

Die direkteur van elke betrokke skool, in oorleg met die vakvoorsitters/ programbestuurders, reik waar nodig oorgangsreëls uit ten einde die oorgang van bestaande programme na nuwe programme moontlik te maak.

Indien die kurrikulum waarvoor 'n student in 'n voorafgaande jaar geregistreer het in hierdie jaarboek gewysig is, sal die student se kurrikulum aangepas word om in ooreenstemming te wees met die weergawe in hierdie jaarboek. Indien enigsins moontlik sal aanpassings so gedoen word dat 'n student se studielas nie daardeur verswaar word nie.

ENG.6 SCHOOL OF CHEMICAL AND MINERALS ENGINEERING

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

Twee BIng-programme, Chemiese Ingenieurswese en Chemiese Ingenieurswese met Mineraalprosessering, word binne dié Skool aangebied.

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.

Chemiese Ingenieurs is betrokke in die navorsing, ontwerp, ontwikkel en bestuur van industriële prosesse waarby roumateriale na produkte met hoër ekonomiese waarde omgesit word.

Chemiese ingenieurswese behels die navorsing, ontwikkeling, konstruksie, bedryf en bestuur van daardie industriële prosesse waarby grondstowwe deur middel van chemiese of fisiese veranderings tot produkte met ’n hoër ekonomiese waarde verwerk word. Sulke prosesse bestaan in die gebiede van plastiek, kunsvesels, petrolraffinering, plofstowwe, voedselverwerking, misstowwe, farmaseutiese middele en kerninstallasies. Die moderne chemiese ingenieur kan by enige stadium vanaf die konsepsie van ’n proses tot by die verkoop van die finale produk betrokke wees.

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

Mineraalprosessering is ’n spesialisveld in Chemiese Ingenieurswese en behels die fisiese en chemiese prosesse wat gebruik word om metale te ontgin.

ENG.6.1 CHANGING A PROGRAMME

During their study, students may only change their programme with the consent of the School Director. Studente mag slegs met die Direkteur se toestemming programme ruil gedurende hulle studie tydperk.

ENG.6.2 TOTAL PROGRAMME CREDITS

A fixed curriculum is followed for the programmes presented in this School, with the credits spread over four years of study. For a detailed breakdown of the total programme credits, credits per semester, and credits per module, refer to the curricula below.

ENG.6.3 CURRICULA

ENG.6.3.1.1 BEng in Chemical Engineering (7CG K01 – I421P)

Programme: BEng in Chemical Engineering
Qualification code: 7CG K01 – I421P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CEMI112	Materials and Corrosion	H	8
CMPG111	Introduction to Computers and Programming	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
NCHE111	Introductory Inorganic and Physical Chemistry	H	12
NPHY111	Basic Physics I	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
CEMI121	Process Principles I	H	16
CMPG121	Structured Programming	H	12
MTHS121	Introductory Algebra and Calculus II	H	12
NCHE121	Organic Chemistry I	H	12
NPHY121	Basic Physics II	H	12
PPEP171	Practical Engineering Practice	X	8

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
CEMI213	Electrotechnics for Chemical Engineers	H	8
CEMI214	Biotechnology I	H	8
FENG211	Understanding the World of Engineering	X	12
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
NCHE211	Analytical Chemistry II	H	8

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM222	Numerical Methods	H	8
CEMI222	Chemical Thermodynamics I	H	16
CEMI224	Process Principles II	H	8
INGF221	Engineering Communications	H	8
MTHS223	Engineering Analysis	H	8
MTHS224	Applied Linear Algebra	H	8
NCHE222	Organic Chemistry II	H	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM312	Numerical Methods for Partial Differential Equations	H	16
CEMI311	Transport Phenomena I	H	16
CEMI313	Chemical Thermodynamics II	H	16
CEMI316	Particle Systems	H	16
INGB311	Engineering Economics	H	12
STTK312	Engineering Statistics	H	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI321	Transport Phenomena II	H	16
CEMI322	Separation Processes I	H	16
CEMI323	Chemical Reactor Theory I	H	16
CEMI326	Process Modelling for Control	H	16
FENG321	Engineering in the South African and Global Context	H	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
BIOT411	Biotechnology II	H	16
CEMI411	Separation Processes II	H	16
CEMI415	Chemical Reactor Theory II	H	16
CEMI417	Process Control	H	16
FENG411	Engineering Management	H	8

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

BEng in Chemical Engineering							
Qualification Programme code: 7CG K01 – I421P							
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.
68	84	68	64	92	76	72	68
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**132**		**168**		**140**	
Total credits of programme: 592							

ENG.6.3.2.1 BEng in Chemical Engineering with Minerals Processing (7CG K02-I422P)

Programme: BEng in Chemical Engineering with Minerals Processing
Qualification code: 7CG K02 – I422P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CEMI112	Materials and Corrosion	H	8
CMPG111	Introduction to Computers and Programming	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
NCHE111	Introductory Inorganic and Physical Chemistry	H	12
NPHY111	Basic Physics I	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
CEMI121	Process Principles I	H	16
CMPG121	Structured Programming	H	12
MTHS121	Introductory Algebra and Calculus II	H	12
NCHE121	Organic Chemistry I	H	12
NPHY121	Basic Physics II	H	12
PPEP171	Practical Engineering Practice	X	8

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
CEMI213	Electrotechnics for Chemical Engineers	H	8
CEMI215	Geology for Process Engineers	H	16
FENG211	Understanding the World of Engineering	X	12
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
NCHE211	Analytical Chemistry II	H	8

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM222	Numerical Methods	H	8
CEMI222	Chemical Thermodynamics I	H	16
CEMI224	Process Principles II	H	8
INGF221	Engineering Communications	H	8
MTHS223	Engineering Analysis	H	8
MTHS224	Applied Linear Algebra	H	8
NCHE222	Organic Chemistry II	H	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM312	Numerical Methods for Partial Differential Equations	H	16
CEMI311	Transport Phenomena I	H	16
CEMI313	Chemical Thermodynamics II	H	16
CEMI316	Particle Systems	H	16
INGB311	Engineering Economics	H	12
STTK312	Engineering Statistics	H	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
CEMI321	Transport Phenomena II	H	16
CEMI322	Separation Processes I	H	16
CEMI323	Chemical Reactor Theory I	H	16
CEMI326	Process Modelling for Control	H	16
FENG321	Engineering in the South African and global context	H	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
CEMI411	Separation Processes II	H	16
CEMI417	Process Control	H	16
CEMI418	Ore Dressing	H	16
CEMI419	Pyrometallurgy	H	16
FENG411	Engineering Management	H	8

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

BEng in Chemical Engineering with Minerals Processing							
Qualification Programme code: 7CG K02 - I422P							
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.
68	84	76	64	92	76	72	68
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**140**		**168**		**140**	
Total credits of programme: 600							

ENG.7 SCHOOL OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

Three BEng programmes, Electrical and Electronic Engineering, Computer and Electronic Engineering, and a new programme in Mechatronic Engineering (started in 2021) are offered in this School.

Drie BIng-programme, Elektriese en Elektroniese Ingenieurswese, Rekenaar- en Elektroniese Ingenieurswese en 'n nuwe program Megatroniese Ingenieurswese (vanaf 2021) word binne dié Skool aangebied.

Electrical and Electronic Engineering

NWU Electrical and Electronic Engineers enable the modern world by moving electrical energy from the source to the point of application. They do this as efficiently as possible, by applying their knowledge of power systems, power conversion, power conditioning, and electrical machines. Training provided by leading experts in power quality, power electronics and electrical machines, sets NWU Electrical and Electronic Engineers apart in industry. Our engineers set the pace in power utilities and electrical consulting industries and relate well to the challenges of utilising renewable energy sources as part of the energy solution of the future.

Elektriese en Elektroniese Ingenieurs *bemagtig die moderne wêreld deur elektriese energie te verskuif vanaf 'n bron na 'n punt waar dit aangewend kan word. Hulle doen dit so effektief as moontlik, deur hul kennis van kragstelsels, -omskakeling, -kondisionering en elektriese masjiene toe te pas. Opleiding wat aangebied word deur leiers op die gebied van kragkwaliteit, drywingselektronika en elektriese masjiene, onderskei NWU Elektriese en Elektroniese Ingenieurs in die industrie. Ons ingenieurs neem die voortou by elektrisiteitsvoorsieningsmaatskappye sowel as elektriese konsultasie maatskappye. Hul begryp ook die uitdagings wat die implementering van hernubare energiebronne as 'n tegnologie van die toekoms bied.*

Computer and Electronic Engineering

NWU Computer and Electronic Engineers make the world a more efficient place by connecting humans and the world we live in to the digital world of computer systems and the internet. They do this by using electronics, embedded computers and the skill of programming to control mechatronic systems and to build the internet of things. Their end-to-end design experience makes NWU Computer and Electronic Engineers highly desirable in industries ranging from telecommunications, process control, and aviation through to the banking sector and software development companies.

Rekenaar- en Elektroniese Ingenieurs *maak die wêreld 'n beter plek deur mense en die wêreld waarin ons leef, aan die digitale wêreld van rekenaarstelsels en die internet te verbind. Hulle doen dit, deur gebruik te maak van elektronika, versonke rekenaars en die vaardigheid van programmering, ten einde megatroniese stelsels te beheer en die "internet van goeters" te realiseer. Hul begin-tot-einde ervaring in ontwerp maak NWU Rekenaar en Elektroniese Ingenieurs hoogs gesog in industrieë wat strek vanaf telekommunikasie, prosesbeheer en lugvaart, regdeur tot die bankwese en sagteware ontwikkelingsmaatskappye.*

Mechatronic Engineering
Mechatronic engineering, which is also referred to as mechatronics, is a multidisciplinary branch of engineering that focuses on the engineering of electrical as well as mechanical systems, and also includes a combination of robotics, electronics, computer, telecommunications, systems, control, and product engineering.

As technology advances over time, various subfields of engineering have succeeded in both adapting and multiplying. The intention of mechatronics is to produce a design solution that unifies each of these various subfields. Originally, the field of mechatronics was intended to be nothing more than a combination of mechanics and electronics, hence the name being a portmanteau of mechanics and electronics. However, as the complexity of technical systems continued to evolve, the definition was broadened to include more technical areas.

ENG.7.1 CHANGING A PROGRAMME

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

Studente kan tydens hulle studie, slegs met die toestemming van die betrokke Skooldirekteur, van program verander.

ENG.7.2 TOTAL PROGRAMME CREDITS

A fixed curriculum is followed for the programmes presented in this School, with the credits spread over four years of study. For a detailed breakdown of the total programme credits, credits per semester, and credits per module, refer to the curricula below.

ENG.7.3 CURRICULA

ENG.7.3.1.1 BEng in Electrical and Electronic Engineering (7CN K01 – I423P)

Programme: BEng in Electrical and Electronic Engineering
Qualification code: 7CN K01 – I423P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
INGM111	Engineering Graphics I	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
NPHY111	Basic Physics I	H	12
REII111	Introduction to Digital Systems	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
INGM122	Materials Science I	H	16
MTHS121	Introductory Algebra and Calculus II	H	12
NPHY121	Basic Physics II	H	12
REII121	Introduction to Microcontrollers	H	12
PPEP171	Practical Engineering Practice	X	8

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI215	Electrotechnique II	H	8
NPHY211	Electricity and Magnetism	H	8
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
REII211	Algorithms and Optimisation	H	8
FENG211	Understanding the World of Engineering	X	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI221	Electrical Systems I	H	16
EERI222	Signal Theory I	H	16
EERI223	Electronics I	H	16
EERI224	Linear Systems	H	12
APPM222	Numerical Methods	H	8
MTHS223	Engineering Analysis	H	8
MTHS224	Applied Linear Algebra	H	8
INGF221	Engineering Communication	H	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI311	Electrical Systems II	H	16
EERI313	Electromagnetics	H	16
EERI318	Electronics II	H	16
STTK312	Engineering Statistics	H	16
INGB311	Engineering Economics	H	12

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EEII321	Power Systems I	H	16
EEII327	Electrical Design	H	16
EERI325	Signal Theory II	H	16
EERI321	Control Theory I	H	16
EERI324	Principles of Measurement	H	12
FENG321	Engineering in the South African and Global Context	X	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
EEII413	Power Electronics	H	16
EEII414	Power Systems II	H	16
EERI414	Signal Theory III	H	16
EERI418	Control Theory II	H	16
FENG411	Engineering Management	H	8

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EEII423	Power Systems III	H	16
FENG421	Engineering Professionalism	H	8
EERI474	Project	H	24
EERI471	Vacation Training seniors	X	8

BEng in Electrical and Electronic Engineering							
Qualification Programme code: 7CN K01 – I423P							
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.
72	80	68	92	76	88	72	56
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**160**		**164**		**128**	
Total credits of programme: 604							

ENG.7.3.2.1 BEng in Computer and Electronic Engineering (7CH K01 – I424P)

Programme: BEng in Computer and Electronic Engineering
Qualification code: 7CH K01 – I424P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
INGM111	Engineering Graphics I	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
NPHY111	Basic Physics I	H	12
REII111	Introduction to Digital Systems	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
INGM122	Materials Science I	H	16
MTHS121	Introductory Algebra and Calculus II	H	12
NPHY121	Basic Physics II	H	12
REII121	Introduction to Microcontrollers	H	12
PPEP171	Practical Engineering Practice	X	8

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI215	Electrotechnique II	H	8
NPHY211	Electricity and Magnetism	H	8
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
REII211	Algorithms and Optimisation	H	8
FENG211	Understanding the World of Engineering	X	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI222	Signal Theory I	H	16
EERI223	Electronics I	H	16
EERI224	Linear Systems	H	12
APPM222	Numerical Methods	H	8
MTHS223	Engineering Analysis	H	8
MTHS224	Applied Linear Algebra	H	8
REII222	Embedded Systems	H	12
INGF221	Engineering Communication	H	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI313	Electromagnetics	H	16
EERI318	Electronics II	H	16
REII312	Network Fundamentals	H	16
REII313	Object-oriented Software Development	H	16
STTK312	Engineering Statistics	H	16
INGB311	Engineering Economics	H	12

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI321	Control Theory I	H	16
REII323	Embedded Operating Systems	H	16
REII327	Computer Engineering Design	H	16
EERI325	Signal Theory II	H	16
EERI324	Principles of Measurement	H	12
FENG321	Engineering in the South African and Global Context	X	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI414	Signal Theory III	H	16
EERI415	Telecommunication Systems	H	16
EERI418	Control Theory II	H	16
REII414	Databases and Web-programming	H	16
FENG411	Engineering Management	H	8

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
REII425	Data Analytics and Machine Learning	H	16
EERI471	Vacation Training seniors	X	8
FENG421	Engineering Professionalism	H	8
EERI474	Project	H	24

BEng in Computer and Electronic Engineering							
Qualification Programme code: 7CH K01 – I424P							
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.
72	80	68	88	92	88	72	56
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**156**		**180**		**128**	
Total credits of programme: 616							

ENG.7.3.3.1 BEng in Mechatronic Engineering (7CR K01 – I401P)

Programme: BEng in Mechatronic Engineering

Qualification code: 7CR K01 – I401P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
NPHY111	Basic Physics I	H	12
REII111	Introduction to Digital Systems	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
INGM111	Engineering Graphics I	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
REII121	Introduction to Microcontrollers	H	12
INGM122	Materials Science I	H	16
NPHY121	Basic Physics II	H	12
MTHS121	Introductory Algebra and Calculus II	H	12
PPEP171	Practical Engineering Practice (Year module)	X	8

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
EERI215	Electrotechnique II	H	8
REII211	Algorithms & Optimisation	H	8
INGM211	Engineering Materials I	H	12
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
FENG211	Understanding the World of Engineering	X	12
NPHY211	Electricity and Magnetism	H	8

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM222	Numerical Methods	H	8
EERI222	Signal Theory I	H	16
EERI223	Electronics I	H	16
INGM225	Strength of Materials I	H	12
MTHS224	Applied Linear Algebra	H	8
INGF221	Engineering Communication	H	12
APPM221	Dynamics II	H	8
REII222	Embedded Systems	H	12

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
MCTR311	Dynamic Systems Modelling	H	12
REII312	Network Fundamentals	H	16
REII313	Object-oriented Software Development	H	16
STTK312	Engineering Statistics	H	16
INGB311	Engineering Economics	H	12
INGM313	Strength of Materials II	H	12

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI324	Principles of Measurement	H	12
EERI321	Control Theory I	H	16
MCTR327	Mechatronic Design	H	16
REII323	Embedded Operating Systems	H	16
FENG321	Engineering in the South African and Global context	H	12

ENG.8 SCHOOL OF MECHANICAL ENGINEERING

Two BEng programmes, Mechanical Engineering and Electromechanical Engineering, are offered in this School.

Twee BIng-programme, Meganiese Ingenieurswese en Elektromeganiese Ingenieurswese, word in hierdie skool aangebied.

Mechanical Engineering

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

The Mechanical Engineering programme maintains a good balance between teaching and learning 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.

Meganiese Ingenieurswese

Meganiese Ingenieurs is betrokke by die ontwikkeling, vervaardiging, bestuur en onderhoud van vervoer-, energieomsetting-, vervaarding-, opwekking-, wapen-, verkoeling- en verhittingstelsels. Daarby word hulle kundigheid ook in bedryfsinstallasies, prosestoerusting, vervaardigingsmasjinerie en myn toerusting toegepas.

Die Meganiese Ingenieurswese kursus handhaaf 'n goeie balans tussen opleiding in die basiese wetenskappe, ingenieurswetenskappe en ontwerp. Groot klem word deurgaans op kreatiewe sintese (ontwerp) geplaas, ten einde ingenieurs in staat te stel om hulle kennis aan te wend om oplossings vir ingewikkelde tegnologiese probleme te kan vind.

Electromechanical Engineering

NWU Electromechanical Engineers ensure the safe and efficient operations of plants and factories by combining elements of electrical and mechanical engineering. Their knowledge of electrical machines, power electronics, mechanical design and thermal flow systems make them invaluable to the industry. Our engineers will serve the Mining, Materials Handling, Power Generation, Chemical, Oil and Gas industries.

Elektromeganiese Ingenieurs *verseker die veilige en effektiewe werking van aanlegte en fabrieke, deur elemente van elektriese en meganiese ingenieurswese te gebruik. Hulle kennis van elektriese masjiene, drywingselektronika, ontwerp van meganiese komponente en fundamentele kennis in termovloeistelsels maak hulle van onskatbare waarde vir die industrie. Ons ingenieurs sal dien in die Mynbou, Materiaalhanterings, Kragopwekking sowel as Chemiese, Olie en Gasindustriële.*

ENG.8.1 CHANGING A PROGRAMME

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

Studente kan tydens hulle studie, slegs met die toestemming van die betrokke Skooldirekteur, van program verander.

ENG.8.2 TOTAL PROGRAMME CREDITS

A fixed curriculum is followed for the programmes presented in this School, with the credits spread over four years of study. For a detailed breakdown of the total programme credits, credits per semester, and credits per module, refer to the curricula below.

ENG.8.3 CURRICULA

ENG.8.3.1.1 BEng in Mechanical Engineering (7CJ K01 – I426P)

Programme: BEng in Mechanical Engineering
Qualification code: 7CJ K01 – I426P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
INGM111	Engineering Graphics I	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
NCHE111	Introductory Inorganic and Physical Chemistry	H	12
NPHY111	Basic Physics I	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
INGM121	Engineering Graphics II	H	12
INGM122	Materials Science	H	16
MTHS121	Introductory Algebra and Calculus II	H	12
NPHY121	Basic Physics II	H	12
PPEP171	Practical Engineering Practice	X	8

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
EERI215	Electrotechnique II	H	8
REII211	Algorithms & Optimization	H	8
INGM212	Engineering Materials	H	12
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
FENG211	Understanding the World of Engineering	X	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM221	Dynamics II	H	8
INGM225	Strength of Materials I	H	12
INGM222	Thermodynamics I	H	12
INGM223	Manufacturing Technology = INGM423	H	12
INGB224	Optimisation and Numerical Methods	H	16
MTHS223	Engineering Analysis	H	8
INGF221	Engineering Communication	H	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
INGM311	Thermodynamics II	H	12
INGM318	Fluid Mechanics I	H	16
INGM313	Strength of Materials II	H	12
INGM315	Systems Engineering	H	12
INGM316	Machine Dynamics	H	16
STTK312	Engineering Statistics	H	16
INGM371	Vacation training	H	8

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI321	Control Theory I	H	16
EERI324	Principles of Measurement	H	12
INGM324	Fluid Mechanics II	H	12
INGM328	Machine Components	H	16
INGM325	Applied Computer Methods	H	16
FENG321	Engineering in the South African and Global Context	X	12

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
INGM418	Thermal Machines	H	12
INGM412	Heat Transfer	H	12
INGM413	Fluid Machines	H	12
MEGI415	Mechanical Systems Design	H	16
INGB311	Engineering Economics	H	12
FENG411	Engineering Management	H	8

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
INGM426	Failure of Materials	H	12
INGM427	Thermal-Fluid System Design	H	16
INGM479	Project	H	16
FENG421	Engineering Professionalism	H	8

BEng in Mechanical Engineering							
Qualification Programme code: 7CJ K01 - I426P							
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.
72	80	72	76	92	84	72	52
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**148**		**176**		**124**	
Total credits of programme: 600							

ENG.8.3.2.1 BEng in Electromechanical Engineering (7CL K01 – I425P)

Programme: BEng in Electromechanical Engineering
Qualification code: 7CL K01 – I425P

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
INGM111	Engineering Graphics I	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
NPHY111	Basic Physics I	H	12
REII111	Introduction to Digital Systems	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
INGM122	Materials Science I	H	16
MTHS121	Introductory Algebra and Calculus II	H	12
NPHY121	Basic Physics II	H	12
PPEP171	Practical Engineering Practice	X	8
REII121	Introduction to Microcontrollers	H	12

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
EERI215	Electrotechnique II	H	8
REII211	Algorithms & Optimisation	H	8
INGM212	Engineering Materials	H	12
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
FENG211	Understanding the World of Engineering	X	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM222	Numerical Methods	H	8
EERI221	Electrical Systems I	H	16
EERI223	Electronics I	H	16
INGM225	Strength of Materials I	H	12
MTHS223	Engineering Analysis	H	8
INGF221	Engineering Communication	H	8
APPM221	Dynamics II	H	8

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
EERI311	Electrical Systems II	H	16
INGM315	Systems Engineering	H	12
INGM 313	Strength of Materials II	H	12
STTK312	Engineering Statistics	H	16
NPHY211	Electricity and Magnetism	H	8
INGM316	Machine Dynamics	H	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EEII321	Power Systems I	H	16
EERI321	Control Theory I	H	16
EERI324	Principles of Measurement	H	12
FENG321	Engineering in the South African and Global Context	X	12
INEM321	Thermo-fluid sciences	H	16
INGM328	Machine Components	H	16

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
INGB311	Engineering Economics	H	12
EEII413	Power Electronics	H	16
INGM413	Fluid Machines	H	12
FENG411	Engineering Management	H	8

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EEII423	Modern Power Systems	H	16
INGM424	Failure of Materials	H	16
FENG421	Engineering Professionalism	H	8
INEM472	Electromechanical Design (Year Module)	H	32
INEM475	Final Year Project (Year Module)	H	12
INEM471	Vacation Training Seniors	X	8

BEng in Electromechanical Engineering							
Qualification Programme code: 7CL K01- I425P							
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.
72	80	72	76	80	88	48	92
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**148**		**168**		**140**	
Total credits of programme: 608							

ENG.9 SCHOOL OF INDUSTRIAL ENGINEERING

Industrial engineers optimise systems by creatively designing solutions that integrate people, processes, technology and data. Industrial engineering originated more than a century ago during the industrial revolution when industries started to search for the best, cheapest and fastest way to manufacture products. However, today it is imperative to employ industrial engineers in various industries due to the emerging challenges of the Industry 4.0 era and the current demands of the marketplace.

It is an Industrial Engineer who helps airport operations to decide when and from which gate airplanes should depart or in a hospital how many beds and nurses to be allocated to each hospital ward. Whether you are driving a motor vehicle, eating a chocolate bar, using a mobile phone, withdrawing money or donating blood, you can be pretty sure that an Industrial Engineer was involved in the design, manufacture or distribution of that product or service.

Industrial engineers are involved across different organisational levels and are responsible for various tasks. This includes analysis of data and problems, design and optimisation of systems and processes, and the management of operations, projects and maintenance activities. Ultimately, industrial engineers integrate systems, processes, people and technology to improve overall efficiencies and profits in an organisation.

Bedryfsingenieurs optimeer stelsels deur kreatiewe oplossings te ontwerp wat mense, prosesse, tegnologie en data integreer. Bedryfsingenieurswese het meer as 'n eeu gelede tydens die industriële rewolusie onstaan, waartydens nywerhede begin soek het na die beste, goedkoopste en vinnigste manier om produkte te vervaardig. Dit is egter in vandag se tyd noodsaaklik om bedryfsingenieurs aan te stel in verskeie industrieë, as gevolg van die nuwe uitdagings wat daar gestel word deur die Industrie 4.0 era en die nywerheidsbehoefte.

Dit is ’n Bedryfsingenieur wat lughawebestuur help besluit hoe laat en vanaf watter hek af vliegtuie moet vertrek, of hoeveel beddens en verpleegsters daar aan elke saal van 'n hospitaal toegedeel behoort te word. Of jy nou vandag ’n motorvoertuig bestuur, ’n sjokoladestafie eet, ’n selfoon gebruik, geld trek of bloed skenk, jy kan redelik seker wees dat ’n Bedryfsingenieur betrokke was by die ontwerp, vervaardiging of verspreiding van daardie produk of diens.

Bedryfsingenieurs is betrokke op verskillende bestuursvlakke van 'n organisasie en is verantwoordelik vir 'n verskeidenheid van take. Hierdie take kan insluit, die analise van data en probleme, die ontwerp en optimering van stelsels en prosesse, en die bestuur van bedrywighede, projekte en instandhoudingsaktiwiteite. Bedryfsingenieurs integreer stelsels, prosesse, mense en tegnologie ten einde die effektiewiteit en winsgewendheid van 'n organisasie te verbeter.

ENG.9.1 CHANGING A PROGRAMME

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

Studente kan tydens hulle studie, slegs met die toestemming van die betrokke Skooldirekteur, van program verander.

ENG.9.2 TOTAL PROGRAMME CREDITS

A fixed curriculum is followed for the programmes presented in this School, with the credits spread over four years of study. For a detailed breakdown of the total programme credits, credits per semester, and credits per module, refer to the curricula below.

ENG.9.3 CURRICULA

ENG.9.3.1.1 BEng in Industrial Engineering (7CK K01 – I427P)

Programme: BEng in Industrial Engineering
Qualification code: 7CK K01 – I427P **(Phasing out in 2022)**

Phasing out

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
NCHE111	Introductory Inorganic and Physical Chemistry	H	12
NPHY111	Basic Physics I	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
INGM111	Engineering Graphics I	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
INGB121	Process Drawings	H	12
INGM122	Materials Science I	H	16
NPHY121	Basic Physics II	H	12
MTHS121	Introductory Algebra and Calculus II	H	12
PPEP171	Practical Engineering Practice	X	8

Phasing out

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
EERI215	Electrotechnique II	H	8
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
REII211	Algorithms and Optimisation	H	8
WVTS211	Understanding the Technological World	X	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
INGB222	Operations Management for Engineers	H	16
INGB224	Optimisation and Numerical Methods	H	16
INGM222	Thermodynamics I	H	12
LLAW221	Introductory Labour Law	H	12
INGF221	Engineering Communication	X	8

3rd Year 2021

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
INGB311	Engineering Economics	H	12
INGB314	Operational Excellence	H	12
INGB317	Simulation Modelling	H	16
INGB318	Supply Chain Management	H	12
REII313	Object-oriented Software Development	H	16
STTK312	Engineering Statistics	H	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI321	Control Theory	H	16
INGB321	Advanced Optimisation	H	16
INGB322	Statistical Learning for Engineers	H	16
INGM223	Manufacturing Technology	H	12
FENG321	Engineering in the South African and Global Context	X	12

4th Year 2022

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
FENG411	Engineering Managment	H	8
INGB413	Quality Assurance	H	12
INGB417	Facilities Design	H	16
INGM315	Systems Engineering	H	12
REII414	Databases and Web-programming	H	16
INGB419	Business Engineering	H	12

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
INGB472	Decision Support Systems *(year module)*	H	20
INGB471	Vacation Training seniors	X	8
INDE479	Project *(year module)*	H	32

BEng in Industrial Engineering (Phasing out 2022)							
Qualification Programme code: 7CK K01 – I427P							
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.
72	80	60	64	84	72	76	60
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**124**		**156**		**136**	
Total credits of programme: 568							

ENG.9.3.1.2 BEng in Industrial Engineering (7CK K01 – I437P)

Programme: BEng in Industrial Engineering
Qualification code: 7CK K01 – I437P

1st Year 2020 & Onwards

YEAR LEVEL 1			
First semester			
Code	**Module name**	**C/F**	**Cr**
ALDE112	Academic Literacy Development	X	12
CMPG115	Programming for Engineers	H	12
NCHE111	Introductory Inorganic and Physical Chemistry	H	12
NPHY111	Basic Physics I	H	12
MTHS111	Introductory Algebra and Calculus I	H	12
INGM111	Engineering Graphics I	H	12

YEAR LEVEL 1			
Second semester			
Code	**Module name**	**C/F**	**Cr**
APPM121	Statics and Mathematical Modelling	H	12
EERI124	Electrotechnique I	H	8
INGB122	Introduction to Industrial Engineering	H	12
INGM122	Materials Science I	H	16
NPHY121	Basic Physics II	H	12
MTHS121	Introductory Algebra and Calculus II	H	12
PPEP171	Practical Engineering Practice	X	8

2nd Year 2021 & Onwards

YEAR LEVEL 2			
First semester			
Code	**Module name**	**C/F**	**Cr**
APPM211	Dynamics I	H	8
APPM212	Differential Equations	H	8
EERI215	Electrotechnique II	H	8
MTHS211	Advanced Calculus I	H	8
MTHS212	Linear Algebra I	H	8
REII211	Algorithms and Optimisation	H	8
FENG211	Understanding the World of Engineering	X	12

YEAR LEVEL 2			
Second semester			
Code	**Module name**	**C/F**	**Cr**
INEM321	Thermal-Fluid Sciences	H	16
INGB222	Operations Management for Engineers	H	16
INGB224	Optimisation and Numerical Methods	H	16
INGF221	Engineering Communication	X	8
LLAW221	Introductory Labour Law	H	12
STTK222	Statistics for Industrial Engineering	H	16

3rd Year 2022 & Onwards

YEAR LEVEL 3			
First semester			
Code	**Module name**	**C/F**	**Cr**
INGB311	Engineering Economics	H	12
INGB314	Operational Excellence	H	12
INGB317	Simulation Modelling	H	16
INGB318	Supply Chain Management	H	12
REII313	Object-oriented Software Development	H	16

YEAR LEVEL 3			
Second semester			
Code	**Module name**	**C/F**	**Cr**
EERI321	Control Theory	H	16
INGB321	Advanced Optimisation	H	16
INGB322	Statistical Learning for Engineers	H	16
INGM223	Manufacturing Technology	H	12
FENG321	Engineering in the South African and Global Context	X	12

4th Year 2023 & Onwards

YEAR LEVEL 4			
First semester			
Code	**Module name**	**C/F**	**Cr**
FENG411	Engineering Managment	H	8
INGB413	Quality Assurance	H	12
INGB417	Facilities Design	H	16
INGM315	Systems Engineering	H	12
REII414	Databases and Web-programming	H	16
INGB419	Business Engineering	H	12

YEAR LEVEL 4			
Second semester			
Code	**Module name**	**C/F**	**Cr**
INGB472	Decision Support Systems *(year module)*	H	20
INGB471	Vacation Training seniors	X	8
INDE479	Project *(year module)*	H	32

BEng in Industrial Engineering							
Qualification Programme code: 7CK K01 – I437P							
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.
72	80	60	84	68	72	76	60
Total: year level 1		**Total: year level 2**		**Total: year level 3**		**Total: year level 4**	
152		**144**		**140**		**136**	
Total credits of programme: 572							

ENG.10 LIST OF PROGRAMME MODULES / *MODULE LYS*

MODULE TYPES

Core modules [indicated as H]

Those modules that define the character or the essence of the programme of a qualification, often referred to as major subjects. The name of a core module is usually linked to the qualifier and/or programme name. The core modules of a programme usually have a clear progression route from one year to the next although there can be exceptions to this rule.

Usually, the successful completion of a core module at one year level is a prerequisite to register for the succeeding (next level) core module in the same specialisation (General Academic Rules Glossary).

Fundamental modules (non-core module) [indicated as X]

Refers to a compulsory module, usually offered at the first- and/or second-year level of a programme of a qualification, which is necessary to support and ensure better understanding of the outcomes and content of the core modules of a programme.

Successful completion of a fundamental module is usually not a prerequisite for registration for other modules at succeeding levels of a programme (General Academic Rules Glossary).

Additional module [indicated as A]

Any module taken by a student in addition to those required for the formal curriculum of the programme for which the particular student is registered.

Additional modules are thus not recognised for purposes of successful completion of a particular qualification programme. (General Academic Rules Glossary).

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.

ASSESSMENT METHODS

The activity a student must carry out to offer proof of learning, like the writing of a class test or examination, the compilation of a portfolio or project report, the execution of a practical assignment, etc. (General Academic Rules Glossary).

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.

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 are given in the table below. The requirements with respect to assumed learning are given for each module in the last column in the table.
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% must be achieved in that prerequisite module, before the following module may be taken.

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

For all relevant updated information about a specific module, students must consult the Study Guide as well as the E-Fundi website.

A study guide is a document prepared to guide the study of the content of a module with a view to achieving the desired module and learning outcomes. A study guide is developed by an NWU academic staff member or an external subject expert approved and contracted for that purpose. The study guide is developed for a specific mode of delivery, taking the study and academic support needs of the student cohort into account (General Academic Rules Glossary).

Please note that if different module particulars appear for the same module in different Calendars (e.g., Faculty of Natural and Agricultural Sciences), the version in the Calendar of the Faculty that offers the module, will take precedence.

Neem asseblief kennis *dat indien die modulebesonderhede vir dieselfde module in verskillende jaarboeke verskil (bv. dié van die Fakulteit Natuur- en Landbouwetenskappe), die weergawe in die Jaarboek van die fakulteit wat die module aanbied, bepalend sal wees.*

Faculty of Law module / *Fakulteit Regte module*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
LLAW221	Introductory Labour Law / *Inleiding tot Arbeidsreg*	12	None

Faculty of Natural and Agricultural Sciences modules / *Fakulteit Natuurwetenskappe modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
APPM121	Statics and Mathematical Modelling / *Statika en Wiskundige Modellering*	12	MTHS111 and NPHY111 (40%)
APPM211	Dynamics I / *Dinamika I*	8	MTHS111 and MTHS121 and (APPM121 or APPM122)
APPM212	Differential Equations / *Differensiaal-Vergelykings*	8	MTHS111 and MTHS121
APPM221	Dynamics II / *Dinamika II*	8	APPM212 and (APPM121 or APPM122)
APPM222	Numerical Methods / *Numeriese Metodes*	8	MTHS111 and MTHS121
APPM312	Partial Differential Equations (Numerical) / *Parsiële Differensiaalvergelykings (Numeries)*	16	APPM222 and MTHS211 and MTHS212
APPM322	Optimisation / *Optimering*	16	MTHS211 and MTHS212 (APPM211 or APPM213 or MTHS224)
CMPG111	Introduction to Computing and Programming / *Inleiding tot Rekenaarwese en Programmering*	12	None
CMPG115	Programming for Engineers / *Programmering vir Ingenieurs*	12	None
CMPG121	Structured Programming I / *Gestruktureerde Programmering*	12	CMPG111or CMPG115
CMPG322	Decision Support Systems II / *Besluitsteunstelsel II*	16	CMPG312 or REII211 and INGB223
MTHS121	Introductory Algebra and Calculus II / *Inleidende Algebra en Calculus II*	12	MTHS111
MTHS211	Advanced Calculus I / *Gevorderde Calculus*	8	MTHS111 and MTHS121

Faculty of Natural and Agricultural Sciences modules / *Fakulteit Natuurwetenskappe modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
MTHS212	Linear Algebra I / *Lineêre Algebra I*	8	MTHS111 and MTHS121
MTHS223	Engineering Analysis / *Ingenieursanalise*	8	MTHS211 (If student failed MTHS211 with ≤40% in the first semester, they can register for MTHS223) * Only applicable in the same year, not over two or more years.
MTHS224	Applied Linear Algebra / *Toegepaste Lineêre Algebra*	8	MTHS212
NCHE111	Introductory Inorganic and Physical Chemistry / *Inleidende Anorganiese en Fisiese Chemie*	12	None
NCHE121	Organic Chemistry / *Organiese Chemie*	12	None
NCHE211	Analytical Chemistry II / *Analitiese Chemie II*	8	NCHE111 and NCHE121
NCHE222	Organic Chemistry II / *Organiese Chemie II*	8	NCHE111 and NCHE121
NPHY111	Basic Physics I / *Basiese Fisika I*	12	None
NPHY121	Basic Physics II / *Basiese Fisika II*	12	NPHY111 and MTHS111
NPHY211	Electricity and Magnetism / *Elektrisiteit en Magnetisme*	8	NPHY111 and NPHY121 and MTHS121
STTK222	Statistics for Industrial Engineering / *Statistiek vir Bedryfsingenieurswese*	16	MTHS121
STTK312	Engineering Statistics / *Ingenieursstatistiek*	16	MTHS121

Faculty of Engineering modules / *Ingenieurswese modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
ALDE112	Academic Literacy Development	12	ALDE111
BIOT411	Biotechnology II / *Biotegnologie II*	16	CEMI315
CEMI112	Materials and Corrosion / *Materiale en Korrosie* ***Previous code: CEMI211***	8	None
CEMI121	Process Principles I / *Prosesbeginsels I*	16	None
CEMI211	Materials and Corrosion / *Materiale en Korrosie* ***New code: CEMI112***	12	None
CEMI213	Electrotechnics for Chemical Engineers / *Elektrotegniek vir Chemiese Ingenieurs*	8	NPHY121
CEMI215	Geology for Process Engineers / *Geologie vir Prosesingenieurs*	16	None
CEMI222	Chemical Thermodynamics I / *Chemiese Termodinamika I*	16	CEMI121
CEMI224	Process Principles II / *Prosesbeginsels II*	8	CEMI121
CEMI311	Transport Phenomena I / *Oordragbeginsels I*	16	CEMI224
CEMI313	Chemical Thermodynamics II / *Chemiese Termodinamika II*	16	CEMI222 and CEMI224
CEMI315	Biotechnology / *Biotegnologie*	8	None
CEMI316	Particle Systems / *Partikelstelsels*	16	CEMI121
CEMI321	Transport Phenomena II / *Oordragbeginsels II*	16	CEMI311
CEMI322	Separation Processes I / *Skeidingsprosesse I*	16	CEMI313
CEMI323	Chemical Reactor Theory I / *Chemiese Reaktorteorie I*	16	CEMI313
CEMI326	Process Modelling for Control / *Prosesmodellering vir Beheer*	16	CEMI224 and CEMI213 and APPM212
CEMI328	Plant Design I / *Aanlegontwerp I*	12	Co-required: CEMI321 and CEMI323
CEMI411	Separation Processes II / *Skeidingsprosesse II*	16	CEMI313 and CEMI322
CEMI415	Chemical Reactor Theory II / *Chemiese Reaktorteorie II*	16	CEMI313 and CEMI323
CEMI417	Process Control / *Prosesbeheer*	16	CEMI326
CEMI418	Ore Dressing / *Ertsbereiding*	16	CEMI316 and CEMI215
CEMI419	Pyrometallurgy / *Pirometallurgie*	16	CEMI313
CEMI471	Vacation Training seniors / *Vakansie-opleiding seniors*	8	None
CEMI477	Plant Design II / *Aanlegontwerp II*	32	Student must be able to complete the degree in that year with all previous modules passed. Curriculum control will be performed after the first semester

Faculty of Engineering modules / *Ingenieurswese modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
			and if the student is not able to complete the degree in that year, he/she will be deregistered for CEMI477. *Student moes alle voorafgaande modules geslaag het en die graad kan voltooi in daardie jaar. Kurrikulum kontrole sal gedoen word na die eerste semester om die uitkoms van alle modules na te gaan. Indien die student nie die graad kan voltooi in daardie jaar nie sal hy/sy gederegistreer word vir CEMI477.*
CEMI479	Project (Year module) / *Projek (Jaarmodule)*	28	Student must be in final year and must be able to complete degree / *Student moet finalejaar wees en graad kan voltooi*
EEII321	Power Systems I / *Kragstelsels I*	16	EERI311
EEII327	Electrical Design / *Elektriese Ontwerp*	16	EERI221 and EERI313 and EERI318 Co-Required: EERI321
EEII414	Power Systems II ***Previous code EEII422***	16	EEII321
EEII413	Power Electronics / *Drywingselektronika*	16	EERI311 and EERI321
EEII422	Power Systems II / *Kragstelsels II* ***New code EEII414***	16	EEII321
EEII423	Power Systems III	16	EEII321
EERI124	Electrotechnique I / *Elektrotegniek I*	8	None
EERI215	Electrotechnique II / *Elektrotegniek II*	8	EERI124 and NPHY121 and MTHS121
EERI221	Electrical Systems I / *Elektriese Stelsels I*	16	EERI215
EERI222	Signal Theory I / *Seinteorie I*	16	EERI215 and APPM212 and MTHS212
EERI223	Electronics I / *Elektronika I*	16	EERI124
EERI224	Linear Systems / *Lineêre Stelsels*	12	EERI124 and MTHS212
EERI311	Electrical Systems II / *Elektriese Stelsels II*	16	EERI221 and APPM211
EERI313	Electromagnetics / *Elektromagnetika*	16	NPHY211 and MTHS211
EERI318	Electronics II / *Elektronika II*	16	EERI223
EERI321	Control Theory I / *Beheerteorie I*	16	APPM212 and EERI215 and MTHS212 and APPM222 or INGB224

Faculty of Engineering modules / *Ingenieurswese modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
EERI324	Principles of Measurement / *Beginsels van Meting*	12	EERI215 and STTK312
EERI325	Signal Theory II / *Seinteorie II*	16	EERI222
EERI414	Signal Theory III / *Seinteorie III*	16	EERI325
EERI415	Telecommunication Systems / *Telekommunikasiestelsels*	16	EERI222
EERI418	Control Theory II / *Beheerteorie II*	16	EERI321
EERI471	Vacation Training seniors / *Vakansie-opleiding seniors*	8	None
EERI474	Project (year module) / *Projek (jaarmodule)*	24	EEII327 Co-required: EEII411 and EEII413 and EERI418 and FENG411
FENG211	Understanding the World of Engineering ***Previous code: WVTS211***	12	None
FENG321	Engineering in the South African and Global Context ***Previous code: WVIS321***	12	FENG211
FENG411	Engineering Management ***Previous code EERI473***	8	Student must be a final year and be able to complete the degree
FENG421	Engineering Professionalism ***Previous code EERI473***	8	Student must be a final year and be able to complete the degree
INEM321	Thermo-fluid Sciences	16	MTHS211 and APPM212
INEM327	Electromechanical Design	16	Student must register for all 3rd year modules in addition to having passed INGM313 *Student moet registreer vir alle 3de jaar modules en INGM313 moe geslaag wees.*
INEM421	Electromechanical Systems Design / *Elektromeganiese Stelselsontwerp* ***Previous code: INEM411***	12	STTK312 and EERI321
INEM471	Vacation Training seniors / *Vakansie-opleiding seniors*	8	None
INEM472	Electromechanical Design	32	INEM321 and INGM328 and EERI223 and EERI311 and EERI321 Student must be final year and must be able to complete degree.

INEM474	Project / *Projek*	24	INEM 327 Student must be final year and must be able to complete the degree. FENG411 and FENG421
INEM475	Project / *Projek*	12	Student must be final year and must be able to complete the degree. Co-required: INEM472
INGB122	Introduction to Industrial Engineering / *Inleiding tot Bedryfsingenieurswese* ***Previous code: INGB121***	12	None
INGB222	Operations Management for Engineers / *Operasionele Bestuur vir Ingenieurs*	16	None
INGB224	Optimisation and Numerical Methods / *Optimering en Numeriese Metodes* ***Previous code: INGB223***	16	MTHS121. Co-requisites: Must be registered for: MTHS211 and MTHS212 and REII211
INGB311	Engineering Economics / *Ingenieursekonomie*	12	None
INGB314	Operational Excellence / *Operasionele Uitnemendheid*	12	INGB222
INGB317	Simulation Modelling / *Simulasie-Modellering* ***Previous code: INGB315***		CMPG115 and MTHS211 and MTHS212 and APPM121 Co-requisite: STTK312 or STTK222
INGB318	Supply Chain Management / *Voorsieningskettingbestuur* ***Previous code: INGB316***	12	INGB222
INGB321	Advanced Optimisation / *Gevorderde Optimering*	16	INGB224
INGB322	Statistical Learning for Engineers / *Statistiese Leer vir Ingenieurs*	16	INGB317 and (STTK312 or STTK222)
INGB413	Quality Assurance / *Kwaliteitsversekering*	12	INGB317
INGB417	Facilities Design / *Fasiliteitsontwerp*	16	INGB311 and INGB314 and INGB318
INGB419	Business Engineering / *Besigheidsingenieurswese* ***Previous code: INGB427***	12	Co-requisite: Student must have passed or be registered for INGB479 or INDE479
INGB471	Vacation Training seniors / *Vakansie-opleiding seniors*	8	Student should be registered for INGB479 or INDE479
INGB472	Decision Support Systems (yearmodule) / *Besluitsteunstelsels (jaarmodule)* *Previous code: INGB421*	20	INGB321 and INGB322

Faculty of Engineering modules / *Ingenieurswese modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
INGB479	Project (year module) / *Projek (jaarmodule)*	40	Co-requisite: Student must have passed or be registered for INGB413, INGB417, INGB419, INGB471, INGB472, REII414, FENG411, INGM315
INDE479	Project (year module) / *Projek (jaarmodule)* ***Previous code: INGB479***		Co-requisite: Student must have passed or be registered for INGB413, INGB417, INGB419, INGB471, INGB472, REII414, FENG411, INGM315
INGF221	Engineering Communication	8	
INGM111	Engineering Graphics I / *Ingenieursgrafika I*	12	None
INGM121	Engineering Graphics II / *Ingenieursgrafika II*	12	INGM111 Participation mark >50%
INGM122	Materials Science / *Materiaalkunde*	16	None
INGM212	Engineering Materials / *Ingenieursmateriale*	12	INGM122
INGM222	Thermodynamics I / *Termodinamika I*	12	MTHS111 Co-required: The student should have passed or be enrolled for MTHS121 *MTHS111* *Newe-vereiste: Die student moes MTHS121 geslaag het, of moet daarvoor geregistreer wees*
INGM223	Manufacturing Technology / *Vervaardigingstegnologie* ***Previous code: INGM423***	12	INGM122
INGM224	Applied Computer Methods / *Rekenaarmetodes* ***New code: INGM329 / in 2022-INGM325***	8	Participation for INGM312 and INGM313
INGM225	Strength of Materials I / *Sterkteleer I* ***Previous code: INGM211***	12	MTHS121 and APPM121
INGM311	Thermodynamics II / *Termodinamika II*	12	INGM222 Participation mark >40%
INGM313	Strength of Materials II / *Sterkteleer II*	12	INGM211 or INGM225 and APPM221
INGM315	System Engineering ***Previous code: INGM417***	12	None

Faculty of Engineering modules / *Ingenieurswese modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**
INGM316	Machine dynamics ***Previous code: INGM419***	16	MTHS211 and MTHS212 and APPM212
INGM318	Fluid Mechanics I / *Stromingsleer I* ***Previous code: INGM312***	16	Pass MTHS211 Participation MTHS223
INGM324	Fluid Mechanics II / *Stromingsleer II* ***Previous code: INGM321***	12	INGM318 and INGM222
INGM328	Machine Components	16	INGM313
INGM329	Applied Computer Methods ***Previous code: INGM224***	12	INGM222 and INGM225 Participation mark for INGM313 >40%
INGM371	Vacation training ***Previous code: INGM471***	8	None
INGM411	Thermal Machines / *Termomasjiene* ***New code INGM418***	16	INGM311 and INGM321
INGM412	Heat Transfer / *Warmte-oordrag*	12	INGM324 or INGM321
INGM413	Fluid Machines / *Stromingsmasjiene*	12	INGM324 or INGM321 or INEM321
INGM415	Failure of Materials / *Faling van Materiale* ***New code: INGM426***	16	INGM212
INGM417	Systems Engineering / *Stelselingenieurswese*	12	None
INGM418	Thermal Machines / *Termomasjiene* ***Previous code: INGM411***	12	INGM311 and INGM321 or INGM324
INGM419	Machine Dynamics / *Masjiendinamika* ***New code: INGM316***	16	MTHS211 and MTHS212 and APPM212
INGM421	Machine Dynamics / *Masjiendinamika* ***New code: INGM316***	16	APPM312
INGM426	Failure of Materials / *Faling van Materiale* ***Previous code: INGM415/INGM424***	12	INGM212
INGM427	Thermal-Fluid System Design / *Termo-Vloeierstelselontwerp*	16	INGM311 and INGM318
INGM471	Vacation Training seniors / *Vakansie-opleiding seniors* Terminated Dec 2020 ***New code: INGM371***	8	None

Faculty of Engineering modules / *Ingenieurswese modules*			
Module code	**Descriptive name**	**Cr**	**Prerequisites**

INGM479	Project (Year module) / *Projek (Jaarmodule)*	16	INGM315 and Student must be able to complete the degree / *INGM315 en* *Student moet graad kan voltooi*
MEGI415	Mechanical Systems Design	16	INGM313 and INGM315
MCTR311	Dynamic Systems Modelling	12	APPM212 and EERI215 and MTHS212 and APPM222
MCTR327	Mechatronic Design	16	Student must enrol for all 3rd year 2nd semester modules and have passed all previous engineering modules / *Student moet vir alle 3de jaar 2de semester modules registreer en alle vorige ingenieursmodules moet reeds geslaag wees.*
PPEP171	Practical Engineering Practice / *Ingenieurspraktyk Prakties*	8	None
REII111	Introduction to Digital Systems / *Inleiding tot Digitale Stelsels*	12	None
REII121	Introduction to Microcontrollers / *Inleiding tot Mikrobeheerders*	12	REII111 and CMPG115
REII211	Algorithms and Optimisation / *Algoritmes en Optimering*	8	CMPG115 and MTHS121 and APPM121
REII222	Embedded Systems / *Versonke stelsels*	12	REII121
REII312	Network Fundamentals / *Grondbeginsels van Netwerke*	16	REII211
REII313	Object-oriented Software Development / *Objek-georiënteerde Sagteware Ontwikkeling*	16	CMPG115 and REII211
REII323	Embedded Operating Systems / *Versonke Bedryfstelsels*	16	REII312 and REII222 and REII313
REII327	Computer Engineering Design / *Rekenaaringenieurswese Ontwerp*	16	Student must enrol for all 3rd year 2nd semester modules and have passed all previous engineering modules / *Student moet vir alle 3de jaar 2de semester modules registreer en alle vorige ingenieursmodules moet reeds geslaag wees.*
REII414	Databases and Web-Programming / *Databasis en Web-Programmering*	16	REII313 and STTK312
REII424	Data Analysis / *Data-Analise* ***New code REII425***	12	MTHS224 and REII211 and STTK312
REII425	Data Analytics & Machine Learning ***Previous code REII424***	16	MTHS224 and REII211 and STTK312
Prescribed modules / Voorgeskrewe modules			

Module code	Descriptive name	Cr	Prerequisites
ALDE111/	Introduction to Academic Literacy / *Inleiding tot Akademiese Geletterdheid*	12	TALL / TAG Test
ALDE112	Academic Literacy / *Akademiese Geletterdheid* ***ALDE122 Presented in 2nd semester*** ***ALDE112 Presented in 1st semester***	12	ALDE111

ENG.11 Module outcomes / *Module uitkomstes*

For all relevant information about modules, students must consult the **study guide** as well as the E- Fundi website of a module.

*Vir alle detail inligting oor modules, moet student die **Studiegids** asook die E-Fundi webblad raadpleeg.*

A **study guide** is a document prepared to guide the study of the content of a module with a view to achieve the desired module and learning outcomes. A study guide is developed by an NWU academic staff member or an external subject expert approved and contracted for that purpose. The study guide is developed for a specific mode of delivery, taking the study and academic support needs of the student cohort into account (General Academic Rules Glossary).

Please note that if different module particulars appear for the same module in different Calendars (e.g., Faculty of Natural and Agricultural Sciences), the version in the Calendar of the Faculty that offers the module, will take precedence.

Neem asseblief kennis *dat indien die modulebesonderhede vir dieselfde module in verskillende jaarboeke verskil (bv. dié van die Fakulteit Natuur- en Landbouwetenskappe), die weergawe in die Jaarboek van die fakulteit wat die module aanbied, bepalend sal wees*

.

ACADEMIC LITERACY / *AKADEMIESE GELETTERDHEID*

Module code: ALDE111	**Semester 1**	**NQF Level: 5**
Name: **Introduction to Academic Literacy /** *Naam**: Inleiding tot Akademiese Geletterdheid***		
Module outcomes*:* On completion of this module the student should be able to: • demonstrate basic knowledge of learning strategies, academic vocabulary and register as well as the reading and writing of academic texts in order to function effectively in the academic environment; • communicate effectively orally and in writing in an appropriate manner in an academic environment; • understand, interpret, and evaluate basic academic texts and write appropriate academic genres in a coherent manner by making use of accurate and appropriate academic conventions; and • listen, speak, read and write accurately, fluently and appropriately in an ethical framework. *Module uitkomste:* *Ná suksesvolle voltooiing van die module sal die student in staat wees om:* • *basiese kennis van leerstrategieë, akademiese woordeskat en register asook die lees en skryf van akademiese tekste te demonstreer ten einde doeltreffend binne die akademiese omgewing te funksioneer;* • *op gepaste wyse binne 'n akademiese omgewing effektief mondelings en skriftelik as individu en as lid van 'n groep te kan kommunikeer;* • *basiese akademiese tekste te verstaan, interpreteer, evalueer en op koherente wyse toepaslike akademiese genres te kan skryf deur gebruik te maak van akkurate en toepaslike akademiese konvensies; en* • *binne 'n etiese raamwerk akkuraat, vlot en toepaslik te kan luister, praat, lees, skryf en leer.*		

Module code: ALDE122	**Semester 2**	**NQF Level: 5**

Name: **Academic Literacy /** *Naam***:** ***Akademiese Geletterdheid***

Module outcomes*:*

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

- demonstrate fundamental knowledge of appropriate computer programs, as well as apply learning, listening, reading and writing strategies, use academic language register and read and write academic texts, in order to function effectively in the academic environment;
- as an individual and a member of a group communicate effectively orally and in writing in an ethically responsible and acceptable manner in an academic environment; and
- as an individual and a member of a group find and collect scientific knowledge in a variety of study fields, analyse, interpret, and evaluate texts, and in a coherent manner synthesise and propose solutions in appropriate academic genres by making use of linguistic conventions used in formal language registers.

Module uitkomste:

Ná suksesvolle voltooiing van die module sal die student:

- *oor fundamentele kennis beskik van toepaslike rekenaarprogramme, leer-, luister-, lees- en skryfstrategieë kan toepas, akademiese taalregister kan gebruik en akademiese tekste kan lees en kan skryf, ten einde doeltreffend binne die akademiese omgewing te kan funksioneer;*
- *as ’n individu en as lid van ’n groep effektief mondelings en skriftelik op ’n etiese verantwoordelike en toepaslike wyse kan kommunikeer in ’n akademiese omgewing; en*
- *wetenskaplike inligting binne ’n verskeidenheid studieterreine as individu en in groepsverband kan soek en versamel, tekste kan ontleed, interpreteer, evalueer en op koherente wyse sintetiseer en oplossings voorstel in toepaslike akademiese genres deur gebruikmaking van linguistiese konvensies soos gebruik in formele taalregisters.*

Module code: ALDE112	**Semester 1**	**NQF Level: 5**

Name: **Academic Literacy /** *Naam***:** ***Akademiese Geletterdheid***

Module outcomes*:*

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

- demonstrate fundamental knowledge of appropriate computer programs, as well as apply learning, listening, reading and writing strategies, use academic language register and read and write academic texts, in order to function effectively in the academic environment;
- as an individual and a member of a group communicate effectively orally and in writing in an ethically responsible and acceptable manner in an academic environment; and
- as an individual and a member of a group find and collect scientific knowledge in a variety of study fields, analyse, interpret, and evaluate texts, and in a coherent manner synthesise and propose solutions in appropriate academic genres by making use of linguistic conventions used in formal language registers.

Module uitkomste:

Ná suksesvolle voltooiing van die module sal die student:

- *oor fundamentele kennis beskik van toepaslike rekenaarprogramme, leer-, luister-, lees- en skryfstrategieë kan toepas, akademiese taalregister kan gebruik en akademiese tekste kan lees en kan skryf, ten einde doeltreffend binne die akademiese omgewing te kan funksioneer;*
- *as ’n individu en as lid van ’n groep effektief mondelings en skriftelik op ’n etiese verantwoordelike en toepaslike wyse kan kommunikeer in ’n akademiese omgewing; en*
- *wetenskaplike inligting binne ’n verskeidenheid studieterreine as individu en in groepsverband kan soek en versamel, tekste kan ontleed, interpreteer, evalueer en op koherente wyse sintetiseer en oplossings voorstel in toepaslike akademiese genres deur gebruikmaking van linguistiese konvensies soos gebruik in formele taalregisters.*

Module code: APPM121	Semester 2	NQF Level: 5

Name: **Statics and Mathematical Modelling /** *Naam***:** ***Statika en Wiskundige Modellering***

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 transmissibility, 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 about axes, the modelling process, geometric similarity and proportionalities, dimensional analysis and the theorem of Buckingham; and
- 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, by fitting models to data and by solving simple differential equations.

Module uitkomste:

Na voltooiing van hierdie module behoort die studente die volgende te kan doen:

- *fundamentele kennis demonstreer van meetkundige vektore en hul bewerkingsreëls, vektore, kragte, komponente, skalaar- en vektorproduk, Cartesiese vorme, resultant van 2- en 3-dimensionele kragtestelsels deur ’n punt, die beginsel van voortplaasbaarheid, momente, koppels, herleiding van stelselskragte na ’n enkele krag en ’n enkele koppel, ewewig in die platvlak en ewewig in die ruimte, wrywing en momente om asse, die modelleringsproses, meetkundige soortgelykheid en eweredighede, dimensionele analise en die stelling van Buckingham; en*
- *probleemoplossingsvaardighede demonstreer deur bekende en onbekende probleme te analiseer, kennis van tegnieke gebruik om resultante van verskillende tipes kragtestelsels te bepaal, ewewigsprobleme in 2- en 3-dimensies oplos, modelle met eweredigheidsverbande en deur dimensionele analise te vorm en op te los en modelle by data te pas.*

Module code: APPM211	Semester 1	NQF Level: 6

Name: **Dynamics I /** *Naam***:** ***Dinamika* I**

Module outcomes:

On completion of this module, students should be able to do the following:

- Demonstrate fundamental knowledge of kinematics and kinetics of a single particle, a system of particles and a rigid body, all moving along a straight line or a curved trajectory; and
- 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, work done, energy, momentum, impulse, moment of inertia, angular impulse and angular momentum.

Module uitkomste:

Na voltooiing van hierdie module behoort die studente die volgende te kan doen:

- *Fundamentele kennis demonstreer van die kinematika en kinetika van ’n enkel deeltjie, ’n stelsel deeltjies en ’n starre liggaam vir reglynige en kromlynige beweging.*
- *Probleemoplossingsvaardighede demonstreer deur bekende en onbekende probleme te analiseer en kennis van kinematika en kinetika te gebruik om tydsverloop, verplasings, snelhede, versnellings, kragte, arbeid verrig, energie, momentum, impuls, traagheidsmoment, hoekimpuls en hoekmomentum te bereken.*

Module code: APPM212	Semester 1	NQF Level: 6

Name: **Differential Equations /** *Naam***:** ***Differensiaalvergelykings***

Module outcomes:

On completion of this module, the student will demonstrate a thorough and advanced knowledge of, and skill in

- the underlying principles,
- the methods, and
- the application of the theory regarding selected aspects of the following topics:

- Solution methods for separable, linear, Bernoulli, homogenous, and exact first order differential equations;
- Euler's method for approximating the solution of a differential equation;
- Solution of homogenous linear second order differential equations with constant coefficients;
- Solution of linear second order differential equations using the methods of undetermined coefficients and of variation of parameters;
- Laplace transforms and inverse Laplace transforms;
- Solution of first and second order initial value differential equations using Laplace transforms of continuous and discontinuous functions; and
- Elementary modelling of practical problems using differential equations.

Module uitkomste:

Na voltooiing van die module, sal die student 'n deeglike en geordende kennis van, en vaardigheid in

- *die onderliggende beginsels;*
- *die metodes; en*
- *die toepassings van die teorie rakende geselekteerde aspekte van die volgende onderwerpe demonstreer:*

- *Oplossingstegnieke vir lineêre, Bernoulli, skeibare, homogene en eksakte eerste orde differensiaalvergelykings;*
- *Euler se metode om 'n differensiaalvergelyking se oplossing te benader;*
- *Oplossing van tweede-orde lineêre homogene differensiaalvergelykings met konstante koëffisiënte;*
- *Oplossing van tweede-orde differensiaalvergelykings met behulp van die metodes van onbepaalde koëffisiënte, en van variasie van parameters;*
- *Laplace transforms en inverse Laplace transforms;*
- *Oplossing van eerste- en tweede-orde differensiaalvergelykings met behulp van Laplace transforms vir kontinue en diskontinue funksies; en*
- *Elementêre modellering van praktiese probleme met behulp van differensiaalvergelykings.*

Module code: APPM221	Semester 2	NQF Level: 6

Name**: Dynamics II /** *Naam***: *Dinamika 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, kinetics of rigid bodies and the motion of satellites and planets; and
- Demonstrate problem-solving skills by solving familiar and unfamiliar problems involving deformations in beams and cables and motion of rigid bodies acted on by forces, and determining the orbits and positions of satellites.

Module uitkomste:

Na voltooiing van hierdie module behoort die studente die volgende te kan doen:

- *Fundamentele kennis demonstreer van die teorie van buigbare kabels, inwendige kragte en vervorming van eenvoudige balke, kinetika van starre liggame en die beweging van satelliete en planete; en*
- *Probleemoplossingsvaardighede demonstreer deur bekende en onbekende probleme oor die vervormings in balke en kabels en beweging van starre liggame onder werking van kragte, sowel as bepaling van bane en posisies van satelliete te doen.*

Module code: APPM222	Semester 2	NQF Level: 6

Name: **Numerical Methods /** *Naam***: *Numeriese Metodes***

Module outcomes:

On completion of this module, the student will demonstrate a thorough and advanced knowledge of, and skill in:

- the underlying principles;
- the methods;
- the application of the theory; and
- the proper use of computer algebra systems (such as MATLAB) regarding selected aspects of the following topics.

Solution of non-linear equations:

- Bisection method;
- Regula Falsi method;
- Newton's method (single equations);
- Secant method;
- Newton's method (systems of non-linear equations);
- Interpolation and polynomial approximation:
    - Lagrange interpolation;
    - Newton divided difference interpolation; and
    - Linear and cubic splines.

Numerical integration and differentiation:

- Trapezium method;
- Simpson's method;
- Romberg's method; and
- Gauss-quadrature.

Numerical solution of initial value differential equations:

- Euler's method;
- Taylor's first order and second order method; and
- Runge-Kutta methods.

Module uitkomste:

Na voltooiing van die module, sal die student 'n deeglike en geordende kennis van, en vaardigheid in

- *Die onderliggende beginsels;*
- *Die metodes;*
- *Die toepassings van die teorie; en*
- *Die behoorlike gebruik van rekenaar-algebra stelsels (soos MATLAB) rakende geselekteerde aspekte van die volgende onderwerpe demonstreer:*

Oplossings van nie-lineêre vergelykings:

- *Halveer metode;*
- *Regula Falsi metode;*
- *Newton se metode (enkel vergelykings);*
- *Sekant (snylyn) metode;*
- *Newton se metode (stelsels nie-lineêre vergelykings);*
- *Interpolasie en polinoom benadering:*
- *Lagrange interpolasie;*
- *Newton se gedeelde differensie interpolasie; en*
- *Lineêre en kubiese latfunksies.*
  Numeriese integrasie en differensiasie:
- *Trapesium metode;*
- *Simpson se metode;*
- *Romberg se metode; en*
- *Gauss-kwadratuurreël.*

Numeriese oplossing van aanvangswaarde differensiaalvergelykings:

- *Euler se metode;*
- *Taylor se eerste orde en tweede-orde metode; en*
- *Runge-Kutta metodes.*

Module code: APPM312	Semester 1	NQF Level: 7

Name: **Partial Differential Equations (Numerical) /**
Naam: ***Parsiële Differensiaalvergelykings (Numeries)***

Module outcomes:
On completing this module, the student should be able to do the following:

- Demonstrate fundamental knowledge and insight into the discretisation of ordinary and partial linear 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 and stability properties of numerical methods, solving parabolic, elliptical and hyperbolic differential equations numerically, and performing iterative methods with MATLAB on a computer;
- Demonstrate problem-solving skills in numerically solving, by means of finite difference methods, 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 uitkomste:
Na voltooiing van hierdie module behoort die student die volgende te kan doen:

- *Fundamentele kennis en insig demonstreer in die diskretisering van gewone en parsiële lineêre differensiaalvergelykings, spesiale eienskappe van tridiagonale matrikse-, berekeningsprobleme wat sleggeaardheid en yl stelsels van lineêre vergelykings meebring, konvergensie-eienskappe van iteratiewe metodes vir stelsels van lineêre vergelykings en die stabiliteitseienskappe van numeriese metodes, die numeriese oplossing van paraboliese, elliptiese en hiperboliese differensiaalvergelykings, en die uitvoering van iteratiewe metodes per rekenaar met MATLAB;*
- *Probleemoplossingsvaardighede demonstreer in die numeriese oplos, deur middel van eindige-verskille-metodes, van tweepuntrandwaardeprobleme, die warmtevergelyking, die potensiaalvergelyking en die golfvergelyking en die rekenaarimplementering daarvan;*
- *'n Liefde vir die studieveld openbaar en begrip te toon vir die verband tussen werklikheid, abstraksie, model en oplossing; en*
- *'n Christelike, of alternatiewe, perspektief op die vakgebied te hê.*

Module code: BIOT411	Semester 1	NQF level: 8

Name: **Biotechnology II /** *Naam***:** ***Biotegnologie II***

Module outcomes:

After completion of this Module the student should have:

Knowledge

The student will acquire knowledge about the physiology of microorganisms and enzymes, as well as the bioprocess considerations for effective treatment of wastewaters or recovery of pure products in adequate bioreactor systems.

Skills

- Ability to select suitable microorganisms for a biological process and recognise the growth phase required to achieve maximum yield.
- Must be able to establish and control physical and chemical conditions necessary for effective performance of the enzymes.
- Must be able to model microbial-growth-kinetics and predict the behaviour of microorganisms under specific conditions in a batch or chemo stat system.
- Ability to select an appropriate bioreactor based on the microbial species and the intended product as well as manipulate operating conditions to ensure improved performance of microorganisms.
- Recognise the bioreactor instruments and scale consideration suitable for effective monitoring and control of chemical and physical environment.
- Must be able to recommend a purification method informed by the complexity of the fermentation broth and the nature of the product.
- Ability to apply biological-based processes to induce chemical transformations necessary in the treatment of wastewaters and formation of useful products.
- Ability to use rudimentary equipment for the making of cheese and beer.
- Demonstrate the ability to use mathematical analyses to predict the performance of bioreactor systems.
- Ability to choose energy sources to minimise footprint and ensure continuity.

Module uitkomste:

Na voltooiing van hierdie module behoort die student oor die volgende te beskik:

Kennis

Kennis oor die fisiologie van mikro-organismes en ensieme, asook die bioproses-oorwegings vir effektiewe behandeling van afvalwater of herstel van suiwer produkte in voldoende bioreaktorstelsels

Vaardighede

- *Vermoë om geskikte mikro-organismes te kies vir 'n biologiese proses en die groeifase wat nodig is om die maksimum opbrengs te bereik, te herken.*
- *Moet in staat wees om fisiese en chemiese toestande wat nodig is vir effektiewe prestasie van die ensieme vas te stel en te beheer.*
- *Moet in staat wees om mikrobiese groei-kinetika te modelleer en die gedrag van mikro- organismes onder spesifieke omstandighede in 'n lot- of chemostaatstelsel te voorspel.*
- *Vermoë om 'n toepaslike bioreaktor gebaseer op die mikrobiese spesies en die beoogde produk te kies, sowel as bedryftoestande te manipuleer om verbeterde prestasie van mikro- organismes te verseker.*
- *Herken die bioreaktor-instrumente en skaal-oorweging geskik vir effektiewe monitering en beheer van chemiese en fisiese omgewing.*
- *Moet in staat wees om 'n suiweringsmetode op grond van die kompleksiteit van die fermentasiesous en die aard van die produk aan te beveel.*
- *Vermoë om biologies-gebaseerde prosesse toe te pas om chemiese transformasies te weeg te bring wat nodig is in die behandeling van afvalwaters en vir die vorming van bruikbare produkte.*
- *Vermoë om basiese toerusting te gebruik vir die maak van kaas en bier.*
- *Die vermoë demonstreer om wiskundige analises te gebruik om die prestasie van bioreaktorstelsels te voorspel.*
- *Vermoë om energiebronne te kies om voetspoor te verminder en volhoubaarheid te verseker*

Module code: CEMI112	Semester 1	NQF level: 5

Name: **Materials and Corrosion /** *Naam:* ***Materiale en Korrosie***

Module outcomes:
After successful completion of this module, the student should have:
Knowledge:
The student will be able to understand materials, material strength, corrosion and corrosion prevention to make decisions on material selections.
Skills:

- Ability to identify the different materials, such as metals, polymers and ceramics.
- Ability to understand the processing of these materials.
- Ability to solve material problems encountered in a chemical engineering environment.
- Ability to identify and describe corrosion processes, electrochemical corrosion and galvanic corrosion.

Solve corrosion problems and determine corrosion rates and how corrosion control is implemented.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:
Materiaalaspekte van welbekende metale, keramieke en polimere, mikroskopiese strukture en elektrochemiese korrosie.
Vaardighede:
Studente sal vaardighede ontwikkel in materiaal-identifikasie en -karakterisering vir ontwerpdoeleindes. Waar probleme in die praktyk voorkom, sal die student in staat wees om gegewens af te lei vanaf die falings wat plaasgevind het, met die oog op veranderings en verbeterings van die konstruksie.

Module code: CEMI121	Semester 2	NQF level: 5

Name: **Process Principles I /** Naam**:** ***Prosesbeginsels 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:
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:

- Being able to carry out elementary chemical calculations, convert between different unit systems and know the concept of dimensional homogeneity.
- To know about the different types of chemical processes and know the most important process variables.
- Understand the fundamentals of material balances and apply these fundamentals to single and multiple unit processes with and without reaction.
- Know how to find, calculate or estimate the relevant physical properties of single-phase systems.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:
Studente verkry 'n formele kennis van verskillende eenheidsisteme, prosesdata-hantering, dimensionele homogeniteit, die mol-eenheid, chemiese en mineraalprosesse en prosesveranderlikes, beginsels van materiaalbalanse, grade van vryheid, stoigiometrie, meervuldige materiaalbalanse, herwinning en verbystrome, reaktiewe prosesse, verbrandingsprosesse, enkelfase-prosesse.
Vaardighede:

- *Studente ontwikkel vaardighede in die omskakeling tussen verskillende eenheidsisteme, om prosesdata statisties korrek te hanteer, lineêre modelle te kan pas en die homogeniteit van 'n model te kan bepaal.*
- *Verdere vaardighede in die bepaling, hantering en manipulering van prosesveranderlikes soos mol, konsentrasie, digtheid, temperatuur en druk; asook om gestadigde materiaalbalanse oor eenvoudige en komplekse prosesse op te los en te analiseer.*

Module code: CEMI211	**Semester 1**	**NQF level: 6**

Name: **Materials and Corrosion /** Naam**: *Materiale en Korrosie***

Module outcomes*:*
After successful completion of this module, the student should have:
Knowledge:
The student will be able to understand materials, material strength, corrosion and corrosion prevention to make decisions on material selections.
Skills:

- Ability to identify the different materials, such as metals, polymers and ceramics.
- Ability to understand the processing of these materials.
- Ability to solve material problems encountered in a chemical engineering environment.
- Ability to identify and describe corrosion processes, electrochemical corrosion and galvanic corrosion.
- Solve corrosion problems and determine corrosion rates and how corrosion control is implemented.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:
Materiaalaspekte van welbekende metale, keramieke en polimere, mikroskopiese strukture en elektrochemiese korrosie.
Vaardighede:

- *Studente sal vaardighede ontwikkel in materiaal-identifikasie en -karakterisering vir ontwerpdoeleindes.*
- *Waar probleme in die praktyk voorkom, sal die student in staat wees om gegewens af te lei vanaf die falings wat plaasgevind het, met die oog op veranderings en verbeterings van die konstruksie.*

Module code: CEMI213	Semester 1	NQF level: 6

Name: **Electrotechnics for Chemical Engineers /** *Naam:* ***Elektrotegniek vir Chemiese Ingenieurs***

Module objective: The objective of this module is to equip students with a critical understanding of how the field of electrotechnics is applicable to the basic training of the chemical engineer.

Module outcomes:

On completion of this module the student will demonstrate:

- Knowledge and informed understanding of the basic terms related to electricity, including AC/DC, as well as three-phase and single-phase power;
- Critical understanding of and the ability to analyse and evaluate basic power generation within the South African context, including renewable energy;
- Detailed knowledge of the basic working of transformers and electrical motors with a view to understand the application of these components on a process plant;
- The ability to understand measurement (pressure, temperature, flow, density and level) in order to be able to select the correct instrumentation for measurement in chemical processes;
- Detailed knowledge and understanding of, and the ability to demonstrate the working of various kinds of valves in different scenarios; and
- The ability to work as part of a team to solve practical problems in the field of electrotechnics.

Module uitkomste:

Met die voltooiing van hierdie module sal die student die volgende demonstreer:

- *Kennis en begrip van die basiese terme wat verband hou met elektrisiteit, insluitende direkte en wisselstroom, asook drie-fase en enkelfase krag;*
- *Kritiese begrip van en die vermoë om kragopwekking, insluitend hernubare energie, binne die Suid-Afrikaanse konteks te kan analiseer en evalueer;*
- *Gedetailleerde kennis van die basiese werking van transformators en elektriese motors ten einde die toepassing van hierdie toerusting op 'n proses-aanleg te verstaan;*
- *Die vermoë om meting (druk, temperatuur, vloei, digtheid en vlak) te verstaan ten einde die korrekte instrumentasie te kies vir meting in 'n chemiese proses;*
- *Gedetailleerde kennis en begrip van die werking van 'n verskeidenheid kleppe, asook die toepaslikheid van hierdie kleppe in bepaalde omstandighede; en*
- *Die vermoë om te werk as deel van 'n span om praktiese probleme op te los binne die veld van elektrotegniek.*

Module code: CEMI214	Semester 1	NQF level: 7

Name: **Biotechnology I /** *Naam:* ***Biotegnologie I***

Module outcomes*:*

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

Knowledge

- The importance of chemical engineering within the field of biotechnology.
- Cell biology and the structure and function of biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Enzymatic and microbial fermentation.
- Cell growth.

Skills

- Design and execute simple biochemical experiments.
- Collect and process experimental data.
- Solve problems related to enzymatic and microbial fermentation.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Selbiologie en die chemiese samestelling van selle.*
- *Die struktuur en funksie van biomolekules: koolstofhidrate, lipiede, proteïene en nukleïensure.*
- *Inleidende ensimologie: die opwekking en aanwending van energie deur organismes.*
- *Intermediêre metabolisme.*

Vaardighede:

- *Die basiese strukturele eienskappe van organismes te beskryf en hoe hulle substanse aanwend om energie te produseer vir oorlewing en voortplanting.*
- *In staat wees om eenvoudige biochemiese eksperimente te ontwerp en uit te voer.*
- *In staat wees om prosesdata te versamel en te verwerk.*

Module code: CEMI215	**Semester 1**	**NQF level: 6**

Name: **Geology for Process Engineers /** *Naam:* ***Geologie vir Prosesingenieurs***

Module outcomes:
After completion of the module, the student will demonstrate:

- A rounded and systematic knowledge and a coherent and critical understanding of a variety of rocks for mining, economic minerals and ore minerals.
- A knowledge of the variety of rock associations with economic potential and geological depositions in South Africa.
- A rounded and systematic knowledge of chemical analysis of minerals to interpret the data, represent it graphically and to interpret trends in compositional changes.
- An ability to identify and characterise different ore bodies.
- An understanding of the different process routes applicable to various commonly found ore bodies and the impact of the mineralogy on these processes.
- An understanding of the environmental impact of mining-related activities in South Africa, in particular acid mine-drainage.

Module code: CEMI222	**Semester 2**	**NQF level: 6**

Name: **Chemical Thermodynamics I /** *Naam:* ***Chemiese Termodinamika I***

Module outcomes*:*
After successful completion of this module, the student should have:
Knowledge:

- 1^{st} and 2^{nd} law of thermodynamics.

How to solve energy and entropy balances using thermodynamic concepts.
Skills:

- Perform energy, entropy and mass balance calculations for open and closed systems.
- Use equations of state or generalised correlations to describe any fluid; and be able to calculate the compressibility factor of gases.
- Establish thermodynamic property relationships for any system and select appropriate equations of state for calculating thermodynamic properties in terms of the measurable system properties temperature and pressure.
- Describe and analyse the thermodynamic properties of a fluid at each location in refrigeration, liquefaction and power generation cycles.
- Appreciate mechanical work in solving thermodynamic problems.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Basiese termodinamika-verwante berekeninge met selfvertroue uit te voer.*
- *Die eerste en tweede wet van die termodinamika toe te pas om ingenieursprobleme te identifiseer, formuleer en op te los.*

- *Die konsep van entropie te begryp en die molekulêre grondslag daarvan te beskryf.*
- *'n Greep op terminologie te toon en termodinamiese berekeninge te doen met inagneming van alle betrokke veranderlikes.*
- *Doeltreffend in groepe saam te werk.*
- *Stip en eties op te tree in die voorlegging van resultate, bevindings, interpretasies en persoonlike gesigspunte in probleemoplossingsaktiwiteite.*
- *Toepaslike kommunikasievaardighede te toon.*
- *Onbevooroordeeld te wees en entrepreneuries te dink in alle probleemoplos-aktiwiteite.*

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

Name: Process Principles II / *Naam:* ***Prosesbeginsels II***

Module outcomes*:*

After successful completion of this module students should have :

Knowledge:

- Energy balances.
- The first law of thermodynamics.
- Forms of energy.
- Heat capacity of gases, liquids and solids.
- Enthalpy of mixtures and solutions.
- Enthalpy-concentration diagrams.
- Enthalpy of formation, vaporisation, melting, combustion and solutions
- Combustion of fuels.

Ability to integrate this knowledge to solve energy balances of processes.

Skills:

- Ability to identify the different forms of energy.
- Ability to solve energy balances on closed and open systems, with or without reactions taking place, while accounting for scenarios such as phase change, mixing and solutions.
- Ability to simultaneously solve energy and material balances on simple systems

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:

- *Energiebalanse.*
- *Die eerste wet van termodinamika.*
- *Vorme van energie.*
- *Warmtekapasiteit van gasse, vloeistowwe en vaste stowwe.*
- *Entalpie van mengsels en oplossings.*
- *Entalpie-konsentrasie-diagramme.*
- *Entalpie van vorming, verdamping, smelting en ontbranding.*
- *Integrering van hierdie kennis om energiebalanse van prosesse op te los.*

Vaardighede:

- *Die konsep van energie, werk en hitte te verstaan en die verskillende vorme van energie kan identifiseer.*
- *In staat wees om termodinamiese vorme te kan aanwend om energiebalanse te kan opstel en oplos oor oop- sowel as geslote stelsels, met en sonder chemiese reaksies, met faseveranderings in ag genome, sowel as vir oplossings en mengsels.*
- *Massa- en energiebalanse kan kombineer en oplos vir eenvoudige stelsels.*

Module code: CEMI311	Semester 1	NQF level: 7

Name: **Transport Phenomena I /** *Naam:* ***Oordragbeginsels I***

Module outcomes*:*
After successful completion of this module, the student should have:
Knowledge:

- Basic knowledge and insight in the mechanisms of fluid dynamics.
- Be able to use mass, energy and momentum balances to describe fluid motion on the macroscopic level.
- Be able to describe the motion of a fluid on the microscopic level by making use of velocity profiles and differential analysis.
- Be able to do dimensional analyses to derive important correlations which determine the type of flow.
- Know and be able to use Buckingham's theory.
- Be able to describe fluid flow where friction is relevant and to use the relevant correlations to calculate friction factors.
- Be able to use the above-mentioned knowledge to describe both internal and external flow.
- Know and be able to apply the basic theory and applications regarding fluid machines.

Skills:

- Be able to describe internal and external flow systems using basic flow dynamics.
- Know and be able to apply dimensional analyses for further study.
- Be able to design reaction and impulse turbines.
- Be able to generate and process experimental data and prepare an appropriate report on the findings.
- Be able to use sources such as the internet and library to obtain and study relevant information on flow dynamics.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Fundamentele kennis omtrent die meganismes gemoeid in momentum-oordrag.*
- *Die makroskopiese beskrywing van fluïde-vloei met behulp van massa, energie- en/of momentumbalanse.*
- *Die gebruik en afleiding van snelheidsprofiele deur differensiaalanalise om fluïde-vloei op mikroskopiese vlak te beskryf.*
- *Die fundamentele begrippe en toepassings van dimensionele analise.*
- *Die gebruik van wrywingsfaktore om fluïde-vloei te beskryf waar wrywing betrokke is.*
- *Die beskrywing van fluïde-vloei in 'n grenslaag.*
- *Die toepassing van al die bogenoemde in die beskrywing van algemene interne en eksterne vloei deur pype en oor voorwerpe onderskeidelik.*
- *Die basiese beginsels van pompe en turbines, asook die gebruik van pomp-werkverrigtingskrommes en die affiniteitswette in die ontwerp en keuse van pompe en turbines.*
- *Die verkryging van kennis aangaande die beskrywing van saampersbare vloeisisteme.*

Vaardighede:

- *Die oplos van algemene momentum-oordagprobleme wat insluit die beskrywing van vloei (nie-saampersbare en saampersbare) deur leipype en die vloei oor voorwerpe.*
- *Die gebruikmaking van pomp-werkverrigtingkrommes en die affiniteitswette in die opskaling en keuse van 'n pompsisteem of turbinesisteem.*
- *Die gebruik van dimensionele analise om relevante dimensielose parameters te ontwikkel, asook die opskaling van relevante eksperimentele data met behulp van die modelteorie.*
- *Verkryging en verwerking van eksperimentele data.*
- *Skryf van 'n gepaste ingenieursverslag oor die eksperimentele data en gebruik van spesifieke hulpbronne, soos die biblioteek en internet, om navorsing oor 'n besondere onderwerp te doen.*

Module code: CEMI313	Semester 1	NQF level: 7

Name: **Chemical Thermodynamics II /** *Naam:* ***Chemiese Termodinamika II***

Module outcomes*:*

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

Knowledge:

Performing complex thermodynamics calculations to determine the composition of coexisting phases during phase separation, and predicting the extent to which a reversible chemical reaction proceeds.

Skills:

- Understand the importance of Gibbs energy and chemical potential in relation to equilibrium calculations.
- Understand the concept of fugacity as a key-parameter in equilibrium calculations.
- Perform fugacity calculations for species in the gas and liquid phases.
- Calculate the composition of coexisting phases, mainly regarding Vapour-Liquid Equilibrium (VLE) and Liquid-Liquid Equilibrium (LLE) from first principles.
- Describe a reversible chemical reaction/system of reactions in terms of the equilibrium extent of the individual reactions/single reaction.
- Co-operate effectively in group work.
- Act ethically sound in presenting results, findings, interpretations and personal views in problem-solving activities.
- Reveal applicable communication skills.
- Think critically and innovatively in all problem-solving activities.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

Kennis:

Met selfvertroue komplekse termodinamika-berekeninge uit te voer in verband met fase-skeiding en chemiese reaksies.

Vaardighede:

- *Die belangrikheid van Gibbs-energie en chemiese potensiaal in verband met ewewigsberekeninge te begryp.*
- *Die konsep van fugasiteit as 'n sleutelparameter in ewewigsberekeninge te begryp.*
- *Die fugasiteitskoëffisiënt in gas-, vloeistof- of soliede fase doeltreffend te bereken.*
- *Damp-vloeistof-ewewig (DVE) en vloeistof-vloeistof-ewewig (VVE) te bereken en die belangrikheid daarvan in te sien in verskeie praktiese prosesse.*
- *Doeltreffend in groepe saam te werk.*
- *Stip en eties op te tree in die voorlegging van resultate, bevindings, interpretasies en persoonlike gesigspunte in probleemoplos-aktiwiteite.*
- *Toepaslike kommunikasievaardighede te toon.*
- *Onbevooroordeeld en entrepreneuries in alle probleemoplos-aktiwiteite te dink.*

Module code: CEMI315	Semester 1	NQF level: 7

Name: **Biotechnology I /** *Naam:* ***Biotegnologie I***

Module outcomes*:*

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

Knowledge

- The importance of chemical engineering within the field of biotechnology.
- Cell biology and the structure and function of biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Enzymatic and microbial fermentation.
- Cell growth.

Skills

The ability to perform the following:

- Design and execute simple biochemical experiments.
- Collect and process experimental data.
- Solve problems related to enzymatic and microbial fermentation.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Selbiologie en die chemiese samestelling van selle.*
- *Die struktuur en funksie van biomolekule: koolstofhidrate, lipiede, proteïene en nukleïensure.*
- *Inleidende ensimologie: die opwekking en aanwending van energie deur organismes.*
- *Intermediêre metabolisme.*

Vaardighede:

- *Beskrywing van die basiese strukturele eienskappe van organismes en hoe hulle substanse aanwend om energie te produseer vir oorlewing en voortplanting.*
- *Ontwerp en uitvoer van eenvoudige biochemiese eksperimente.*
- *Versameling en verwerking van prosesdata.*

Module code: CEMI316	**Semester 1**	**NQF level: 7**

Name: **Particle Systems /** *Naam:* ***Partikelstelsels***

Module outcomes*:*
After successful completion of this module students should have:
Knowledge:

- Properties of particles and the handling of dry particles, the properties of slurries and the handling thereof and design of equipment that can handle these systems.
- Solid-liquid separation system and the design of the appropriate equipment.

Skills:

- Describe populations of particles in terms of their physical and chemical properties.
- Design screens and other apparatus to classify particles in terms of size and or density.
- Design systems to store and convey particles.
- Describe slurries in terms of physical properties such as density and viscosity.
- Design mixer tanks, piping systems and pumps to transport slurries, to design and describe waste dumps.
- Design settling dams, thickeners, filters and thermal dryers.
- Describe the operating aspects of all the above-mentioned processes and understand and describe the interaction between the different processes.
- Use laboratory equipment to obtain information, experimentally, on the above-mentioned processes for later use in design and optimisation thereof.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Die eienskappe van partikels, die hantering van droë partikels en die ontwerp van toerusting om droë partikels te hanteer.*
- *Die eienskappe van flodderstelsels en die ontwerp van toerusting om flodders te kan hanteer.*
- *Vloeistofsisteme en die ontwerp van toepaslike toerusting vir die skeiding van hierdie sisteme.*
- *Die bedryf van AL bogenoemde sisteme en die integrasie daarvan.*

Vaardighede:

- *Om partikels te analiseer in terme van grootte en vorm.*
- *Om grootteverspreidingsdata te genereer en te analiseer.*
- *Om grootteverspreidingsmodelle te pas en industriële toerusting te ontwerp wat partikels in*

terme van grootte skei.

- *Om toerusting te ontwerp en analiseer wat droë partikels stoor en vervoer.*
- *Om flodders te beskryf in terme van viskositeit, en toerusting te ontwerp om flodders te meng en te vervoer.*
- *Om toerusting te ontwerp vir die skeiding van vastestof-vloeistof sisteme.*
- *Om laboratorium-toerusting te gebruik om partikelsisteme te analiseer en data te genereer.*

Module code: CEMI321	**Semester 2**	**NQF level: 7**

Name: **Transport Phenomena II /** *Naam:* ***Oordragbeginsels II***

Module outcomes*:*
After successful completion of this module, the student should have:
Knowledge:

- The mechanisms of conduction, convection, radiation, diffusion-mass transfer and convective mass transfer.
- Ability to determine transfer rate for steady-state and non-steady-state conduction.
- Ability to use numerical, as well as graphical techniques to solve conduction problems.
- Ability to do dimensional analyses for convective systems and be able to solve natural and forced convection problems.
- Ability to determine transfer coefficients for convection systems.
- Ability to solve heat transfer for simultaneous conduction and convection systems.
- Ability to solve transfer for simultaneous heat and mass transfer systems.
- Ability to use the concept of black and grey bodies to solve radiation problems.
- The laws of radiation and ability to apply them to solve the heat transfer by radiation for different systems.
- Ability to apply Fick's law to shell balances to solve steady-state and non-steady-state mass transfer problems.
- Ability to calculate the mass transfer for flow over a flat plate, spheres, cylinders and packed beds by using the different analogies between momentum, mass and heat transfer.
- Ability to determine the mass transfer rate for different systems.

Skills:

- Calculate heat and mass transfer rate for different systems.
- Design systems for effective heat and mass transfer.
- Analyse shell and tube heat exchangers using HTRi software.
- Design shell and tube heat exchangers to comply with an industrial design specification.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Fourier se wet.*
- *Gestadigde warmte-oordrag deur geleiding.*
- *Warmte-oordrag met hitte-opwekking en gestadigde warmte-oordrag deur vinne.*
- *Ongestadigde warmte-oordrag.*
- *Gestadigde geforseerde warmte-oordrag deur konveksie.*
- *Gestadigde natuurlike konveksie-oordrag.*
- *Hitteruilerontwerp metodes.*
- *Fick se wet.*
- *Gestadigde massa-oordrag deur diffusie.*
- *Gestadigde konvektiewe massa-oordrag.*
- *Ongestadigde warmte-oordrag.*

Vaardighede:

- *Die oplos van warmte- en massa-oordragprobleme met behulp van analitiese en numeriese metodes.*
- *Die gebruik van industriële ontwerp-sagteware vir die ontwerp van 'n hitteruiler.*
- *Die bedryf van 'n hitteruiler, asook die meting van sekere eksperimentele groothede en die verwerking van die gemete resultate om sinvolle afleidings te kan maak en professioneel te kan weergee in 'n praktikum-verslag.*
- *Die lees van 'n industriële hitteruiler- ontwerpspesifikasie en die ontwikkeling van 'n ontwerpverslag wat voldoen aan industriële vereistes.*

Module code: CEMI322	**Semester 2**	**NQF level: 7**

Name: **Separation Processes I /** *Naam:* ***Skeidingsprosesse I***

Module objective:

Development of skills for the conceptional design, modelling, optimisation, and selection of equilibrium-based separation processes, with specific reference to absorption, stripping and distillation. Application of basic knowledge in the development of more complex processes.

Module outcomes:
After successful completion of this module, students should have:
Knowledge:

- The various separation processes with specific focus on distillation, absorption and stripping.
- The appropriate equipment necessary for these separation processes.
- The use of thermodynamic models in equilibrium-based separation processes.
- The advantages and disadvantages of various design choices.

Skills:

- Flash calculations in multi-component processes.
- Design of adsorption, stripping and distillation columns for binary and multi-component feed streams.
- Troubleshoot and optimise separation processes.
- Simulate a distillation column using ASPEN/HYSYS.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Die gepaste toerusting nodig in skeidingstegnologie.*
- *Die interpretasie van skeidingsprosesvloeiskemas.*
- *Die gebruik van termodinamiese modelle in ewewiggebaseerde skeidingsprosesse.*
- *Berekeninge rakende flitsing in multi-komponent prosesse.*
- *Ontwerp van adsorpsie, stropings- en distillasiekolomme vir binêre en multi-komponent-voerstrome, asook die optimalisering van skeidingsprosesse.*

Vaardighede:

- *Interpretasie van eksperimentele data op 'n effektiewe wyse.*
- *Om in groepe saam te werk en binne die beperkte tyd die inligting aan te bied in 'n verslag, sowel as d.m.v. mondelinge terugvoering.*

Module code: CEMI323	Semester 2	NQF level: 7

Name: **Chemical Reactor Theory I /** *Naam:* ***Chemiese Reaktorteorie I***

Module objective:
The main objective of this module is to equip students with the basic fundamentals of 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, specifically mass- and energy balances and thermodynamic concepts applicable to problem-solving. Skills that are developed are based on the utilisation 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:

Knowledge:
- 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:
- Perform reaction and reactor problems using analytical and numerical methods.
- Use of different industrial design software for the design of a reactor and reaction systems.
- Operation of different reactors.
- Measuring of certain experimental quantities and the processing of results to meaningful deductions in order to reach conclusions, communicated professionally in a practical report.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:
- *Reaksiekinetika en reaksietempo's vir verskillende reaksiestelsels.*
- *Bedryf en funksionering van verskillende reaktor-tipes.*
- *Afleiding vanuit eerste beginsels van die bedryfs- en ontwerpvergelykings van 'n verskeidenheid reaktortipes.*
- *Isotermiese en nie-isotermiese bedryf en ontwerp.*
- *Drukval oor reaktore, ongestadigde bedryf van reaktore, hersirkulasiereaktore, membraanreaktore, termodinamiese effekte en veelvoudige reaksies.*

Vaardighede:

- *Oplos van reaksie- en reaktorprobleme met behulp van analitiese en numeriese metodes.*
- *Die gebruik van verskillende industriële ontwerpsagteware vir die ontwerp van 'n reaktor en reaksiesisteme.*
- *Die bedryf van verskillende reaktore.*
- *Die meting van sekere eksperimentele groothede en die verwerking van die gemete resultate om sinvolle afleidings te kan maak en professioneel te kan weergee in 'n praktikum-verslag.*

Module code: CEMI326	Semester 2	NQF level: 7

Name: **Process Modelling for Control /** *Naam:* ***Prosesmodellering vir Beheer***

Module objective:
The objective of this module is to equip the student with skills to perform dynamic modelling of processes, to be able to solve such models and to perform techniques on such models to be able to analyse and assess the behaviour of processes in order to eventually control such processes.

Module outcomes:
After successful completion of this module, students should have:
Knowledge:

- A basic overview knowledge of the discipline of process modelling and control.
- A thorough understanding of the behaviour of first- and higher-order processes through behaviour analysis techniques.
- Knowledge of the fundamental and empirical approaches to modelling chemical processes.

Skills:

- Develop steady-state and dynamic models that describe chemical process behaviour.
- Mathematical skills to solve differential equations that describe process dynamics.
- Using computer packages to solve differential equations that describe chemical process dynamics.
- Mathematical skills to linearise non-linear process models as well as to determine process stability of such processes.
- Ability to work individually and in groups.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:

- *Massa- en energiebalanse aanwend om prosesse dinamies te modelleer en simuleer.*
- *Dinamiese gedrag van stelsels verstaan en evalueer.*
- *Alle prosesveranderlikes klassifiseer.*
- *Eenvoudige terugvoer-beheerlusse (P, PI of PID) verstaan en evalueer.*

Vaardighede:

- *Dinamiese modelle van prosesse af te lei.*
- *Dinamiese modelle op 'n rekenaarpakket simuleer en 'n prosesgedrag genereer.*
- *Die prosesgedrag evalueer en gepaste afleidings rakende die natuur van die proses daaruit af te lei.*
- *'n Eenvoudige terugvoer-beheerlus (P, PI of PID) op te stel en in te stem op 'n gepaste rekenaarpakket.*

Module code: CEMI328	Semester 2	NQF level: 7

Name: **Plant Design I /** *Naam:* ***Aanlegontwerp I***

Module outcomes*:*
After successful completion of this module, students should have:
Knowledge:

- Be competent to perform procedural and non-procedural design and synthesis of engineering products or processes.
- Acquired knowledge on environmental management systems and risk assessment from a chemical engineering context.
- Be able to handle and have an overview of environmental related design problems such as water related (BOD) and air pollution related (stack design).
- Be able to do hazard analyses on chemical plants and process components.

Skills:

- Understand the application of Aspen in solving engineering problems.
- Appreciate and be able to link environmental hazards associated with chemical processes and address problems using engineering knowledge acquired up to so far.
- Developed analytical and problem-solving skills.
- Be able to carry out a HAZOP analysis on chemical processes and plants.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student oor die volgende te beskik:
Kennis:

- *Bevoegdheid om prosedurele en nie-prosedurele ontwerp en sintese van ingenieursprodukte of -prosesse uit te voer.*
- *Hantering en oorsig van die omgewingsverwante ontwerpprobleme i.v.m. water (BOD) en lugbesoedeling (skoorsteen-ontwerp).*
- *Gevaarontledings op chemiese aanlegte en proseskomponente.*

Vaardighede:

- *Verstaan die toepassing van Aspen in die oplossing van ingenieursprobleme.*
- *Waardeer en in staat om omgewingsgevare in verband te bring met chemiese prosesse en probleme aan te pak met behulp van ingenieurskennis tot dusver verkry.*
- *Analitiese en probleemoplossingsvaardighede.*
- *In staat om 'n Hazop-analise op chemiese prosesse en aanlegte uit te voer.*

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

Name: **Separation Processes II /** *Naam:* ***Skeidingsprosesse II***

Module outcomes:
After successful completion of this module, students should have:
Knowledge:

- The concepts and technologies related to water purification, membrane separation processes, solubility of elements, leaching, precipitation, crystallisation, solvent extraction, ion exchange, electro-winning and electro-refining.

Skills:

- Demonstrate sufficient knowledge about the context of water pollution and remediation strategies to restore water suitable for drinking purposes.
- Must be able to identify the type of membrane adequate for a given task and predict its performance.
- Ability to explain the behaviour of elements in solution through construction of the Pourbaix diagram and application of thermodynamic principles.
- Ability to advise on a suitable leaching technique based on the grade and the mineralogical composition of the compound.
- Ability to determine optimum conditions for higher leaching rate.
- Recognise the limitations and the advantages of the various metal purification techniques.
- Ability to determine the capacity and specificity of extracting matrices in ion exchange and solvent extractions systems.
- Ability to establish conditions suitable for the separation or purification of metals through precipitation.
- Ability to explain the mechanisms of electro-winning and electro-refining, as well as suggest optimisation conditions based on information obtained through calculations.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Voorbereidingsmetodes, logingstegnieke, presipitasie, kristallisasie, ioon-uitruiling, vloeistof-vloeistof ekstraksie, sementasie, reduksie en elektrowinning.*
- *Begrip van die toepaslike berekeninge.*
- *Watersuiwering en membraanprosesse.*

Vaardighede:

- *Konstruksie van Pourbaix-diagramme vir verskillende sisteme, asook die opstel en beskrywing van logingsreaksies en -prosesse.*
- *Beskrywing van die meganismes vir bakteriese en drukloging.*
- *Bepaling van harsbesetting, limietkapasiteit en bedvolumes van 'n ioonuitruilsisteem deur gebruik te maak van die basiese beginsels van ioonuitruilmeganismes.*
- *Bepaling van die aantal stadia van 'n vloeistof-vloeistof ekstraksiesisteem.*
- *Toepassing van presipitasie, reduksie en sementasie as metaalherwinningsprosesse.*
- *Die beskrywing van elektrowinning en die uitvoer van nodige berekeninge.*
- *Die doen van nodige berekeninge m.b.t membraantegnologie en watersuiweringsprosesse.*

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

Name: **Chemical Reactor Theory II /** *Naam:* ***Chemiese Reaktorteorie II***

Module outcomes:
After successful completion of this module, students 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.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:
Kennis:

- *Kennis en insig om eenvoudige modelle vir nie-ideale vloei te gebruik om die omsetting in 'n nie-ideale reaktor te voorspel.*
- *Modelle kan ontwikkel om die vloeipatrone binne 'n reaktor te voorspel.*
- *'n Reaktor kan ontwerp vir 'n heterogene katalise-reaksie met komplekse reaksiekinetika.*
- *Reaktore vir reaksie met de-aktiverende en vergiftigde kataliste kan ontwerp.*
- *Reaktor-regeneratorsisteme kan ontwerp vir de-aktiverende kataliste.*
- *Reaktore kan ontwerp vir nie-katalitiese heterogene reaksies.*

- *Reaksietenks en -torings kan ontwerp vir gas-vloeistof-reaksies met adsorpsie.*
- *Multi-fase reaktore kan ontwerp en biochemiese reaktore kan ontleed.*
- *Reaktore kan ontleed en ontwerp.*

Vaardighede:

- *Besef die belangrikheid van optimale chemiese reaktorontwerp vir die chemiese industrie.*
- *Voorspel nie-ideale vloeipatrone en ontwikkel toepaslike modelle vir die vloei.*
- *Ontwerp reaktore met heterogene katalitiese reaksies wat komplekse kinetika het.*
- *Inagneming van de-aktivering van kataliste tydens 'n heterogene reaksie.*
- *Ontwerp van tenke en torings vir gas-vloeistof reaksies.*
- *Ontwerp van multi-fase-reaktore, sowel as biochemiese reaktore.*

Module code: CEMI417	**Semester 1**	**NQF level: 8**

Name: **Process Control** */ Naam:* ***Prosesbeheer***

Module outcomes:

After successful completion of this module, students should have:

Knowledge:

- Detailed knowledge of measuring equipment (sensors) as well as actuators (valves, conveyor belts) for efficient design of control systems.
- A thorough understanding of feedback control theory, stability criteria and tuning techniques.
- A thorough understanding and knowledge of advanced control systems.
- Knowledge and understanding of control strategies and techniques for multivariable control systems.
- Knowledge in designing and implementing plant-wide control strategies.

Skills:

- Skills to implement both simple feedback controllers as well as advanced controllers on existing process models and/or simulations.
- Mathematical and computer literacy to perform a frequency response analysis on processes and to efficiently use this information in the design of control systems.
- Ability to work individually and in groups.

Module uitkomste:

Na suksesvolle afhandeling van hierdie module moet die student oor die volgende beskik:

Kennis:

- *Gedetailleerde kennis van meetinstrumente (sensors) sowel as aktueerders (kleppe, vervoerbande) vir die effektiewe ontwerp van beheerstelsels.*
- *'n Deeglike begrip van terugvoerbeheer teorie, stabiliteitskriteria asook instemmingstegnieke.*
- *'n Deeglike begrip en kennis van gevorderde beheerstelsels.*
- *Kennis en begrip van beheerstrategieë en tegnieke wat van toepassing is op multiveranderlike beheerstelsels.*
- *Kennis in die ontwerp en implementering van aanlegwye beheerstrategieë.*

Vaardighede:

- *Vaardighede om beide terugvoerbeheerders asook gevorderde beheerders op bestaande prosesmodelle te modelleer en/of te simuleer.*
- *Wiskundige en rekenaargeletterdheid om 'n frekwensiegedrag analise op prosesse uit te voer en om hierdie inligting effektief aan te wend tydens die ontwerp van beheerstelsels.*
- *Die vermoë om beide individueel sowel as in groepe te kan werk.*

Module code: CEMI418	Semester 1	NQF level: 8

Name: **Ore Dressing /** *Naam:* ***Ertsbereiding***

Module outcomes:

After successful completion of this module, students should have:

Knowledge:

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

Skills:

- To integrate and apply the principles of separation equilibrium and kinetics to mineral processes.
- To simulate mineral plants and the associated process units with the help of available computer packages.
- To use the principles of ore commination and mineral liberation to design crushing circuits.
- To use the principles of mineral separation to design concentration processes.
- To safely use laboratory equipment during practicals.
- To be able to function effectively in groups.
- To communicate scientifically in different mediums.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:

- *Die beginsels van die sintese en ontwerp van mineraalaanlegte.*
- *Die prosesse van vrystelling en konsentrasie van belangrike minerale.*
- *Die tipes eenhede in bogenoemde prosesse en die bedryf daarvan.*
- *Steenkoolprosessering en -aanlegte.*

Vaardighede:

- *Om die beginsels van skeidingsewewig en -kinetika te integreer en op mineraalprosesse toe te pas.*
- *Om mineraal-aanlegte en die geassosieerde proses-eenhede te simuleer met behulp van beskikbare rekenaarpakkette.*
- *Om die beginsels van vrystelling en breking van minerale uit ertse te gebruik om malingskringlope te ontwerp.*
- *Om die beginsels van mineraalskeiding te gebruik om konsentrasieprosesse te ontwerp.*
- *Om die koppeling en die verbande tussen die prosesstappe te verstaan.*
- *Om laboratoriumtoerusting te gebruik tydens praktika.*
- *Om effektief in groepe te kan funksioneer.*
- *Om wetenskaplik in verskillende mediums te kan kommunikeer.*

Module code: CEMI419	Semester 1	NQF level: 8

Name: **Pyrometallurgy /** *Naam:* ***Pirometallurgie***

Module outcomes:
After successful completion of this module, students 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.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:

- *Verstaan metallurgiese termodinamiese beginsels soos gebruik in pirometallurgiese prosesse.*
- *Kennis oor vuurvaste materiale.*
- *Kennis oor oonde en hulle konstruksie.*

Vaardighede:

- *In staat wees om die Wette van Termodinamika in relevante pirometallurgiese probleme te gebruik.*
- *Gebruik Ellingham-diagramme om voorspellings oor pirometallurgiese aanleg-operasies te maak.*
- *Onderskei tussen oksied/nie-oksied en suur/basiese/neutrale vuurvaste materiale en konstrueer eenvoudige fasediagramme vir die belangrikste vuurvaste materiale.*
- *Bepaal aanlegkondisies van die vuurvaste materiale vanaf die fasediagramme.*
- *Bespreek die klassifikasiebeginsels van vuurvaste materiale.*
- *Voer verbrandingsberekeninge uit soos gebruik in pirometallurgiese prosesse.*
- *Onderskei tussen chemiese en fisiese voorbereidingsprosesse.*
- *Verstaan direkte reduksie van hematiet en los relevante probleme op.*
- *Verstaan kopermetallurgie, voer relevante besprekings en los probleme op.*
- *Beskryf die reduksie van vaste oksiedertse en doen berekeninge.*
- *Bespreek die karbotermiese reduksie van ferrolegering.*
- *Beskryf die reduksie van alumina.*

- *Bepaal chemiese vergelykings en los probleme op.*
- *Gee ’n kort beskrywing van ’n raffineringsproses.*
- *Voer ’n navorsingsprojek uit oor ’n relevante pirometallurgiese proses.*

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

Name: **Vacation Training seniors** / *Naam:* ***Vakansie-opleiding 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 a) daily operations and/or b) engineering problem-solving and/or c) engineering design and/or d) engineering project work, under the guidance of a practising engineer.

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.

Module assessment:
A student is expected to submit a short report on the work done during this period. The report should include, but is not limited to, a) The employer’s details, b) Detail on the type of work done, c) The outcome of the work done and d) The employer’s report.

Hierdie is ’n verpligte bywoningsmodule vir ’n tydperk van vier tot ses weke gedurende die vakansie.

Moduledoelwit:
Studente word gedurende dié vakansie-opleiding blootgestel aan a) die daaglikse bedrywighede en/of b) probleemoplossing in ingenieurswese en/of c) ingenieursontwerp en/of d) projekwerk in ingenieurswese, onder die toesig van ’n praktiserende ingenieur.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student ’n begrip te hê van die vaardighede waaroor ’n professionele ingenieur moet beskik, die proses van ingenieurswese en probleemoplossing.

Module assessering:
Dit word van ’n student verwag om ’n kort verslag oor die werk gedoen gedurende hierdie typerk in te handig. Die verslag moet onder andere die volgende bevat (maar is nie beperk tot slegs hierdie nie): a) Die werkgewer se inligting, b) Inligting oor die tipe werk wat gedoen is, c) die uitkomste van die werk wat gedoen is en d) die werkgewer se verslag.

Module code: CEMI477	Semester 2	NQF level: 8

Name: **Plant Design II /** *Naam:* ***Aanlegontwerp II***

Module outcomes:

After successful completion of this module, students should have:

Skills:

- Design a technically and economically viable process plant.
- Effectively communicate in writing and orally the designed process plant as well as all aspects related to the process by which the plant was designed.
- Critically assess the impact of engineering activities on the social, industrial and physical environment.
- Effectively work as an individual in teams and in multidisciplinary environments.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:

- *Ontwerpaspekte van welbekende aanlegte.*
- *Die omvang van 'n volledige aanlegontwerpprojek.*
- *Ekonomiese beoordeling van 'n aanleg.*
- *Die konsep van geoptimiseerde hitte-integrasie.*
- *Vorige kennis soos verwerf in voorafgaande modules, word geïntegreer.*

Vaardighede:

- *Kundigheid in die gebruik van moderne inligtingsbronne.*
- *Implementering van hiërargiese metode vir aanlegontwerp en die vaardighede om enige aanlegontwerp te analiseer.*
- *Kommunikasievaardighede (mondeling, skriftelik, individueel of in groepe).*
- *Uitvoering van hitte-integrasie-analise volgens knyptegnieke vir hitteruilers, distillasiekolomme en hittepompe.*
- *Uitvoering van 'n Hazop-analise vir 'n konseptuele ontwerp.*
- *Om kreatiewe prosedurele en nie-prosedurele ontwerp en sintese van komponente, stelsels, bedrywe, produkte of prosesse uit te voer (ECSA ELO 3).*
- *Om skriftelik en mondeling effektief te kommunikeer met ingenieurs, asook met 'n wyer gemeenskap (ECSA ELO 6).*
- *Om 'n kritiese bewustheid van die impak van ingenieursaktiwiteite op die sosiale, industriële en fisiese omgewing te ontwikkel (ECSA ELO 7).*
- *Om effektief as 'n individu in spanne en in multidissiplinêre omgewings te werk (ECSA ELO 8)*

Module code: CEMI479	Year course	NQF level: 8

Name: **Project /** *Naam:* ***Projek***

Module outcomes:

After successful completion of this module, students should have:

Knowledge:

- Planning of engineering projects.
- Literature surveys.
- Processing and interpretation of results.
- Reporting of results, both written and oral.
- The use of advanced analytical equipment.

Skills:

- Conceptualise a research problem.
- Conduct a literature survey to obtain the necessary knowledge regarding a specific problem.
- Formulate a hypothesis that can lead to laboratory planning.
- Plan a laboratory investigation according to known research methodologies.
- Obtain the physical apparatus to conduct the investigation.
- Complete the research process.
- Report results through oral presentations and poster presentations.
- Report research results in a written report complying with acceptable levels of style, language and grammar.
- Integrate prior knowledge and skills for problem-solving.
- Use advanced analytical equipment.
- Manage project to meet set milestones and complete project on time.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis:

- *Beplanningsmetodes van ingenieursprojekte.*
- *Metodiek van literatuursoektogte.*
- *Kennis oor die spesifieke navorsingsonderwerp.*
- *Metodes van data verwerwing, verwerking, interpretasie en aanbieding.*
- *Gebruik en werking van laboratorium- en analitiese apparaat.*
- *Laboratoriumveiligheid.*

Vaardighede:

- *Om navorsingsprobleme te kan konseptualiseer en formuleer.*
- *Om 'n literatuurstudie te onderneem.*
- *Om 'n hipotese te formuleer.*
- *Om 'n navorsingsprojek te beplan volgens aanvaarde metodiek.*
- *Om die nodige apparaat te verkry, of ontwerp en laat bou.*
- *Om laboratoriumapparaat te bedryf.*
- *Interim en finale verslagdoening, deur middel van plakkate, mondelinge aanbiedings en geskrewe verslae.*

Module code: CMPG111	Semester 1	NQF Level: 5

Name: **Introduction to Computing and Programming /**
*Naam**: Inleiding tot Rekenaarwese en Programmering***

Module outcomes:
After the successful completion of this module, the student should demonstrate:

Knowledge scope: basic / fundamental / elementary knowledge / informed understanding

- Fundamental knowledge of the main areas of the computer science discipline including system areas and application areas.

Methods and procedures: identify, select, organise and implement standard methods / procedures / rules / formulas

- The ability to identify, select and implement standard procedures and methods related to the manipulation of spreadsheets and database tables with a view to organise, process and present data and transfer data between different applications.
- The ability to identify, select and implement standard structured programming methods related to computer programming with a view to solve simple computational problems.

Practical skill: demonstrate / implement / apply a basic practical skill

- The ability to apply knowledge of tables, computations and functions in order to manipulate data on spreadsheets and database tables;

Basic problem-solving skill

- The ability to identify, analyse and define basic problems specific to the field of computer programming.
- The ability to select from a range of possible options the best solution to a discipline-specific problem and to apply the solution to support progress in the practice of designing and implementing structured programs.

Identify ethical and professional behaviour

- Identify social and ethical issues in the field of IT.

Module uitkomste:
Na afloop van die suksesvolle voltooiing van hierdie module, behoort die student die volgende te kan demonstreer:

Kennisbasis: basies / fundamenteel / elementêre kennis / ingeligte begrip

- *Fundamentele kennis van die hoofareas van die rekenaarwetenskapsdissipline insluitend stelsel- en toepassingsareas.*

Metodes en prosedures: identifiseer, selekteer, organiseer en implementeer standaard metodes / prosedures / reëls / formules

- *Die vermoë om standaardprosedures en -metodes in verband met die manipulasie van sigblaaie en databasisse te identifiseer, selekteer en te implementeer, om data sodoende te organiseer, verwerk, voor te stel en tussen verskillende toepassings oor te dra.*
- *Die vermoë om standaard gestruktureerde programmeringsmetodes te identifiseer, selekteer en te implementeer, om sodoende eenvoudige probleme met die rekenaar op te los.*

Praktiese vaardigheid: demonstreer / implementeer / pas 'n basiese praktiese vaardigheid toe

- *Die vermoë om kennis van tabelle, berekeninge en funksies toe te pas om sodoende data op sigblaaie en databasistabelle te manipuleer.*

Basiese probleemoplossingsvaardighede

- *Die vermoë om basiese probleme, spesifiek tot die veld van rekenaarprogrammering, te identifiseer, ontleed en te definieer.*
- *Die vermoë om die beste oplossing uit 'n versameling moontlikhede van 'n dissipline-spesifieke probleem te kies en om deur toepassing van die oplossing die praktyk van ontwerp en implementering van gestruktureerde programme te bevorder.*

Identifiseer etiese en professionele gedrag

- *Identifiseer sosiale en etiese kwessies in die veld van IT.*

Module code: CMPG115	**Semester 1**	**NQF Level: 5**

Name: **Programming for Engineers I /** *Naam***:** ***Programmering vir Ingenieurs I***

Module outcomes:

On completion of this module, the student should be able to demonstrate a thorough knowledge of, and skill in the underlying principles, methods and the application of the following topics:

- Knowledge of and insight in the basic structure, data types, and functions, including structured problem-solving and debugging, testing and execution of applications of a structured programming language.
- The student will have to demonstrate that he/she can apply the acquired knowledge and insight to solve elementary problems, develop an algorithm to solve problems, codify the algorithm, and to debug, test and execute it on the computer.

Module uitkomste:

Na voltooiing van die module, behoort die student 'n deeglike kennis van, en vaardigheid in die onderliggende beginsels, metodes en toepassing van die volgende onderwerpe te kan demonstreer:

- *Basiese kennis en insig oor 'n gestruktureerde programmeringstaal se basiese strukture, datatipes, funksies asook gestruktureerde probleemoplossing wat insluit: ontfouting, toetsing en uitvoering van toepassings.*
- *Die student sal kan bewys lewer dat hy/sy die kennis en insig wat verwerf is, kan toepas ten opsigte van eenvoudige probleemoplossing met programmering, 'n algoritme kan ontwikkel om die probleem op te los, die algoritme kan implementeer (kodeer), ontfout, toets en uitvoer met behulp van die rekenaar.*

Module code: CMPG121	Semester 2	NQF Level: 5

Name: **Structural Programming /** *Naam***:** ***Gestruktureerde Programmering***

Module outcomes:
After the successful completion of this module, the student should demonstrate:

Knowledge scope: basic / fundamental / elementary knowledge / informed understanding

- Fundamental knowledge of the main areas of structured programming including the basic structure, data types and functions.
- Knowledge of more advanced structured programming aspects such as arrays, records, file input and output, sorting and recursion.

Methods and procedures: identify, select, organise and implement standard methods / procedures / rules / formulas

- The ability to use structured programming constructs in designing, coding, debugging, testing and execution of applications in a procedural programming language.
- The ability to understand basic representation of data in computer memory.

Practical skill: demonstrate / implement / apply a basic practical skill

- The ability to apply knowledge of programming constructs to develop algorithms to solve programming problems.

Basic problem-solving skill

- The student should be able to demonstrate that he/she can apply the acquired knowledge and insight to solve elementary problems by developing algorithms, code the algorithms in a procedural language, and debug and test it on the computer.

Identify ethical and professional behaviour

- Identify social and ethical issues in the field of programming.
- Doing arithmetical calculations.
- Using Java's decision-making structures (choice) 'if' and 'switch' in problem-solution scenarios.
- Using the repetitive structures of Java (loops) 'while', 'do-while' and 'for' in problem-solution scenarios.
- Writing structured classes and programmes that yield neat output.
- Use classes and methods already defined in Java.
- Create and use methods for modular programming.
- Use one and two-dimensional vectors (arrays) as internal storage structures.

Module uitkomste:
Na afloop van die suksesvolle voltooiing van hierdie module, behoort die student die volgende te kan demonstreer:

Kennisbasis: basies / fundamenteel / elementêre kennis / ingeligte begrip

- *Fundamentele kennis van die hoofareas van gestruktureerde programmering insluitend die basiese struktuur, datatipes en funksies.*
- *Kennis van meer gevorderde gestruktureerde programmeringsaspekte soos skikkings, rekords, lêertoevoer en -afvoer, sortering en rekursie.*

Metodes en prosedures: identifiseer, selekteer, organiseer en implementeer standaard metodes / prosedures / reëls / formules

- *Die vermoë om gestruktureerde programmeringskonstrukte te gebruik tydens die ontwerp, kodering, ontfouting, toetsing en uitvoering van toepassings in 'n prosedurele programmeringstaal.*
- *Die vermoë om basiese voorstelling van data in die geheue van die rekenaar te verstaan.*

Praktiese vaardigheid: demonstreer / implementeer / pas 'n basiese praktiese vaardigheid toe

- *Die vermoë om kennis van programmeringskonstrukte toe te pas om algoritmes te ontwikkel om programmeringsprobleme op te los.*

Basiese probleemoplossings vaardighede

- *Die student behoort te kan demonstreer dat hy/sy die toepaslike kennis en insig kan gebruik om elementêre probleme op te los deur algoritmes te ontwikkel, die algoritmes te kodeer in 'n prosedurele taal, dit te ontfout en op 'n rekenaar te toets.*

Identifiseer etiese en professionele gedrag

- *Identifiseer sosiale en etiese kwessies in die veld van programmering.*
- *Doen rekeningkundige berekenings.*
- *Gebruik Java se besluitnemingstrukture en wysig na probleemoplossings scenarios.*
- *Gebruik die herhalende strukture van Java ('loops') vir gebruik in probleemoplossings scenarios.*
- *Die skryf van klasse en programme wat netjiese uitset lewer.*
- *Gebruik van klasse en metodes wat in Java gedefinieer is.*
- *Skep en gebruik metodes vir modulêre programmering.*
- *Gebruik een- en tweedimensionele vektore (skikkings) as interne stoorstrukture.*

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

Name: **Power Systems I /** *Naam:* ***Kragstelsels 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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Die basiese beginsels van enkelfrekwensie-drywingdefinisies vir albei enkel- en drie-fase-kragstelsels, toepassing van die admittansiematriks, transformatorbeginsels en modellering, die per-eenheid stelsel, simmetriese komponente, gestadigdetoestand transmissielyn-werking en -modellering bemeester het; en*
- *Kragstelsels onder gestadigdetoestande kan analiseer.*

Module code: EEII327	Semester 2	NQF level: 7

Name: **Electrical Design /** *Naam:* ***Elektriese Ontwerp***

Module objective:

This module introduces the systems engineering process. A customised version of this process is applied to a complex engineering problem. Due to the scope and complexity of engineering problems, a high degree of teamwork is required.

Module outcomes:

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

- Understands the systems engineering process;
- Can apply design guidelines and constraints;
- Can interpret a development specification and the allocation of requirement;
- Apply a customised systems engineering process on a complex engineering project;
- Can successfully work as an individual and in groups; and
- Use appropriate CAD, simulation and other relevant engineering software tools during the design process.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Algemene projek- en verkrygingsbestuurstegnieke verstaan en kan toepas, produk-lewensiklusse kan bestuur, 'n konsepsionele en voorlopige ontwerp kan voltooi, elemente van detailontwerp kan afhandel en ontwerphulpbronne en -tegnieke kan bestuur;*
- *Suksesvol as 'n enkeling en in groepe kan werk;*
- *Ontwerpriglyne en -beperkinge kan toepas; en*
- *'n Ontwikkelingspesifikasie en die toewysing van vereistes kan interpreteer.*

Module code: EEII414	Semester 1	NQF level: 8

Name: **Power Systems II /** *Naam:* ***Kragstelsel II***

Module outcomes:

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

- Has the ability to perform loadflow studies and transients stability studies for complex power systems;
- Has applied knowledge of flexible AC transmission system (FACTS) devices relevant to power systems;
- Has applied knowledge and skills in various renewable and non-renewable power sources including the interaction of these in interconnected power systems;
- Has applied knowledge of and engagement in power system voltage and frequency control;
- Has applied knowledge and skills of power system technical performance including power quality.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Die vermoë het om lasvloei en stabiliteitsstudies in komplekse kragstelsels te doen;*
- *Toegepaste kennis het van FACTS ("flexible AC transmission systems") soos toepaslik in kragstelsels;*
- *Toegepaste kennis het in verskeie hernubare en nie-hernubare kragbronne asook die interaksies binne die saamgestelde kragstelsel;*
- *Toegepaste kennis van en toepassing van kragstelsel spanning en frekwensiebeheer het;*
- *Toegepaste kennis en analise van kragstelsel tegniese prestasie asook kragkwaliteit het.*

Module code: EEII413	Semester 2	NQF level: 8

Name: **Power Electronics /** *Naam:* ***Drywingselektronika***

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
- Can successfully build a converter to control an electrical machine.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Die funksionering van verskeie drywingselektroniese skakelaars insluitende diodes, transistors, MOSFET's, tiristors en IGBT's van verskeie omsetter-topologieë bemeester het;*
- *Die fisika en skakel-oorgange van verskillende skakelaars begryp;*
- *Die verliese, geassosieer met verskillende skakelaars, kan bereken;*
- *Skakelaars in verskeie omsetter-topologieë kan toepas; en*
- *'n Omsetter om 'n elektriese masjien te beheer, suksesvol kan bou.*

Module code: EEII423	Semester 2	NQF level: 8

Name: **Power Systems III /** *Naam:* ***Kragstelsels III***

Module outcomes:

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

- Has the ability to design, specify and evaluate distribution power systems;
- Has applied knowledge and skills of energy studies and electricity tariffs;
- Has the ability to specify, design and evaluate electrical protection schemes;
- Has applied knowledge and skills in the application of IEC 61850 principles.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Die vermoë het om distribusiestelsels te ontwerp, spesifiseer en evalueer;*
- *Toegepaste vermoë en kennis het van energie studies en elektrisiteitstariewe;*
- *Die vermoë het om beskermingstelsels the ontwerp, spesifiseer en evalueer;*
- *Toegepaste kennis en vermoëns het in die toepassing van IEC 61850 beginsels.*

Module code: EERI124	Semester 2	NQF level: 5

Name: **Electrotechnique I /** *Naam:* ***Elektrotegniek I***

Module outcomes:

The outcomes have been mastered when the student can:

- Successfully demonstrate the application of Ohm's law;
- Successfully demonstrate the application of Kirchhoff's laws; and
- Perform circuit analysis on simplistic circuits consisting of only resistive networks.

Assessment criteria:

After successful completion of the module, the student should demonstrate:

- Basic knowledge of common circuit elements such as resistors, voltage sources, and current sources;
- The ability to identify Ohm's law and Kirchhoff's' laws and apply Ohm's law to resistor networks in series, parallel, and star/delta configurations;
- Application of basic circuit analysis to both known and unknown circuits;
- Implementation of circuit analysis techniques (node voltages and mesh currents);
- Effective command of equivalent circuit transformations (Thevenin and Norton equivalents); and
- The ability to solve basic electronic circuit problems.

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.

Module code: EERI215	Semester 1	NQF level: 6

Name: **Electrotechnique II /** *Naam:* ***Elektrotegniek II***

Module outcomes:

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

- Detailed knowledge and clear understanding of capacitors and inductors;
- Insight into steady-state alternating current circuit analysis (phasors and the concept of impedance);
- Thorough understanding and the ability to calculate power in alternating current networks;
- The capability to perform basic transient analysis of simple RL and RC circuits;
- A basic understanding of operational amplifiers (ideal devices only); and
- The ability to solve simplistic problems that require integration of knowledge from Electrotechnique I (EERI124).

Assessment criteria:

The outcomes have been mastered when the student can:

- Apply circuit analysis techniques to complex circuits consisting of R, L, and C devices;
- Perform analysis of simplistic alternating current circuits;
- Determine the transient response of basic RL and RC circuits;
- Develop basic circuits with the operational amplifier as the core element.

Module code: EERI221	Semester 2	NQF level: 6

Name: **Electrical Systems I /** *Naam:* ***Elektriese Stelsels I***

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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *'n Grondige kennis opgedoen het van basiese eenhede en afgeleide eenhede, asook die per-eenheid stelsel van meting en die fundamentele beginsels van elektrisiteit en meganika, elektriese netwerkbeginsels en aktiewe, reaktiewe en komplekse drywing in enkel- en drie-fase lineêre netwerke onder gestadigdetoestande;*
- *Vaardighede het om per-eenheid waardes te gebruik om berekeninge te doen; en*
- *Elektriese netwerkteorie en stroombaanwette kan gebruik om die werking van masjiene onder gestadigdetoestand te analiseer en wiskundige modelle vir hulle af te lei. Die student behoort ook in staat te wees om die gestadigdetoestand-werking van enkel en drie-fase netwerke wiskundig te analiseer.*

Module code: EERI222	Semester 2	NQF level: 6

Name: **Signal Theory I /** *Naam:* ***Seinteorie I***

Module outcomes:

<u>Knowledge</u>

- Knowledge about the basic properties and behaviour of continuous time, linear time invariant systems; and
- Knowledge of the properties and limitations of the Fourier series and the Fourier-transform.

<u>Skills</u>

- Ability to describe basic signals with mathematical equations and to analyse these signals using Fourier series and the Fourier-transform;
- Ability to analyse linear time invariant systems in both the time and frequency domain to obtain knowledge about the behaviour and compute the response of such systems to arbitrary input signals; and
- Ability to design lower order passive Butterworth, Chebyshev and Elliptic filters in both the high pass, low pass, band pass and band stop format.

Module uitkomste:

<u>Kennis</u>

- *Kennis oor die basiese eienskappe en gedrag van deurlopende tyd, lineêre tyd-onafhanklike stelsels; en*
- *Kennis van die eienskappe en beperkings van die Fourier-reeks en die Fourier-transform.*

<u>Vaardighede</u>

- *Vermoë om basiese seine met wiskundige vergelykings te beskryf en om hierdie seine met behulp van Fourier-reekse en die Fourier-transform te analiseer;*

- *Vermoë om lineêre tyd-onafhanklike stelsels in beide die tyd- en frekwensie domein te analiseer om kennis op te doen oor die gedrag en responsie van sulke stelsels op willekeurige insetseine; en*
- *Vermoë om lae-orde passiewe Butterworth-, Chebyshev- en Elliptiese filters in die hoëdeurlaat-, laedeurlaat-, banddeurlaat- en bandstopformate te ontwerp.*

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

Name: **Electronics I /** *Naam:* ***Elektronika I***

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
- 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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *'n Grondige kennis verkry het van elementêre halfgeleierfisika, pn-vlakke, toepassing, analise en ontwerp van diode stroombane, gelykstroom- en wisselstroom-werking van bipolêre en veldeffek-transistors, versterkerkonfigurasies, modellering, toepassing, ontwerp en analise van analoogversterkers, basiese eienskappe en gedrag van deurlopende tyd, lineêre tyd invariante stelsels; en*
- *Die vermoë ontwikkel het om modelle van diodes en transistors te gebruik in die analise van stroombane gedurende die toepassing en ontwerp van analoog-elektroniese stroombane.*

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

Name: **Linear Systems I** *Naam:* ***Lineêre Stelsels***

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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *'n Beheersende vermoë verkry het om analoogstroombane te analiseer deur gebruikmaking van die Laplace-transformtegniek, die konvolusie-integraal en om die oordragfunksie van analoogstroombane te bepaal;*
- *'n Vermoë verkry het om analoogstroombane te analiseer deur toepassing van beginsels van die fisika;*

- *Die kenmerke van verskillende benaderingsfunksies vir filterontwerpe kan bepaal, asook tegnieke om die benaderingsfunksies prakties te implementeer; en*
- *'n Beheersende vermoë verkry om aktiewe analoogfilters deur gebruikmaking van verskillende metodes te ontwerp en om die ontwerpe op verskillende maniere te implementeer deur gebruikmaking van Bode-diagramme en ander tegnieke.*

Module code: EERI311	**Semester 1**	**NQF level: 7**

Name: **Electrical Systems II /** *Naam:* ***Elektriese Stelsels II***

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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *'n Beheersende vermoë verkry het om die prestasie van elektromagnetiese omsetters, d.w.s. transformators, induksiemotors en sinkrone-masjiene te analiseer; en*
- *Die fisika en teorie van transformators, induksiemotors en sinkrone-masjiene verstaan en kan aanwend in praktiese toepassings deur gebruikmaking van komplekse algebra.*

Module code: EERI313	**Semester 1**	**NQF level: 7**

Name**: Electromagnetics /** *Naam:* ***Elektromagnetika***

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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *'n Grondige kennis het van die beginsels van transmissie en refleksie van elektromagnetiese golwe, golfleiers, die modellering van transmissielyne en golfleiers as elektriese komponente, die stralingspatrone van antennes en die elektriese en magnetiese velde in verskeie toepassings;*
- *Die verkreë kennis kan gebruik om golfleiers en stralingspatrone van antennes te modelleer en te analiseer en om die elektriese en magnetiese velde in verskeie toepassings te bereken; en*
- *Elektromagnetiese probleme kan opstel en numeries oplos om sodoende in staat te wees om rekenaarpakkette te kan gebruik om dié probleme op te los.*

Module code: EERI318	Semester 1	NQF level: 7

Name: **Electronics II /** *Naam:* ***Elektronika 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 co-operate 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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Gevorderde standaard-konfigurasies van aktiewe komponente ken;*
- *Kundig is in die analisering en ontwerp van terugkoppeling, multi-stadium en kragversterkers as geïntegreerde stroombane;*
- *Die vermoë het om die frekwensie en tydrespons van elektroniese stroombane te bepaal;*
- *Sein-beskrywings kan manipuleer in 'n ortogonale ruimte met besondere verwysing na seine in die frekwensiedomein; en*
- *Moduleringtegnieke kan gebruik vir die ontwerp en analise van inligtingskanale vir oordrag van analoog- of digitale inligting.*

Module code: EERI321	Semester 2	NQF level: 7

Name: **Control Theory I /** *Naam:* ***Beheerteorie I***

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, and model systems through state space representation.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Die hoofelemente van moderne analoogbeheerstelselteorie bemeester het, nl. modelbeheerstelselkomponente, bepaling van gestadigdetoestand-foute en dinamiese responsie, uitvoer van stabiliteitsanalise, frekwensie-responsievoorstellings, beheerderontwerp en simulering en toestandruimte-modellering van stelsels;*
- *Blokdiagramme van stelsels kan opstel, stelsels modelleer, gestadigdetoestand-foute en dinamiese response kan bepaal; en*

- *Stabiliteitsanalise met Routh-Hurwitz- en wortellokus-metodes kan uitvoer, frekwensie-responsie-voorstellings deur gebruikmaking van Bode-diagramme en ander kan uitvoer, stelselresponsie deur simulasiemodelstelsels deur toestandruimte-representasie kan verifieer.*

Module code: EERI324	**Semester 2**	**NQF level: 7**

Name: **Principles of measurement /** *Naam:* ***Beginsels van Meting***

Module outcomes:

After completion of the EERI324 module, the student should demonstrate:

- Understanding of the underlying principles of measurement devices, such as heat, pressure, and flow transducers;
- A fundamental understanding of the error in measurement;
- Detailed knowledge of various types of sensors;
- The ability to analyse a sensor system's performance;
- The ability to design a measurement system based on specified performance limits; and
- Advanced practical skill in the construction of a measurement system with specific performance requirements.

Assessment criteria:

The outcomes have been mastered when the student can:

- Successfully deploy a sensor to accomplish a specific measurement task;
- Select an appropriate actuator for a given task; and
- Fundamentally calculate error in measurement and the associated actuation.

Module code: EERI325	**Semester 2**	**NQF level: 7**

Name: **Signal Theory II /** *Naam:* **Seinteorie II**

Module objective:

The purpose of the Signal Theory II module is to teach the student the basic principles of digital signal theory. The differences between analogue signal theory and digital signal theory are discussed throughout the course as well as the advantages and disadvantages of digital signal theory. At the end of the course the student will be able to analyse basic digital signal processing systems.

Module outcomes:

In this module the student obtains the ability to analyse discrete-time systems, to mathematically formulate the relationship between discrete-time systems and analogue systems and to realise discrete-time systems using different methods. The student also learns how to handle discrete-time systems using Fourier-transform. In the practicum sessions industry problems are addressed and solved using digital signal processing principles.

Module uitkomste:

In hierdie module verwerf die student die vermoë om diskrete tydstelsels te analiseer, om die verwantskap tussen diskrete tydstelsels en analoogstelsels wiskundig te formuleer en om diskrete tydstelsels te hanteer met behulp van verskillende metodes. Die student leer hoe om diskrete tydstelsels te hanteer met behulp van Fourier-transform. In die praktiese sessies word bedryfsprobleme aangespreek en opgelos met behulp van digitale seinverwerkingsbeginsels.

Module code: EERI414	**Semester 1**	**NQF level: 8**

Name: **Signal Theory III /** *Naam:* ***Seinteorie III***

Module outcomes:

- In this module the student obtains the ability to handle discrete-time systems in the z-domain, to work with discrete-time systems in the transform domain and to understand digital filter structures.
- The student also learns to design IIR and FIR digital filters. In the practicum sessions industry problems are addressed and solved using digital signal processing principles.

Module uitkomste:

- *In hierdie module verwerf die student die vermoë om diskretetyd-stelsels in die z-domein te hanteer, om te werk met diskretetyd-stelsels in die transformasie-domein en digitalesein-filterstrukture te verstaan.*
- *Die student leer ook om IIR- en FIR-digitale filters te ontwerp. In die praktiese sessies word bedryfsprobleme aangespreek en opgelos met behulp van digitale sein-verwerkingsbeginsels.*

Module code: EERI415	**Semester 1**	**NQF level: 8**

Name: **Telecommunication Systems /** *Naam:* ***Telekommunikasiestelsels***

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 synthesisers; and
- Is able to analyse optical networks.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Die basiese beginsels waarop radio- en optiese kommunikasie berus, verstaan;*
- *In staat is om verskillende radio- en optiese kommunikasiestelsels te vergelyk en evalueer;*
- *In staat is om radiogebaseerde kommunikasiestelsels insluitende sellulêre stelsels, ontvangers en senders, mengers, fasesluit-lusse en frekwensie-sintetiseerders te karakteriseer, analiseer en ontwerp; en*
- *In staat is om optiese netwerke te analiseer.*

Module code: EERI418	**Semester 1**	**NQF level: 8**

Name: **Control Theory II /** *Naam:* ***Beheerteorie II***

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.

Module uitkomste:

Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Toestandveranderlike terugkoppelingstelsels kan ontwerp en wiskundige modelle van eenvoudige lineêre stelsels kan opstel;*
- *Die z-transform en inverse z-transform kan toepas en monsterneming en rekonstruksie kan beskryf;*
- *Die puls-oordragfunksies vir ooplus- en geslotelus-stelsels kan bepaal;*
- *Die tydresponsie-kenmerke van ooplus- en geslotelus-stelsels kan bepaal;*
- *Die stabiliteit van digitale stelsels kan bepaal;*
- *Die werking en toepassing van kunsmatige neurale netwerke en wasige logika-stelsels kan beskryf;*
- *Digitale beheerders volgens voorafbepaalde kriteria kan ontwerp;*
- *Die impak van ingenieursaktiwiteite op die gemeenskap en die omgewing kan analiseer; en*
- *Take of projekte in groepsverband kan afhandel.*

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

Name: **Vacation training seniors /** *Naam:* ***Vakansie-opleiding seniors***

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

Module objective:

During vacation training, students are exposed to a) daily operations and/or b) engineering problem-solving and/or c) engineering design and/or d) engineering project work, under the guidance of a practising engineer.

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.

Module assessment:
A student is expected to submit a short report on the work done during this period. The report should include, but is not limited to, a) The employer's details, b) Detail of the type of work done, c) The outcome of the work done and d) The employer's report.

Hierdie is 'n verpligte bywoningsmodule vir 'n tydperk van vier tot ses weke gedurende die vakansie.

Moduledoelwit:
Studente word gedurende dié vakansie-opleiding blootgestel aan a) die daaglikse bedrywighede en/of b) probleemoplossing in ingenieurswese en/of c) ingenieursontwerp en/of d) projekwerk in ingenieurswese, onder die toesig van 'n praktiserende ingenieur.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student 'n begrip te hê van die vaardighede waaroor 'n professionele ingenieur moet beskik, die proses van ingenieurswese en probleemoplossing.

Module assessering:
Dit word van 'n student verwag om 'n kort verslag oor die werk gedoen gedurende hierdie typerk in te handig. Die verslag moet onder andere die volgende bevat (maar is nie beperk tot slegs hierdie nie): a) Die werkgewer se inligting, b) Inligting oor die tipe werk wat gedoen is, c) die uitkomste van die werk wat gedoen is en d) die werkgewer se verslag.

Module code: EERI474	**Year module**	**NQF level: 8**

Name: **Project /** *Naam:* ***Projek***

Module objective:
This module serves as part two of the final year capstone project. The aim of the project module is to lead students to solve a comprehensive practical engineering problem. Through the demonstrations, presentations, and written reports students must demonstrate their competence in the following:

- Problem-solving;
- Engineering design and synthesis;
- Professional and technical communication;
- Individual working ability;
- Independent learning ability; and
- Engineering professionalism.

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

- Can adhere to an engineering design process;
- Can realise the detail design aspects of their assigned project;
- Can implement and test the functionality of the developed solution;
- Can evaluate the suitability of the developed solution;
- Can successfully present the developed solution to a panel;
- Can document the design, testing and evaluation of the solution; and
- Can demonstrate the functionality of the solution to a panel.

Moduledoelwit:
Hierdie module dien as deel twee van die finalejaar-sluitsteenprojek. Die doel van die projekmodule is om die student te lei om 'n omvattende praktiese ingenieursprobleem op te los. Deur demonstrasies, aanbiedings, en skriftelike verslae moet die student sy bevoegdheid in die volgende demonstreer:

- *Probleemoplossing;*
- *Ingenieursontwerp en sintese;*
- *Professionele en tegniese kommunikasie;*
- *Vermoë om individueel te werk;*
- *Onafhanklike leervermoë; en*
- *Ingenieursprofessionaliteit.*

Module uitkomste:
Om hierdie module suksesvol te voltooi, moet die student:

- *Nakoming van 'n ingenieursontwerpproses kan demonstreer;*
- *Die detailontwerpsaspekte van sy/haar toegewese projek kan verwerklik;*
- *Die ontwikkelde oplossing kan implementeer en die funksionaliteit daarvan kan toets;*
- *Die geskiktheid van die ontwikkelde oplossing kan evalueer;*
- *Die ontwikkelde oplossing suksesvol aan 'n paneel kan aanbied;*
- *Die ontwerp, toetsing en evaluering van die oplossing kan dokumenteer; en*
- *Die funksionaliteit van die oplossing aan 'n paneel kan demonstreer.*

Module code: FENG211	**Semester 1**	**NQF level: 6**
Name: **Understanding the World of Engineering**		

Module outcomes:
After successful completion of this module, the student shall have:
Knowledge*:*

- Detailed knowledge and clear understanding of the origins, composition, coherence and philosophical underpinnings of Engineering as a subject field.
- Knowledge and a clear understanding of prevalent schools of thought that affects the practice, implementation and developments in the fields of technology and engineering.
- A coherent understanding of the inter-relationship between science, technology and society, and the ability to use this framework to explain and interpret contemporary problems.
- Coherent knowledge, understanding and appreciation of ethics, social justice and diversity in the contexts in which engineers live and practice.
- The ability to communicate, collaborate and ethically engage with others by means of objective, reasonable, rational, and sound arguments.

Assessment criteria:

- Describe the historical development of science and engineering in Europe but also in other parts of the world.
- Comprehend the effect that philosophical underpinning had on the development of science and engineering.
- Differentiate between natural and engineering sciences.
- Describe the design process and comprehend the underlying assumptions and points of departure in the development and application of the design process.
- Present the characteristics and nature of a number of current foundational views.
- Describe their own worldview – both as an engineer and an individual.
- Describe the most important points of departure in the implementation of engineering and within the environmental, economic and social contexts.
- Provide examples by means of which the inter-wovenness of science, technology and society can be demonstrated.
- Understand the practice of the engineering profession in present-day South Africa.
- Present the characteristics and the influence of different world views and ideologies on the practice of engineering and technology.
- Explain how some world views and ideologies manifest in present-day society and give examples of the way in which such world views and ideologies influence the current society both technologically and economically.
- Use examples from engineering and technology to try and explain the causes, the interwoven nature and resultant discrepancies about the distribution of resources, diseases, etc.
- Demonstrate an understanding of the extent, range and impact of diversity in the contexts in which engineers live and practice – not only in South Africa but also the world.
- Demonstrate knowledge and a critical understanding of specific forms of ethics that apply to the field of study.
- As part of a multidisciplinary group, present an own point of view, both verbally and in writing.

Module code: FENG321	**Semester 2**	**NQF level: 7**

Name: **Engineering in the South African and Global Context /** *Naam:*

Module outcomes:
After successful completion of this module, the student shall have:

Knowledge*:*

- The ability to motivate their own and critically analyse alternative foundational views with regard to the implementation and impact of engineering and technology in the environmental, economic and social contexts.
- The ability to evaluate different approaches to managing contemporary problems and propose ways of dealing with these problems that will make a meaningful contribution within a diverse society as well as demonstrate an ethic of care and socialresponsibility.
- When interacting with others, demonstrate the ability to identify, analyse, critically reflect on and address complex issues and/or challenges related to engineering by means of objective, reasonable, rational, and sound arguments.

Assessment criteria:

- Present the characteristics and nature of a number of current foundational views.
- Be able to identify their own worldview – both as an engineer and an individual.
- Describe the most important points of departure in the implementation of engineering and within the environmental, economic and social contexts.
- Identify, prioritise and describe the most important points of departure in the implementation of engineering and substantiate their prioritisation within the environmental, economic and social contexts.
- Engage in conversation with persons who have different world views in a meaningful and constructive way when addressing current issues in engineering and society.
- Comprehend and analyse the interaction and interdependence between worldview, implementation and action – both as an engineer and an individual.
- Formulate, in writing or conversation, an own viewpoint.
- Evaluate and assess, in writing or conversation, another point of view in a way that meets the stated criteria.
- Work effectively as member of a multidisciplinary, multicultural task team to propose sound scientific solutions to a selection of contemporary societal challenges.

Module code: FENG411	**Semester 1**	**NQF level: 8**

Name: **Engineering Management /** *Naam: Ingenieursbestuur*

Module outcomes:
After successful completion of this module, the student will demonstrate:

- Knowledge of the system-, requirements-, and full life cycles;
- Capacity to apply management principles to ensure that engineering work is organised, efficient, and delivered on time;
- Application of cost-estimation and budgeting to engineering work;
- Risk mitigation strategies as applied to an engineering project;
- Efficiently working as part of a multidisciplinary team; and
- Clear communication skills in a multidisciplinary work environment.

Assessment criteria:

- Demonstrate active involvement in a multidisciplinary engineering team;
- Apply principles of risk management and project management to a project as a
- whole;
- Perform cost-estimation and budgeting to engineering projects; and
- Clearly demonstrate the capacity to communicate in a manner that is pursuant to
- the engineering objective at hand.

Module code: FENG421	**Semester 2**	**NQF level: 8**

Name: **Engineering Professionalism /** *Naam: Professionele Ingenieurswese*

Module outcomes:

After successful completion of this module, the student will demonstrate:

- Critical awareness of the impact of engineering activity on society and the
- natural world;
- Knowledge of what engineering professionalism encompasses; and
- Competence in evaluating the ethics associated with engineering activities.

Assessment criteria:

- Analyse an engineering project in term of the various impacts thereof, including, environmental, social, ethical, and financial;
- Reason about the ethical considerations associated with engineering works; and
- Demonstrate critical evaluation of the professional conduct of an engineer in practice.

Module code: INEM327	**Semester 2**	**NQF level: 7**

Name: **Electromechanical Design /** *Naam:* ***Elektromeganiese Ontwerp***

Module outcomes:

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

Knowledge*:*

Detailed understanding of the Systems Engineering process.

Skills*:*

- Teamwork;
- Documentation of engineering design;
- Execution of detailed engineering design; and
- Use of engineering tools in executing a development.

Assessment criteria:

Since projects are completed in teams, the learner's competence in working as a member of an engineering team (ELO 8), as well as independently, is assessed. The functionality of the final solution is used to assess the degree of teamwork that was achieved. The project scope necessitates a high degree of teamwork in order to be completed successfully.

Module code: INEM421	Semester 1	NQF level: 8

Name**: Electromechanical Systems Design /** Naam***: Elektromeganiese Stelselsontwerp***

Module outcomes:
After successful completion of this module, the student must demonstrate:

- In-depth and integrated knowledge of reliability concepts to be applied in the electrical and mechanical engineering environment;
- An ability to critically evaluate the inter-dependencies of different equipment within a process/system;
- An ability to integrate previous knowledge in different disciplines to assess processes and systems;
- Advanced ability to identify hazards and evaluate risk based on the inter-dependencies of different equipment within a process/system;
- An ability to critically evaluate the maintainability of different designs for a process/system;
- A critical understanding of the different trade-off options relating to reliability, availability, maintainability, and safety (RAMS); and
- A critical understanding of different maintenance philosophies and how, where and when to apply them.

Assessment criteria:
The student will prove that he/she has attained the outcomes of the INEM421 module when he/she can:

- Analyse the hazards associated with a given process/system;
- Analyse the risks and failure modes of a given process/system;
- Identify the reliability of a given process/system;
- Identify the reliability constraints of a given process/system;
- Identify suitable design criteria to design for maintainability;
- Recommend upgrades and enhancements to a given process/system to improve RAMS; and
- Design a suitable maintenance programme for a given system.

Module code: INEM471	Year module	NQF level: 8

Name: **Vacation Training seniors /** *Naam:* ***Vakansie-opleiding 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 a) daily operations and/or b) engineering problem-solving and/or c) engineering design and/or d) engineering project work, under the guidance of a practising engineer.

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.

Module assessment:
A student is expected to submit a short report on the work done during this period. The report should include, but is not limited to, a) The employer's details, b) Detail of the type of work done, c) The outcome of the work done and d) The employer's report.

Hierdie is 'n verpligte bywoningsmodule vir 'n tydperk van vier tot ses weke gedurende die vakansie.

Moduledoelwit:
Studente word gedurende dié vakansie-opleiding blootgestel aan a) die daaglikse bedrywighede en/of b) probleemoplossing in ingenieurswese en/of c) ingenieursontwerp en/of d) projekwerk in ingenieurswese, onder die toesig van 'n praktiserende ingenieur.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student ’n begrip te hê van die vaardighede waaroor ’n professionele ingenieur moet beskik, die proses van ingenieurswese en probleemoplossing.

Module assessering:
Dit word van ’n student verwag om ’n kort verslag oor die werk gedoen gedurende hierdie typerk in te handig. Die verslag moet onder andere die volgende bevat (maar is nie beperk tot slegs hierdie nie): a) Die werkgewer se inligting, b) Inligting oor die tipe werk wat gedoen is, c) die uitkomste van die werk wat gedoen is en d) die werkgewer se verslag.

Module code: INEM474	Year module	NQF level: 8

Name: **Project /** *Naam:* ***Projek***

Module objective:

This module serves as part two of the final year capstone project. The aim of the project module is to lead students to solve a comprehensive practical engineering problem. Through the demonstrations, presentations, and written reports the students must demonstrate their competence in the following:

- Problem-solving;
- Engineering design and synthesis;
- Professional and technical communication;
- Individual working ability;
- Independent learning ability; and
- Engineering professionalism.

Module outcomes:

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

- Can adhere to an engineering design process;
- Can realise the detail design aspects of their assigned project;
- Can implement and test the functionality of the developed solution;
- Can evaluate the suitability of the developed solution;
- Can successfully present the developed solution to a panel;
- Can document the design, testing and evaluation of the solution; and
- Can demonstrate the functionality of the solution to a panel.

Moduledoelwit:

Hierdie module dien as deel twee van die finalejaar-sluitsteenprojek. Die doel van die projekmodule is om die student te lei om 'n omvattende praktiese ingenieursprobleem op te los. Deur demonstrasies, aanbiedings, en skriftelike verslae moet die student sy bevoegdheid in die volgende demonstreer:

- *Probleemoplossing;*
- *Ingenieursontwerp en sintese;*
- *Professionele en tegniese kommunikasie;*
- *Vermoë om individueel te werk;*
- *Onafhanklike leervermoë; en*

Ingenieursprofessionaliteit.

Module uitkomste:

Om hierdie module suksesvol te voltooi, moet die student:

- *Nakoming van 'n ingenieursontwerpproses kan demonstreer;*
- *Die detailontwerpsaspekte van sy/haar toegewese projek kan verwerklik;*
- *Die ontwikkelde oplossing kan implementeer en die funksionaliteit daarvan kan toets;*
- *Die geskiktheid van die ontwikkelde oplossing kan evalueer;*
- *Die ontwikkelde oplossing suksesvol aan 'n paneel kan aanbied;*
- *Die ontwerp, toetsing en evaluering van die oplossing kan dokumenteer; en*
- *Die funksionaliteit van die oplossing aan 'n paneel kan demonstreer.*

Module code: INGB122	Semester 2	NQF level: 5

Name: **Introduction to Industrial Engineering /** *Naam:* ***Inleiding tot Bedryfsingenieurswese***

Module outcomes:

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

- Appreciate the role of the industrial engineer as process and system optimiser;
- Describe and measure any process in terms of process inputs, process transformation and process outputs;
- Select amongst work study and other process optimisation methodologies an appropriate methodology for a given problem;
- Execute the first step of process optimisation by documenting the process within context of the relevant methodology;
- Interpret, create and communicate through a variety of process drawings;
- Use work measurement techniques to determine standard process times;
- Show an understanding of the role of industrial engineers in various sectors of the industry;
- Show an understanding of various techniques (optimisation modelling, statistics and simulation modelling, operations and supply chain management, business management and engineering design) that industrial engineers can apply in order to define, design, refine and deploy physical and conceptual systems.

NOTE: Previous code INGB121

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module sal die student in staat wees om:

- *Die rol van die bedryfsingenieur as proses- en stelseloptimiseerder te kan waardeer;*
- *Enige proses in terme van die prosesinsette, prosesomsetting en prosesuitsette te kan beskryf en te meet;*
- *Uit werkstudie en ander proses optimeringsmetodologieë 'n toepaslike metode vir 'n gegewe probleem te kan kies;*
- *Die eerste stap van proses-optimalisering te kan uitvoer deur die dokumentering van die proses binne die konteks van die betrokke metode;*
- *Deur middel van 'n verskeidenheid van prosestekeninge te kan interpreteer, skep en kommunikeer;*
- *Werkmeettegnieke te kan gebruik om standaard-prosestye te bepaal;*
- *'n Begrip te toon van die rol van bedryfsingenieurs in verskeie sektore van die nywerheid; en*
- *'n Begrip te toon van verskeie tegnieke (optimering, statistiek en simulasie-modellering, operasionele en voorsieningskettingbestuur, besigheidsbestuur en ingenieursontwerp) wat bedryfsingenieurs kan toepas om fisiese en konseptuele stelsels te definieer, ontwerp, verfyn en ontplooi.*

Module code: INGB222	Semester 2	NQF level: 6

Name: **Operations Management for Engineers /**
Naam: ***Operasionele Bestuur vir Ingenieurs***

Module outcomes:

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

- Appreciate the role of the industrial engineer in the analysis, design, integration, implementation and optimisation of operations;
- Formulate an operations strategy;
- Evaluate the economic impact of product development;
- Analyse, improve and measure the performance of manufacturing processes and service systems;
- Contrast alternative approaches to operations management and evaluate applicability in different environments;

- Appreciate the role of information technology in operations management;
- Evaluate, integrate and improve the elements and processes of operations planning and control; and
- Initiate and support continuous improvement capacity building.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Die rol van die bedryfsingenieur in die analise, ontwerp, integrasie, implementering en die optimalisering van operasies te kan waardeer;*
- *'n Bedryfstrategie te kan formuleer;*
- *Die ekonomiese impak van die produkontwikkeling te kan evalueer;*
- *Die werksverrigting van die vervaardigingsprosesse en diensstelsels te kan analiseer, verbeter en meet;*
- *Alternatiewe benaderings tot operasionele bestuur te kan kontrasteer en toepaslikheid in verskillende omgewings te kan evalueer;*
- *Die rol van inligtingstegnologie in bedryfsbestuur te kan waardeer;*
- *Die elemente en prosesse van bedryfsbeplanning en beheer te kan evalueer, integreer en verbeter; en*
- *Deurlopende kapasiteitbou-verbetering te kan inisieer en ondersteun.*

Module code: INGB224	**Semester 2**	**NQF level: 6**

Name: **Optimisation and Numerical Methods I /** *Naam:* ***Optimering en Numeriese Metodes***

Module outcomes:
After successful completion of this module the student will:

- Appreciate the role of the Industrial Engineer as process optimiser;
- Describe any process in terms of process inputs, process transformation, and process outputs;
- Select amongst work study and other process optimisation methodologies an appropriate methodology for a given problem.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Die bedryfsingenieur se rol as proses optimeerder te waardeer;*
- *Enige proses in terme van proses insette, prosesverwerking en proses uitsette te beskryf; en*
- *'n Gepaste proses optimiseringsmetodologie te kies uit werkstudie en ander metodologieë om 'n gegewe probleem aan te spreek.*

Module code: INGB311	**Semester 1**	**NQF level: 7**

Name: **Engineering Economics /** *Naam:* ***Ingenieursekonomie***

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

- Interpret financial statements;
- Use basic accounting equations and financial ratios to describe the financial position of a business;
- Understand the concepts of time value of money, discounted cash flows, inflation, depreciation, depletion, present worth, annual worth, internal rate of return, external rate of return, and investment balance diagrams;
- Perform appropriate calculations and analyses with respect to the above, including sensitivity analyses; and
- Communicate recommendations.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Finansiële state te kan vertolk;*
- *Basiese rekeningkundige vergelykings en finansiële verhoudings om die finansiële posisie van 'n onderneming te beskryf, te kan gebruik;*
- *Die konsepte tydwaarde van geld, verdiskonteerde kontantvloei, inflasie, waardevermindering, uitputting, huidige waarde, jaarlikse waarde, interne opbrengskoers, eksterne opbrengskoers, en beleggingsbalans-diagramme te kan verstaan;*
- *Toepaslike berekeninge en analises met betrekking tot bogenoemde, insluitend sensitiwiteitsanalises, te kan uitvoer; en*
- *Aanbevelings te kan kommunikeer.*

Module code: INGB314	**Semester 1**	**NQF level: 7**

Name: **Operational Excellence /** *Naam:* ***Operasionele Uitnemendheid***

Module outcomes:

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

- Understand and apply relevant continuous improvement problem-solving tools and techniques to problems that occur in the operational environment ;
- Apply organisational behaviour theory and principles to formulate solutions pertaining to human behaviour related problems that occur in an operational environment;
- Demonstrate how continuous improvement initiatives affect people in organisations and how change management techniques can effectively be applied;
- Collaborate in a team to analyse case studies related to organisational behaviour aspects in an operational environment;
- Draw from theoretical knowledge to independently analyse case studies;
- Appreciate the role of an industrial engineer in positively influencing human behaviour by means of continuous improvement initiatives; and
- Demonstrate an understanding of leadership roles, teamwork and individual behaviour aspects in an operational environment.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Kontinue verbetering probleemoplossingstegnieke te verstaan en op relevante probleme in 'n operasionele omgewing toe te pas;*
- *Organisasie gedragsteoriëe en -beginsels toe te pas deur oplossings te formuleer vir probleme wat verband hou met menslike gedrag in die operasionele omgewing;*
- *Komplekse teoretiese konsepte effektief te kommunikeer en oor te dra;*
- *Die impak van kontinue verbeteringsinitiatiewe op mense in organisasies te verstaan asook hoe veranderingsbestuur tegnieke effektief toegepas kan word;*
- *Gevallestudies wat verband hou met organisasie gedragsaspekte in 'n operasionele omgewing in spanverband te analiseer;*
- *Gevallestudies vanaf teoretiese kennis onafhanklik te analiseer;*
- *Die rol van 'n bedryfsingenieur met betrekking tot die positiewe invloed op menslike gedrag tydens kontinue verbeteringsinisiatiewe te waardeer; en*
- *Leierskaprolle, spanwerk en individuele gedragsaspekte in 'n operasionele omgewing te verstaan.*

Module code: INGB317	Semester 1	NQF level: 7

Name: **Simulation Modelling /** *Naam:* ***Simulasie-Modellering***

Module outcomes:

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

- Demonstrate a coherent understanding of the similarities, differences, advantages and disadvantages of various simulation paradigms;
- Apply appropriate techniques to solve discrete-event simulation problems and Monte Carlo;
- Define problems involving stochastic processes by means of simulation models;
- Make use of simulation approaches to perform experimental design studies;
- Use simulation and statistical programming software; and
- Perform sensitivity analysis based on different scenarios.

NOTE: Previous code INGB315

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *'n Samehangende begrip van die ooreenkomste, verskille, voordele en nadele van verskeie simulasieparadigmas te hê;*
- *Toepaslike tegnieke toe te pas om diskrete-gebeurtenis simulasieprobleme en Monte Carlo op te los;*
- *Probleme wat stogastiese prosesse behels deur middel van simulasiemodelle te definieer;*
- *Van simulasiebenaderinge gebruik te maak om eksperimentele ontwerpstudies uit te voer;*
- *Simulasie en statistiese programmeringsagteware te gebruik; en*
- *Sensitiwiteitsontleding gebaseer op verskillende scenario's uit te voer.*

Module code: INGB318	Semester 1	NQF level: 7

Name: **Supply Chain Management /** *Naam:* ***Voorsieningskettingbestuur***

Module outcomes:

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

- Understand the contribution of supply chain management to organisational competitiveness in local and global contexts.
- Contribute to a discussion on global and local supply chain trends, challenges and opportunities.
- Select and apply appropriate techniques and approaches to analyse supply chain networks, location decisions, demand and inventory management.
- Evaluate the structure and functioning of elements of supply chain networks and make appropriate recommendations for improvement.
- Understand the influence and importance of supply chain measures and make appropriate decisions regarding these in different contexts.

NOTE: Previous code INGB316

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat wees om:

- *Die bydrae wat die bestuur van die voorsieningsketting maak tot 'n organisasie se mededingendheid, lokaal sowel as globaal, te verstaan;*
- *Insette te kan lewer tot 'n bespreking van neigings, uitdagings en geleenthede in globale en lokale voorsieningskettings;*

- *Toepaslike tegnieke en benaderings kan selekteer en toepas om netwerke van voorsieningskettings te analiseer, lokaliseringsbesluite te neem en vraag en inventariste bestuur;*
- *Om die struktuur en funksionering van die elemente van 'n voorsieningsketting te kan evalueer en om toepaslike verbeterings te kan aanbeveel;*
- *Om die invloed en belangrikheid van maatreëls vir voorsieningskettings te verstaan, en om in verskillende kontekste besluite hieroor te kan neem.*

Module code: INGB321	**Semester 2**	**NQF level: 7**

Name: **Advanced Optimisation /** *Naam:* ***Gevorderde Optimering***

Module outcomes:

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

- Formulate complex optimisation problems by making use of mixed integer linear programming approaches;
- Determine the best course of action in improving computing time and memory usage when solving large-scale optimisation problems;
- Identify and implement appropriate decomposition approaches when solving large-scale optimisation problems; and
- Develop auxiliary algorithms and heuristic approaches to solve optimisation problems by employing commercially available software.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Komplekse optimeringsprobleme te formuleer met behulp van gemengde heeltallige programmeringsbenaderings;*
- *Die beste benadering te volg om berekeningstyd en geheue verbruik te verbeter tydens die oplos van grootskaalse optimeringsprobleme;*
- *Gepaste ontbindingsmetodes te identifiseer en implementeer vir die oplos van grootskaalse optimeringsprobleme; en*
- *Hulp algoritmes en heuristieke te ontwikkel vir die oplos van optimeringsprobleme met behulp van kommersiële sagteware.*

Module code: INGB322	**Semester 2**	**NQF level: 7**

Name: **Statistical Learning for Engineers /** *Naam:* ***Statistiese Leer vir Ingenieurs***

Module outcomes:

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

- Explain how the statistical learning techniques of linear regression models, classification models, resampling methods, tree-based methods, and unsupervised learning techniques are used to address both theoretical and real-world problems;
- Critically evaluate a big data set and identify the most appropriate statistical learning technique(s) that can be applied to analyse the data set;
- Implement these statistical learning techniques in the software package R to address and analyse various statistical learning problems and then interpret and draw conclusions from the output; and
- Professionally (and concisely) convey the information that has been derived from a statistical learning analysis in an oral presentation or written report.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Te verduidelik hoe statistiese leer tegnieke soos lineêre regressie, klassifikasie, hersteekproefneming, boomsoek metodes en ongekontroleerde leer metodes aangewend word om beide teoretiese en werklike-wêreld problem mee op te los;*

- *'n Groot data stel krities te evalueer vir die toepassing van die mees geskikte statistiese leer metodes vir ontledingsdoeleindes;*
- *Om verskeie statistiese leer tegnieke te implementeer met behulp van die sagteware-pakket R om statistiese leer probleme te analiseer en te interpreteer; en*
- *Op 'n professionele wyse die inligting verkry uit 'n statistiese leer ontleding te dokumenteer en te kommunikeer deur middel van 'n mondelingse voordrag.*

Module code: INGB413	**Semester 1**	**NQF level: 8**

Name: **Quality Assurance /** *Naam:* ***Kwaliteitsversekering***

Module outcomes:

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

- Know and understand international quality management systems and the fundamental concepts of quality.
- Appreciate the interdependency of quality management and continuous improvement initiatives.
- Analyse performance and capability of a process by means of relevant statistical methods.
- Make use of statistical process control to analyse data.
- Understand the difference between statistical process control (SPC), engineering process control (EPC) and acceptance sampling.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Internasionale gehaltebestuurstelsels en die fundamentele konsepte van gehalte te ken en te verstaan.*
- *Die interafhanklikheid van kwaliteitsbestuur en deurlopende verbetering te verstaan.*
- *Die proses se uitsette met behulp van die tersaaklike statistiese metodes kan evalueer.*
- *Gebruik te maak van statistiese prosesbeheer om data te ontleed.*
- *Die verskil tussen statistiese proses beheer, ingenieursprosesbeheer en "acceptance sampling" te verstaan.*

Module code: INGB417	**Semester 1**	**NQF level: 8**

Name: **Facilities Design /** *Naam:* ***Fasiliteitsontwerp***

Module outcomes:

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

- Appreciate the importance and impact of systematic planning and continuous redesign of facilities.
- Evaluate a complex and ill-defined facilities design problem to draw up a set of design requirements.
- Apply appropriate theory, principles, data and methods to design facilities that meet a set of design requirements.
- Design a solution using a structured and rigorous design process to solve a facilities design problem.
- Evaluate a proposed design solution against the design requirements.
- Comment on and discuss the implications of design solutions including costs, risks, change management and implementation.
- Identify the impact of design solutions on greater systems in which the proposed facility exists.

- Select and apply appropriate best practices of efficient flow planning, workstation design, materials handling, system design, ergonomics and visual management.
- Use algorithms, tools and techniques to optimise flow, capacity and layouts.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Die belangrikheid en die impak van sistematiese beplanning en kontinue herontwerp van fasiliteite te begryp;*
- *'n Komplekse en swak-gedefiniëerde fasiliteitsontwerpsprobleem te kan evalueer om 'n stel ontwerpvereistes op te stel;*
- *Die toepaslike teoretiese beginsels, data en metodes toe te pas om aan 'n stel ontwerpsvereistes te voldoen;*
- *'n Gestruktureerde en streng ontwerpsproses te kan opstel as oplossing van 'n fasiliteitsontwerpsprobleem;*
- *'n Voorgestelde ontwerpsoplossing te kan meet aan die ontwerpsvereistes;*
- *Die implikasies van ontwerpsoplossings, soos koste, risiko, die bestuur van veranderings en implementering te kan bespreek en kommentaar te kan lewer;*
- *Die impak van ontwerpsoplossings op groter sisteme waarin die voorgestelde fasiliteit sal bestaan, te identifiseer;*
- *Die beste praktyke, doeltreffende vloeidiagramme, werkstasiebeplanning, materiaalhantering, sisteemontwerp, ergonomika en visuele bestuur te selekteer en toe te pas; en*
- *Algoritmes, gereedskap en tegnieke te kan gebruik om vloei, kapasiteit en uitleg te optimeer.*

Module code: INGB472	**Year Module**	**NQF level: 8**

Name: **Decision Support Systems /** *Naam:* ***Besluitsteunstelsels***

Module outcomes:

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

- Know and understand business analytics concepts: decision-making processes; analytics data and technology; and descriptive, predictive and prescriptive analytics, including modelling and optimisation; and
- Analyse problems to be solved through business analytics, the management of analytics data, the use of analytics software and the application of software tools to practical problems.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Bedryfsanalise-konsepte te ken en verstaan: besluitnemingsprosesse; data-analise en tegnologie; en beskrywende, voorspellende en voorskriftelike analise, insluitende modelering en optimisering; en*
- *Probleme wat deur middel van bedryfsanalise opgelos kan word, die bestuur van data-analise, die gebruik van sagteware en die toepassing van hulpmiddels op praktiese probleme te analiseer.*

Module code: INGB419	Semester 2	NQF level: 8

Name: **Business Engineering /** *Naam:* ***Besigheidsingenieurswese***

Module outcomes:

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

- Know and understand business engineering concepts: business process engineering (BPR), servitisation, entrepreneurship, intrapreneurship, technopreneurship, sociopreneurship, business ethics, business models, value propositions, customer behaviour, ERP systems and how they interrelate;
- Use BPR to map existing and improved business processes;
- Identify and develop value offerings;
- Identify application areas for engineering knowledge in the business environment;
- Conceptualise business architecture;
- Model existing business processes using BPR and recommend improvements;
- Identify potential problem areas within the context of business processes;
- Recognise different business models and value propositions in their day to day encounters;
- Explain the impact of Industry 4.0 on Business Engineering;
- Understand the 4th Industrial revolution and emergence of Industry 5.0; and
- Reflect on their professional status.

NOTE: Previous code INGB427

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Besigheidsingenieurswesekonsepte te ken en verstaan: Besigheidsprosesingenieurswese (BPR), servitisasie, entrepreneurskap, intrapreneurskap, tegnopreneurskap, sosiopreneurskap, besigheidsetiek besigheidsmodelle, waardeproposisies, kliente-gedra, ERP-stelsels en hulle interverwantskappe te ken en verstaan;*
- *BPR te gebruik om bestaande en verbeterde prosesse te karteer;*
- *Waardeproposisies te identifiseer en ontwikkel;*
- *Toepassingsareas vir ingenieurskennis in die besigheidsomgewing te identifiseer;*
- *Besigheidsargitektuur te konseptualiseer;*
- *Bestaande besigheidsprosesse te modelleer d.m.v. BPR en oplossings voor te stel;*
- *Potensiële probleemareas binne die konteks van besigheidsprosesse te identifiseer;*
- *Verskillende besigheidsmodelle en waardeproposisies in alledaagse omgang te herken;*
- *Die impak te verduidelik van Industrie 4.0 op besigheidsingenieurswese;*
- *Die 4de Industriele Revolusie en die ontstaan van Industrie 5.0 te verstaan; en*
- *Reflekteer op hulle professionele status.*

Module code: INGB471	Semester 2	NQF level: 8

Name: **Vacation training seniors /** *Naam:* ***Vakansie-opleiding seniors***

This is a compulsory attendance module done for a period of four to six weeks during the vacation. It is linked to a student's final year project.

Module objective:

During vacation training, students are exposed to a) daily operations and/or b) engineering problem-solving and/or c) engineering design and/or d) engineering project work, under the guidance of a practising engineer.

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.

Module assessment:
A student is expected to submit a short report on the work done during this period. The report should include, but is not limited to, a) The employer's details, b) Detail of the type of work done, c) The outcome of the work done and d) The employer's report.

Hierdie is 'n verpligte bywoningsmodule vir 'n tydperk van vier tot ses weke gedurende die vakansie wat aansluit by die finalejaarsprojek.

Module doelwit:
Studente word gedurende dié vakansie-opleiding blootgestel aan a) die daaglikse bedrywighede en/of b) probleemoplossing in ingenieurswese en/of c) ingenieursontwerp en/of d) projekwerk in ingenieurswese, onder die toesig van 'n praktiserende ingenieur.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student 'n begrip te hê van die vaardighede waaroor 'n professionele ingenieur moet beskik, die proses van ingenieurswese en probleemoplossing.

Module assessering:
Dit word van 'n student verwag om 'n kort verslag oor die werk gedoen gedurende hierdie typerk in te handig. Die verslag moet onder andere die volgende bevat (maar is nie beperk tot slegs hierdie nie): a) Die werkgewer se inligting, b) Inligting oor die tipe werk wat gedoen is, c) die uitkomste van die werk wat gedoen is en d) die werkgewer se verslag.

Module code: INGB479	Year module	NQF level: 8

Name: **Project /** *Naam:* ***Projek***

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

- Define the problem and divide it into smaller problems;
- Synthesise, 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 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.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *Die probleem te kan definieer en in kleiner probleme te verdeel;*
- *Die moontlike oplossings te sintetiseer, analiseer en evalueer;*
- *Die ontwerp van eksperimentele prosedures te kan dokumenteer;*
- *Die ontwerp van eksperimentele hardeware te kan vervaardig;*
- *Aspekte van die ontwerp te kan toets, die ontwerp te kan evalueer of om die eksperimente te kan doen;*
- *Gegewens deur die biblioteek en/of internet te kan inwin;*
- *Beide mondeling en skriftelik verslag oor die projek te kan doen; en*
- *Projekbestuursagteware te gebruik om vordering met die projek te bestuur.*

Module code: INDE479	Year module	NQF level: 8

Name: **Project /** *Naam:* ***Projek***

Module outcomes:

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

- Define the problem and divide it into smaller problems;
- Synthesise, 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 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.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *Die probleem te kan definieer en in kleiner probleme te verdeel;*
- *Die moontlike oplossings te sintetiseer, analiseer en evalueer;*
- *Die ontwerp van eksperimentele prosedures te kan dokumenteer;*
- *Die ontwerp van eksperimentele hardeware te kan vervaardig;*
- *Aspekte van die ontwerp te kan toets, die ontwerp te kan evalueer of om die eksperimente te kan doen;*
- *Gegewens deur die biblioteek en/of internet te kan inwin;*
- *Beide mondeling en skriftelik verslag oor die projek te kan doen; en*
- *Projekbestuursagteware te gebruik om vordering met die projek te bestuur.*

Module code: INGM111	Semester 1	NQF level: 5

Name: **Engineering Graphics I /** *Naam:* ***Ingenieursgrafika I***

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.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *Gebruik te kan maak van basiese geometriese vorms om ontwerp-oplossings te skep en te kommunikeer;*
- *Tegniese ontwerp-oplossings deur gebruikmaking van sketse en CAD te kan skep; en*
- *Te kan kommunikeer in e-formaat.*

Module code: INGM121	Semester 2	NQF level: 5

Name: **Engineering Graphics II** / *Naam:* ***Ingenieursgrafika II***

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.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *3D-modelle van onderdele en samestellings; en vervaardiging- en samestellingstekeninge te kan skep;*
- *In groepe vir die oplos van ingenieursontwerpe te kan werk; en*
- *In e-formaat te kan kommunikeer.*

Module code: INGM122	Semester 2	NQF level: 5

Name: **Materials Science I /** *Naam:* ***Materiaalkunde I***

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.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *Die geskiktheid van sommige belangrike ingenieursmateriale vir sekere toepassings op grond van hulle eienskappe te kan evalueer; en*
- *Eksperimentele data in die laboratorium te kan analiseer en interpreteer.*

Module code: INGM211	Semester 1	NQF level: 6

Name: **Strength of Materials I** *Naam:* ***Sterkteleer I***

Module outcomes:

After successful completion of this module, the student should be able to use the knowledge gained to define and solve problems:

- Stress: axial, shear, bending, combined stress condition;
- Strain;
- Thin walled pressure vessels;
- Safety factors; and
- Stress concentrations.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om die kennis te verwerf om probleme te definieer en op te los:

- *Spanning: aksiaal-, skuif-, buig-, saamgestelde spanningstoestand;*
- *Vervorming;*
- *Dunwandige drukvate;*
- *Veiligheidsfaktore; en*
- *Spanningskonsentrasies.*

Module code: INGM212	Semester 1	NQF level: 6

Name: **Engineering Materials /** *Naam:* ***Ingenieursmateriale***

Module outcomes:

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

- Classify carbon steels, alloy steels, stainless steels, cast irons, tool steels, copper and zinc alloys, Ti-alloys, Ni-alloys, refractory metals and engineering ceramics, in terms of main general composition, phase chemistry where applicable to classification and properties, general engineering properties and general and potential application in engineering design or otherwise;
- Demonstrate knowledge of the principles and methods that are available to improve engineering properties of ferrous and non-ferrous alloys;
- To specify materials for simple mechanical designs taking cognisance of the possible influence of requirements with respect to failure, corrosion and the impact on the environment;
- The student will also have been subjected to:
- Basic considerations for material selection;
- Group projects in terms of:
    - Procedural and non-procedural design;
    - Synthesis of components & systems.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Koolstofstaal, legeerstaal, vlekvrye staal, gietysters, gereedskap staal, koper- en sinklegerings, Ti-legerings, Ni-legerings, vuurvaste metale en ingenieurskeramieke, te kan klassifiseer in terme van die belangrikste algemene samestelling, fasechemie waar van toepassing op klassifisering en eienskappe, algemene ingenieurseienskappe en algemene en potensiële toepassing op ingenieursontwerp of andersins;*
- *Kennis van die beginsels en metodes wat beskikbaar is om ingenieurseienskappe van ysterhoudende en nie-ysterhoudende legerings te verbeter, te kan demonstreer;*
- *Materiale te spesifiseer vir eenvoudige meganiese ontwerpe met inagneming van die moontlike invloed van die vereistes met betrekking tot faling, korrosie en die impak op die omgewing.*
- *Die student sal ook blootgestel gewees het aan:*
- *Basiese oorwegings vir materiaalkeuse;*
- *Groepprojekte in terme van:*
    - *Prosedurele en nie-prosedurele ontwerp; en*
    - *Sintese van komponente en stelsels.*

Module code: INGM222	Semester 2	NQF level: 6

Name: **Thermodynamics I /** *Naam:* ***Termodinamika I***

Module outcomes:

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

Knowledge

Knowledge and understanding of thermodynamic concepts: mass and energy conservation, reversible and real processes, properties of real, ideal and perfect substances and how they interrelate.

Skills

- The ability to solve thermodynamic problems; and
- The ability to co-operate better with others through attending tutorials that are done cooperatively.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis

Kennis en begrip van termodinamiese konsepte: massa- en energiebehoud, omkeerbare en reële prosesse, eienskappe van reële, ideale en perfekte stowwe en hoe hulle onderling verband hou.

Vaardighede

- *Die vermoë om termodinamiese probleme op te los.*
- *Die vermoë om beter met ander saam te werk deur bywoning van tutoriale wat koöperatief gedoen word.*

Module code: INGM223	Semester 2	NQF level: 6

Name: **Manufacturing Technology /** *Naam:* ***Vervaardigingstegnologie***

Module outcomes:

On successful completion of the module, the student will have basic knowledge of the following:

Knowledge

- Characteristics and manufacturability properties of engineering materials;
- Material-forming manufacturing processes: manufacturing of components from metals, plastics, composites and ceramics;
- Material-removal manufacturing processes: manufacturing components from different materials; and
- Material jointing processes: jointing of different materials, e.g., welding, brazing, adhesive bonds, etc.

Skills

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:

- Understand the economic aspects related to manufacturing as well as the impact they have on the design process;
- Be able to apply knowledge with respect to material properties and manufacturing processes and technology to solve industrially oriented problems regarding material forming, manufacturing and value adding processes;
- Be able to suggest suitable testing, inspection, and quality assurance procedures for application in the manufacture of a specific component;
- Be able to optimise manufacturing processes to manufacture a component more competitively;
- Be able to design components with the emphasis on manufacturability of the component/product;

- Understand the impact of different manufacturing technologies on the environment, workforce and surroundings;
- Understand the dangers and issues relating to the safe use of different manufacturing technologies, and therefore understand the professional responsibility of the manufacturing engineer to conduct manufacturing operations in a responsible and safe manner.

Module uitkomste:
Na die suksesvolle voltooiing van die module moet die student basiese kennis van die volgende hê:
Kennis

- *Karakteristieke en vervaardigbaarheidseienskappe van ingenieursmateriale;*
- *Materiaalvormingsvervaardigingsprosesse om komponente te vervaardig uit metale, plastieke, komposiete en keramieke;*
- *Materiaalverwyderingsvervaardigingsprosesse om komponente van verskillende materiale te vervaardig; en*
- *Materiaal-lasprosesse wat gebruik word om verskillende materiale te heg, bv sweiswerk, sweissoldering, plakhegting, ens.*

Vaardighede
Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Die toepassings en beperkings van die verskillende vervaardigingsprosesse te ken en verstaan; en om dit suksesvol te kan toepas op ingenieursprobleme i.v.m. vervaardiging;*
- *Die ekonomiese aspekte wat verband hou met die vervaardiging te verstaan, asook die impak wat dit op die ontwerp-proses het;*
- *Om kennis toe te pas met betrekking tot materiaaleienskappe en vervaardigingsprosesse en -tegnologie om industrie-georiënteerde probleme m.b.t. materiaalvorming, vervaardiging en waardetoevoegingsprosesse op te los;*
- *Om geskikte toetsing-, inspeksie-, en gehalteversekeringsprosedures vir toepassing in die vervaardiging van 'n spesifieke komponent te stel;*
- *Om produksieprosesse te optimaliseer om 'n komponent meer mededingend te vervaardig;*
- *Om komponente te ontwerp met die klem op vervaardigbaarheid van die komponent/produk;*
- *Die impak van verskillende vervaardigingstegnologieë op die omgewing, arbeidsmag en omstreke te verstaan; en*

Die gevare en kwessies m.b.t. die veilige gebruik van verskillende vervaardigingstegnologieë te verstaan, en daarom die professionele verantwoordelikheid van die vervaardigingsingenieur om vervaardigingbedrywighede op 'n verantwoordelike en veilige manier te doen te verstaan.

Module code: INGM224	Semester 2	NQF level: 6

Name: **Computer Methods /** *Naam:* ***Rekenaarmetodes***

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 the 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 analyses 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.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- Termiesevloei- en materiaalsterkte-probleme te kan identifiseer en interpreteer;
- Simulasies en analises om probleme op te los, te kan beplan en ontwikkel;
- Basiese termiesevloei-programme met behulp van Engineering Equation Solver (EES) te kan skryf, oplos en analiseer;
- Pypnetwerke met Flownex te kan ontwerp en analiseer; en
- Basiese strukturele probleme met behulp van NASTRAN te kan ontwerp en oplos.

Module code: INGM311	Semester 1	NQF level: 7

Name: **Thermodynamics II /** *Naam:* ***Termodinamika II***

Module outcomes:

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

- Analyse power and refrigeration cycles;
- Do an energy 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.

Module uitkomste:

Na die suksesvolle voltooiing van die module behoort die student in staat te wees om:

- *Krag- en verkoelingsiklusse te kan analiseer;*
- *'n Energie-analise van oop- en geslote sisteme te kan doen;*

- *Veranderlikes soos droëboltemperatuur, relatiewe humiditeit en spesifieke humiditeit in die analise van prosesse uitgevoer op lug te kan gebruik;*
- *Die Eerste Wet op prosesse uitgevoer op lug te kan toepas;*
- *Die Psigrometriese Kaart in die berekening en analise van prosesse uitgevoer in lugversorging te kan gebruik;*
- *Gegewe die afgas-analise, brandstof, lug-brandstof verhouding of ander standaard spesifikasies, die verbrandingsreaksie te kan balanseer en die energie vrygestel (arbeid of drywing) in verbrandingsreaksies te kan bereken; en*
- *Termodinamiese verhoudings te kan gebruik om die waarde van interne energie, entalpie en entropie te bereken vir komponente gebruik in termodinamiese stelsels.*

Module code: INGM312	**Semester 1**	**NQF level: 7**

Name: **Fluid Mechanics I /** *Naam:* ***Stromingsleer I***

Module outcomes:

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

Knowledge

- General concepts;
- Fundamentals of fluid flow analysis;
- Fundamental laws for systems and control volumes including integral and differential form as well as dimensional analysis; and
- Incompressible viscous flow in pipes and ducts.

Skills

After completion of this module, the student will have developed the following skills:

- 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 mechanics phenomena; and
- Calculate the losses that are present in steady-state incompressible flow in pipes and ducts and apply it in the solution of practical pipe network problems and the design of simple pipe systems.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

Kennis

- *Algemene konsepte;*
- *Grondbeginsels van fluïdvloei-analise;*
- *Fundamentele wette vir stelsels en beheervolumes insluitende integrale en differensiale vorms, asook dimensionele analise; en*
- *Onsamedrukbare viskeuse vloei in pype en kanale.*

Vaardighede

Na voltooiing van hierdie module sal die student die volgende vaardighede ontwikkel het:

- *Toepassing van die wiskundige formulerings vir snelheid, versnelling, massa-vloeitempo en kragte om die eienskappe van vloeivelde te beskryf;*
- *Toepassing van die vergelykings om die behoud van massa, lineêre momentum en hoekmomentum in beide integrale en differensiale vorm te beskryf en praktiese probleme in vloeimeganika op te los;*
- *Toepassing van dimensionele-analisetegnieke om skaleringswette vir eenvoudige eksperimentele studies van vloeimeganika-verskynsels af te lei; en*

- *Berekening van die verliese teenwoordig in gestadigde onsamedrukbare vloei in pype en kanale en toepassing in die oplos van praktiese pypnetwerkprobleme en die ontwerp van eenvoudige pypstelsels.*

Module code: INGM313	**Semester 1**	**NQF level: 7**

Name: **Strength of Materials II /** *Naam:* ***Sterkteleer II***

Module outcomes:

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

- Stress and strain transformation;
- Failure criteria;
- Analysis of shaft for failure;
- Deflection of beams;
- Euler struts;
- Energy methods; and
- Thick-walled cylinders.

Module uitkomste:

Na die suksesvolle afhandeling van hierdie module kan die student in staat te wees om fundamentele kennis toe te pas van:

- *Vervorming- en spanningstransformasie;*
- *Falingskriteria;*
- *Analise van staaf vir faling;*
- *Buig van balke;*
- *Euler-stutte;*
- *Energie-metodes; en*
- *Dikwandsilinders.*

Module code: INGM321	**Semester 2**	**NQF level: 7**

Name: **Fluid Mechanics II /** *Naam:* ***Stromingsleer II***

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:

Attain engineering science knowledge about a wide variety of fluid mechanics. After successful completion of this module, the student should be able to:

- Apply the basic knowledge and principles of compressible flow and boundary layer theory to solve problems;
- Use the applicable engineering tools such as the software package EES; and
- Analyse and interpret results obtained from assignments and practical experiments.

NOTE: New code INGM324

Module uitkomste:

Verwerf ingenieurswetenskapskennis oor 'n wye verskeidenheid van vloeimeganika. Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Basiese kennis en beginsels van saamdrukbare vloei, potensiaalvloei en grenslaagteorie te kan toepas om probleme op te los;*
- *Toepaslike ingenieursgereedskap, soos die sagteware-pakket EES, te kan gebruik; en*

- *Resultate verkry uit opdragte en praktiese eksperimente te kan analiseer en interpreteer.*

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

Name: **Structural Analysis /** *Naam:* ***Struktuurleer***

Module outcomes:

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

Knowledge

- Matrix structural analysis;
- Weak formulation;
- Finite element formulation;
- Finite element solution of one-dimensional second order equations;
- Finite element solution of one-dimensional fourth order equations; and
- Finite element solution of coupled and constrained one-dimensional equations.

Skills

- Identify, formulate and 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.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student oor die volgende te beskik:

Kennis

- *Matriks strukturele analise;*
- *Swak formulering;*
- *Eindige-elementformulering;*
- *Eindige-element-oplossing van een-dimensionele tweede-orde vergelykings;*
- *Eindige-element-oplossing van een-dimensionele vierde-orde-vergelykings; en*
- *Eindige-element-oplossing van gekoppelde en beperkte een-dimensionele vergelykings.*

Vaardighede

- *Identifiseer, formuleer en los strukturele probleme op;*
- *Pas spesialiskennis oor soepelheid, styfheid en eindige-element-metodes toe om ingenieursprobleme te analiseer en op te los; en*
- *Gebruik die gepaste ingenieursgereedskap soos EES en ’n eindige-element-kode om ingenieursprobleme te simuleer.*

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

Name: **Machine Design /** *Naam:* ***Masjienontwerp***

Module outcomes:

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

- Analyse existing designs of basic machine elements: cams, crank diagrams, universal joints, governor belt drive systems; and
- Have a basic understanding of oils and lubricants.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module moet die student in staat wees om:

- *Bestaande ontwerpe van basiese masjien-elemente: nokke, krukdiagramme, kruiskoppelings, reëlaar-dryfband-aandryfstelsels te kan analiseer; en*
- *Oor ’n basiese begrip van olies en smeermiddels te beskik.*

Module code: INGM325	Semester 2	NQF level: 7

Name: **Advanced Computer Methods /** *Naam:* ***Gevorderde Rekenaar Metodes***

Module outcomes:

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

- Identify and interpret fluid dynamic flow and strength of materials problems;
- Plan and develop simulations to solve complex fluid and structural engineering problems;
- Design and analyse flow problems using NX Flow; and
- Design and solve basic structural problems using NX NASTRAN.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module moet die student in staat wees om:

- *Komplekse berekeningsvloei-en materiaalsterkte-probleme te kan identifiseer en interpreteer;*
- *Simulasies om komplekse ingenieursprobleme op te los, te kan beplan en ontwikkel;*
- *Ontwerp en analise van basiese vloeiprobleme deur gebruik te maak van NX vloei;*
- *Ontwerp en analise van basiese strukturele probleme deur gebruik te maak van NX NASTRAN*

Module code: INGM327	Semester 2	NQF level: 7

Name: **Mechanical Design /** *Naam:* ***Meganiese Ontwerp***

Module outcomes:

After successful completion of this module, the student shall 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.

Assessment outcomes:

- Analyse and design the basic elements of machine design;
- Complete a comprehensive design problem that covers many of the basic elements;and
- Compile a manufacturing drawing pack for the comprehensive design problem.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat wees om:

- *Bestaande ontwerpe van basiese masjienelemente te kan analiseer;*
- *Basiese masjienelemente te kan ontwerp; en*
- *Skriftelik met tegniese gehore deur middel van sketse, tekeninge en ’n formele ingenieursontwerpverslag te kan kommunikeer.*

Assesseringsuitkomste:

- *Analiseer en ontwerp van die basiese elemente van masjienontwerp;*
- *Voltooi ’n omvattende ontwerpprobleem wat baie van die basiese elemente dek; en*
- *Stel ’n vervaardigingstekeningpak saam vir die omvattende ontwerpprobleem.*

Module code: INGM411	Semester 1	NQF level: 8

Name: **Thermal Machines /** *Naam:* ***Termomasjiene***

Module outcomes:

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

Knowledge

- In the fields of gas turbines and internal combustion engines.

Skills:

- Applying the fundamental knowledge of gas turbine and reciprocating internal combustion engine theory together with specialised knowledge of thermodynamic cycles, fluid dynamics, heat transfer, and computer programming to solve thermo-machine problems;
- The design of basic thermo-machine cycles done by means of convergent and divergent synthesis of existing knowledge;
- The optimisation in the design of typical gas turbine cycles by using programming in Engineering Equation Solver (EES); and
- The analysis and interpretation of experimental data done during practical sessions

NOTE: New code INGM418

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student oor die volgende te beskik:

Kennis:

- *Omtrent die velde van gasturbines en binnebrandenjins.*

Vaardighede:

- *Toepassing van die basiese kennis van gasturbine- en resiprokerende binnebrandenjin-teorie saam met gespesialiseerde kennis van termodinamiese siklusse, vloeidinamika, hitte-oordrag, en rekenaarprogrammering om termomasjienprobleme op te los;*
- *Die ontwerp van basiese termomasjien-siklusse gedoen deur middel van konvergente en divergente sintese van bestaande kennis;*
- *Die optimalisering in die ontwerp van tipiese gasturbine-siklusse gedoen deur die gebruik van programmering in Engineering Equation Solver (EES); en*
- *Die analise en interpretasie van eksperimentele data wat tydens praktiese sessies gedoen is.*

Module code: INGM412	Semester 1	NQF level: 8

Name: **Heat Transfer /** *Naam:* ***Warmte-oordrag***

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.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student in staat te wees om:

- *Basiese kennis en begrippe van warmte-oordrag, insluitende geleiding, eksterne vloei, vloei in pype en termiese straling te kan toepas om praktiese probleme op te los;*
- *Basiese hitteruilerontwerp te kan doen deur integrering van die kennis opgedoen van verskillende warmte-oordragmetodes in 'n oplosstrategie;*
- *Gebruik te kan maak van ingenieurs-sagtewaregereedskap, soos Excel en EES, om warmte-oordagprobleme op te los; en*
- *Resultate verkry vanaf praktiese eksperimente te kan analiseer en interpreteer.*

Module code: INGM413	Semester 1	NQF level: 8

Name: **Fluid Machines /** *Naam:* ***Stromingsmasjiene***

Module outcomes:

After successful completion of this module, students should have:

Knowledge

- Fundamental fluid machine concepts and definitions, hydraulic pumps, hydraulic turbines, centrifugal compressors and fans, axial flow compressors and fans.

Skills

- Ability to predict the right fluid machine for the right application;
- Ability to predict the performance of a full-size fluid machine given the performance of a scale model;
- Ability to 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
- Ability to predict the performance of fluid machines in basic flow networks.

Module uitkomste:

Na die suksesvolle afhandeling van hierdie module behoort studente oor die volgende te beskik:

Kennis

- *Fundamentele stromingsmasjien-konsepte en -definisies, hidrouliese pompe, hidrouliese turbines, sentrifugale kompressors en waaiers, aksiaalvloeikompressors en waaiers.*

Vaardighede

- *Keuse van die regte stromingsmasjien vir die regte toepassing;*
- *Voorspelling van die werksverrigting van 'n stromingsmasjien, gegewe die werksverrigting van 'n skaalmodel;*
- *Voorspelling van die werksverrigting van 'n stromingsmasjien, gegewe die geometrie van die masjien, asook die vloeitoestande voor en na die masjien; en*
- *Voorspelling van die werksverrigting van stromingsmasjiene in vloeinetwerke.*

Module code: INGM415	Semester 1	NQF level: 8

Name: **Failure of Materials /** *Naam:* ***Faling van Materiale***

Module outcomes:

After successful completion of this module, students should have:

Knowledge

- Of the most important failure phenomena and the prevention of failure through suitable design and operation. This knowledge is conveyed during lectures, case studies, and practical investigations of failed components.

Skills

- Ability to understand the different conditions for specific type of material failures;
- Ability to do computations for fatigue and brittle failures; and
- Ability to apply knowledge for vibration analysis and diagnostics of problems during machine condition monitoring, as a predictive maintenance approach.

NOTE: New code INGM424

Module uitkomste:
Na die suksesvolle afhandeling van hierdie module behoort studente oor die volgende te beskik:
Kennis

- *Van die belangrikste falingsverskynsels en die voorkoming van faling deur geskikte ontwerp en bedryf. Hierdie kennis word oorgedra tydens lesings, gevallestudies en praktiese ondersoeke van gefaalde komponente.*

Vaardighede

- *Vermoë om die verskillende toestande by spesifieke tipes materiaalfalings te verstaan;*
- *Vermoë om berekenings te doen i.v.m. vermoeidheid en brosfalings; en*
- *Vermoë om kennis toe te pas m.b.t. vibrasie-analise en -diagnose van probleme tydens masjienkondisiemonitering as voorspelbare onderhoudsbenadering.*

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

Name: **Systems Engineering /** *Naam:* ***Stelselingenieurswese***

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 them;
- 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.

Module uitkomste:
Na voltooiing van hierdie module behoort die student in staat te wees om:

- *'n Gebruikersvereiste in ingenieursterme te kan definieer, 'n funksionele analise van die stelsel te kan doen en kreatief stelselbegrippe te kan genereer en evalueer;*
- *'n Stelsel in substelsels en komponente op te kan breek, toepaslike tegniese werkverrigtingsmaatreëls te kan toewys en ontwerp volgens die spesifikasies;*
- *Skriftelik met tegniese gehore deur middel van verslae te kan kommunikeer; en*
- *In 'n groep te kan werk.*

Module code: INGM421	Semester 1	NQF level: 8

Name: **Machine Dynamics /** *Naam:* ***Masjiendinamika***

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:

- Use the flexibility method to determine the unknown reaction forces and the element forces of statically indeterminate structures;
- Use the stiffness method to determine the displacements of statically determinate and indeterminate structures;
- Derive the weak formulation and set up the associated Galerkin finite element formulation for one-dimensional second order and fourth order differential equations;
- Use the finite element method to determine the approximate solution of one-dimensional second order and fourth order differential equations;
- Communicate effectively and function in a team in the context of the above-mentioned problem-solving skills that have been developed; and
- Reason and act ethically correct based on an established value system.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *Die fundamentele kennis van masjiendinamiese teorie, insluitende bewegingswette, natuurlike en geforseerde vibrasies asook gespesialiseerde kennis om vibrasieprobleme op te los, te kan toepas;*
- *Die gebruik van verskillende meettoerusting om data van vibrasieprobleme in te win, te kan verstaan;*
- *Kennis van die diagnosering van vibrerende stelsels vir toestandmonitering en voorkomende instandhouding van toerusting te kan toepas; en*
- *Eksperimentele data, gemeet gedurende praktiese sessies, te kan analiseer en interpreteer.*

Module code: INGM423	Semester 2	NQF level: 8

Name: **Manufacturing Technology /** *Naam:* ***Vervaardigingstegnologie***

Module outcomes:

After successful completion of this module, students should have:

<u>Knowledge</u>

- Characteristics and manufacturability properties of engineering materials;
- Material-forming manufacturing processes to manufacture components from metals, plastics, composites and ceramics;
- Material-removal manufacturing processes to manufacture components from different materials; and
- Material jointing processes used to join different materials, e.g. welding, brazing, adhesive bonds, etc.

<u>Skills</u>

- 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;

- Understand the economic aspects related to manufacturing as well as the impact it has on the design process;
- Be able to apply knowledge with respect to material properties and manufacturing processes and technology to solve industrially oriented problems regarding material forming, manufacturing and value adding processes;
- Be able to suggest suitable testing, inspection, and quality assurance procedures for application in the manufacture of a specific component;
- Be able to optimise manufacturing processes to manufacture a component more competitively;
- Be able to design components with the emphasis on manufacturability of the component/product;
- Understand the impact of different manufacturing technologies on the environment, workforce and surroundings; and
- Understand the dangers and issues relating to the safe use of different manufacturing technologies, and therefore understand the professional responsibility of the manufacturing engineer to conduct manufacturing operations in a responsible and safe manner.

Module uitkomste:

Na die suksesvolle afhandeling van hierdie module behoort studente oor die volgende te beskik:

Kennis

- *Karakteristieke en vervaardigbaarheidseienskappe van ingenieursmateriale;*
- *Materiaalvormingsvervaardigingsprosesse om komponente te vervaardig uit metale, plastieke, komposiete en keramieke;*
- *Materiaalverwyderingsvervaardigingsprosesse om komponente van verskillende materiale te vervaardig; en*
- *Materiaal-lasprosesse wat gebruik word om verskillende materiale te heg, bv. sweiswerk, sweissoldering, plakhegting, ens.*

Vaardighede

- *Ken en verstaan die toepassings en beperkings van die verskillende vervaardigingsprosesse en in staat om dit suksesvol te kan toepas op ingenieursprobleme i.v.m. vervaardiging;*
- *Verstaan die ekonomiese aspekte wat verband hou met die vervaardiging, asook die impak wat dit op die ontwerpsproses het;*
- *In staat om kennis toe te pas met betrekking tot materiaaleienskappe en vervaardigingsprosesse en -tegnologie om industrie-georiënteerde probleme m.b.t. materiaalvorming, vervaardiging en waardetoevoegingsprosesse op te los;*
- *In staat om geskikte toetsing-, inspeksie-, en gehalteversekeringsprosedures vir toepassing in die vervaardiging van ’n spesifieke komponent te stel;*
- *In staat om produksieprosesse te optimaliseer om ’n komponent meer mededingend te vervaardig;*
- *In staat om komponente te ontwerp met die klem op vervaardigbaarheid van die komponent/produk;*
- *Verstaan die impak van verskillende vervaardigingstegnologieë op die omgewing, arbeidsmag en omstreke; en*
- *Verstaan die gevare en kwessies m.b.t. die veilige gebruik van verskillende vervaardigingstegnologieë, en verstaan daarom die professionele verantwoordelikheid van die vervaardigingsingenieur om vervaardigingsbedrywighede op ’n verantwoordelike en veilige manier te doen.*

Module code: INGM425	Semester 2	NQF level: 8

Name: **Aircraft Design** / *Naam:* ***Vliegtuigontwerp***

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, students should have:

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 of this and other modules to design a basic aircraft, according to specifications.

Previously INGM416

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module behoort die student oor die volgende te beskik:

Kennis

- *Verstaan die grondbeginsels van stromingsleer, hefkrag, sleepkrag, stukrag, vliegtuig-werkverrigting, stabiliteit en beheer.*

Vaardighede

- *Die gebruik van XFOIL (2D-rekenaar-progammatuur vir die ontwerp en optimisering van draagvlakke); en*
- *Integrering van kennis en vaardighede van hierdie en ander modules om inligting te ondersoek en te bestuur, data te analiseer en gebruik, en 'n vliegtuig te ontwerp volgens gegewe spesifikasies.*

Module code: INGM427	Semester 1	NQF level: 8

Name: **Thermal-Fluid System Design /** *Naam:* ***Termo-vloeierstelselontwerp***

Module outcomes:

After successful completion of this module, students should have:

Knowledge

- Knowledge of the fields of steam turbines and coal fired boilers.

Skills

- Ability to 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;
- Combined cycle principles;
- Boiler operational problems, control system philosophy, clinker formation and sootblowing philosophies; and
- Steam boiler auxiliary plant, combustion, and airflow optimisation with coal quality impact factors;
- Safety precautions, air pollution and impact on society.

Module uitkomste:
Na die suksesvolle voltooiing van hierdie module moet 'n student oor die volgende beskik:
Kennis

- *Kennis op die gebied van stoomturbines en steenkoolgestookte ketels.*

Vaardighede

- *Ontwerp 'n basiese Rankine-siklus d.m.v. konvergente en divergente sintese van bestaande kennis, met klem op voerpomp-kombinasies en regeneratiewe voerwater- verhittingsopsies;*
- *Gekombineerde siklus-beginsels;*
- *Ketel-bedryfsprobleme, beheerstelsel-filosofie, klinkervorming en roetblaasfilosofieë;*
- *Stoomketel-hulpaanleg, verbranding, en lugvloei-optimering met die steenkoolkwaliteit-impak faktore; en*
- *Veiligheidsmaatreëls, lugbesoedeling en impak op die samelewing.*

Module code: INGM471 / INGM371	**Year module**	**NQF level: 8/7**

Name: **Vacation Training seniors /** *Naam:* ***Vakansie-opleiding 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 a) daily operations and/or b) engineering problem-solving and/or c) engineering design and/or d) engineering project work, under the guidance of a practising engineer.

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.

Module assessment:
A student is expected to submit a short report on the work done during this period. The report should include, but is not limited to, a) The employer's details, b) Detail of the type of work done, c) The outcome of the work done and d) The employer's report.

Hierdie is 'n verpligte bywoningsmodule vir 'n tydperk van vier tot ses weke gedurende die vakansie.

Moduledoelwit:
Studente word gedurende dié vakansie-opleiding blootgestel aan a) die daaglikse bedrywighede en/of b) probleemoplossing in ingenieurswese en/of c) ingenieursontwerp en/of d) projekwerk in ingenieurswese, onder die toesig van 'n praktiserende ingenieur.

Module uitkomste:
Na suksesvolle voltooiing van hierdie module behoort die student 'n begrip te hê van die vaardighede waaroor 'n professionele ingenieur moet beskik, die proses van ingenieurswese en probleemoplossing.

Module assessering:
Dit word van 'n student verwag om 'n kort verslag oor die werk gedoen gedurende hierdie typerk in te handig. Die verslag moet onder andere die volgende bevat (maar is nie beperk tot slegs hierdie nie): a) Die werkgewer se inligting, b) Inligting oor die tipe werk wat gedoen is, c) die uitkomste van die werk wat gedoen is en d) die werkgewer se verslag.

Module code: INGM479	Year module	NQF level: 8

Name: **Project /** *Naam:* ***Projek***

Module outcomes:

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

- Define the problem and divide it into smaller problems;
- Synthesise, 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 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.

Module uitkomste:

Na voltooiing van hierdie module behoort die student in staat te wees om:

- *Die probleem te kan definieer en in kleiner probleme te verdeel;*
- *Die moontlike oplossings te sintetiseer, analiseer en evalueer;*
- *Die ontwerp of eksperimentele prosedures te kan dokumenteer;*
- *Die ontwerp of eksperimentele hardeware te kan vervaardig;*
- *Aspekte van die ontwerp te kan toets, die ontwerp te kan evalueer of om die eksperimente te kan doen;*
- *Gegewens deur die biblioteek en/of internet te kan inwin;*
- *Beide mondeling en skriftelik verslag oor die projek te kan doen; en*
- *Projekbestuursagteware te kan gebruik om vordering met die projek te bestuur.*

Module code: LLAW221	Semester 2	NQF level: 6

Name: **Introduction to Labour Law** / *Naam:* ***Inleiding tot Arbeidsreg***

Module outcomes:

Upon successful completion of this module students should be able to demonstrate the following:

- A detailed knowledge and understanding of the principles of labour law with specific reference to:

1) what labour law entails, the different sources and the distinction between individual and collective labour law;

2) the nature and essentialia of a contract of employment;

3) the rights and obligations of the employer and employee in an employment relationship; and the conclusion and termination of a contract of employment as well as remedies for breach of contract.

- A comprehensive knowledge and understanding of the influence and application of the *Constitution of the Republic of South Africa,* 1996 on the field of labour law and specifically on core labour legislation such as the *Labour Relations Act* 66 of 1995*, Basic Conditions of Employment Act* 75 of 1997, the *Employment Equity Act* 55 of 1998 and other core labour legislation.
- Ability to select, evaluate and apply legal principles to solve fundamental problems in a defined environment in the field of labour law as well as an understanding of the ethical implications of decisions, actions and practices specifically relevant to labour law and to represent the employment parties during dispute resolution processes. This will include discipline-specific methods and techniques of scientific enquiry and information gathering on subject-related topics from relevant sources, as well as analysing, evaluating and synthesising the information and providing conclusions to a given context in the field of labour law.
- Accurate and coherent written and verbal communication of principles, rules and solutions to problem-solving tasks or projects by means of preparing for a disciplinary hearing, conciliation, arbitration, the writing of legal opinions and written answers to evaluations with an understanding of and respect for intellectual property conventions, copyright and rules on plagiarism.
- Monitor own learning progress and apply relevant learning strategies and management of resources to successfully realise all learning outcomes of this module.

Na suksesvolle afhandeling van LLAW 221 behoort die student in staat te wees om die volgende te kan demonstreer:

Module uitkomste:

- *Gedetailleerde kennis toon van en begrip vir die beginsels van arbeidsreg met spesifieke verwysing na*

1. *wat arbeidsreg behels, die verskillende bronne en onderskeid tussen individuele en kollektiewe arbeidsreg;*
2. *die aard van en essentialia van ’n dienskontrak;*
3. *die regte en verpligtinge van die werkgewer en werknemer in ’n arbeidsverhouding en die sluit en terminering van ’n dienskontrak, asook remedies vir kontrakbreuk.*

- *Gedetailleerde kennis en begrip van die invloed en toepassing van die Grondwet van die Republiek van Suid-Afrika, 1996 op die gebied van arbeidsreg en spesifiek op kern-arbeidswetgewing, byvoorbeeld die Wet op Arbeidsverhoudinge 66 van 1995, die Wet op*

Basiese Diensvoorwaardes 75 van 1997, die Wet op Gelyke Indiensneming 55 van 1998 en ander kern-arbeidswetgewing.

- *Die vermoë om regsbeginsels te selekteer, te evalueer en toe te pas met die doel om fundamentele probleme in 'n gedefinieerde omgewing op die gebied van arbeidsreg op te los asook om die etiese implikasies van besluite, optredes en praktyke wat spesifiek met arbeidsreg verband hou, te verstaan en die indiensnemingspartye tydens dispuutresolusie-prosesse te verteenwoordig. Dit sal insluit: dissipline-spesifieke metodes en tegnieke rakende wetenskaplike ondersoek en inligtingsinsameling oor vakverwante onderwerpe uit toepaslike bronne, asook die sintetisering van die inligting en die verskaffing van gevolgtrekkings vir 'n gegewe konteks op die gebied van arbeidsreg.*
- *Akkurate en samehangende geskrewe verbale kommunikasie van beginsels, reëls en oplossings vir probleemoplossingstake of projekte deur middel van die voorbereiding vir 'n dissiplinêre verhoor, konsiliasie, arbitrasie, die skryf van regsmenings en geskrewe antwoorde op evaluerings met begrip van en respek vir intellektuele-eiendomkonvensies, kopiereg en reëls rakende plagiaat.*
- *Eie leervordering kan moniteer en toepaslike leerstrategieë en die bestuur van hulpbronne kan toepas om alle leeruitkomste van hierdie module suksesvol te bereik.*

Module code: MTCR311	**Semester 1**	**NQF Level: 7**

Name: **Introductory Algebra and Analysis I /** *Naam***: *Inleidende Algebra en Analise I***

Module outcomes:

To successfully complete this module the student needs to demonstrate that he/she

- can apply a structured multi-domain modelling methodology.
- can derive dynamic mathematical models of a multi-domain engineering systems.
- can construct and simulate multi-domain models using Simscape/Simulink/Matlab software.
- can apply the modelling methodology to real-world problems as presented in a typical lab setup

Module code: MTCR327	**Semester 2**	**NQF Level: 7**

Module outcomes:

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

- Understands the systems engineering process;
- Can apply design guidelines and constraints;
- Can interpret a development specification and the allocation of requirement;
- Apply a customised systems engineering process on a complex engineering project;
- Can successfully work as an individual and in groups; and

Can use appropriate CAD, simulation and other relevant engineering software tools during the design process.

Module code: MTHS111	**Semester 1**	**NQF Level: 5**

Name: **Introductory Algebra and Analysis I /** *Naam***: *Inleidende Algebra en Analise I***

Module outcomes:

On completing this module students ought to be able to do the following:

- Demonstrate fundamental knowledge of the concept of functions, absolute value function, circle measure and inverse functions, trigonometric and inverse trigonometric functions, exponential and logarithmic functions, limits, continuity, differentiability and indefinite integrals of all the above-mentioned functions, L'Hospital's rule and its applications, the natural number system including mathematical induction, the integer number system including the division and Euclidian algorithms and their applications, rational and irrational numbers, the real number system, and the complex number system including De Moivre's theorem and its applications;

- Demonstrate problem-solving skills by analysing familiar and unfamiliar problems, using the knowledge of techniques to calculate the domain and range, limits, continuity, derivatives and indefinite integrals of all the above-mentioned functions, calculate limits using L'Hospital's rule, prove theorems with mathematical induction, determine greatest common dividers and use it to solve Diophantine equations, and perform operations with complex numbers.

Module uitkomste:
Na voltooiing van hierdie module behoort die student die volgende te kan doen:

- *Fundamentele kennis demonstreer van die funksiebegrip, absolutewaardefunksie, sirkelmaat en inverse funksies, trigonometriese en inverse trigonometriese funksies, eksponensiale en logaritmiese funksies, limiete, kontinuïteit, differensieerbaarheid en onbepaalde integrale van al bogenoemde funksies, L'Hospital se reël en sy gebruike, die natuurlike getallestelsel insluitend wiskundige induksie, die heelgetallestelsel insluitend die delings- en Euklidiese algoritmes en hul gebruike, rasionale en irrasionale getalle, die reële getallestelsel, en die komplekse getallestelsel insluitend De Moivre se stelling en sy gebruike;*
- *Probleemoplossingsvaardighede demonstreer deur bekende en onbekende probleme te analiseer, kennis van tegnieke gebruik om definisie-en waardeversamelings, limiete, kontinuïteit, afgeleides en onbepaalde integrale van al bogenoemde funksies te bereken, limiete met behulp van l'Hospital se reël te bereken, stellings deur wiskundige induksie bewys, grootste gemene delers bepaal en dit gebruik om diofantiese vergelykings op te los, en bewerkings met komplekse getalle uit te voer.*

Module code: MTHS121	Semester 2	NQF Level: 5

Name**: Introductory Algebra and Analysis II /** *Naam***: *Inleidende Algebra en Analise II***

Module outcomes:

After completion of this module students ought to be able to do the following:

- Demonstrate fundamental knowledge of vectors in three dimensional space, their properties and applications, polynomials in one variable including the factor theorem, the remainder theorem, synthetic division and Euclidean algorithm, rational functions including partial fractions, permutation, combinations, the binomial theorem, the use of derivatives in optimisation and curve sketching, Taylor series including the basic theorems on the convergence of series, the fundamental theorems of differential and integral calculus, Riemann sums, the basic properties and applications of the definite integral, advanced integral techniques, hyperbolic and inverse hyperbolic functions, and applications of integration to surfaces, lengths and volumes;
- Demonstrate problem-solving skills by analysing familiar and unfamiliar problems, using knowledge of techniques to describe three dimensional spaces, to calculate dot, cross and triple products and use it to solve a variety of problems, determine roots and greatest common dividers of polynomials, decompose rational functions into partial fractions, determine the number of arrangements and selections from a set, do binomial expansions, sketch functions, formulate optimisation problems mathematically and use knowledge of derivatives to solve them, calculate Taylor series and judge its convergence, determine Riemann sums, determine definite integrals, and calculate surfaces, lengths and volumes.

Module uitkomste:

Na voltooiing van hierdie module behoort studente die volgende te kan doen:

- *Fundamentele kennis demonstreer van vektore in driedimensionele ruimte, hul eienskappe en gebruike, polinome in een veranderlike insluitend die faktorstelling, die resstelling, sintetiese deling en Euklidiese algoritme, rasionale funksies insluitend parsiële breuke, permutasies, kombinasies, die binomiaalstelling, die gebruik van afgeleides in optimalisering en krommesketsing, Taylor-reekse insluitend die basiese stellings oor die konvergensie van reekse, die fundamentele stellings van differensiaal- en integraalrekene, Riemannsomme, die bepaalde integraal se basiese eienskappe en gebruike, gevorderde integrasietegnieke, hiperboliese en inverse hiperboliese funksies, en toepassings van integrasie op oppervlaktes, lengtes en volumes;*
- *Probleemoplossingsvaardighede demonstreer deur bekende en onbekende probleme te analiseer, kennis van tegnieke gebruik om drie-dimensionele ruimtes te beskryf, punt-, kruis- en trippelprodukte te bereken en gebruik om 'n verskeidenheid van probleme op te los, wortels en grootste gemene delers van polinome te bepaal, rasionale funksies in parsiële breuke te ontbind, die aantal rangskikkings en keuses uit 'n versameling te bepaal, binomiaaluitbreidings te doen, funksies te skets, optimeringsprobleme in 'n wiskundige formulering te giet en die kennis van afgeleides gebruik om dit op te los, Taylor-reekse te bereken en die konvergensie daarvan te beoordeel, Riemannsomme te bepaal, bepaalde integrale te bepaal, en oppervlaktes, lengtes en volumes te bereken.*

Module code: MTHS211	Semester 1	NQF Level: 6

Name**: Advanced Calculus I /** *Naam***: *Gevorderde Calculus*** *I*

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, 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; and
- Demonstrate the ability to use the geometric and physical meaning of the above-mentioned concepts to describe the underlying mathematical structure of applied problems and to interpret the significance of the mathematical solutions.

Module uitkomste:

Na voltooiing van hierdie module behoort studente die volgende te kan doen:

- *Grondige kennis en begrip demonstreer in al die aspekte van differensiaalrekening van meerveranderlike funksies: parsiële- en rigtingafgeleides, die gradiëntfunksie; optimeringsprobleme insluitende Lagrange se metode, rigtingsafgeleides en gradiënte, asook berekening van dubbel- en drievoudige-integrale;*
- *Probleemoplossingsvaardighede demonstreer deur bekende en onbekende probleme te analiseer, kennis van tegnieke gebruik om praktiese probleme wat deur meer veranderlike funksies gemodelleer word, op te los; en*
- *Die meetkundige en fisiese betekenis van die bogenoemde konsepte kan gebruik om die onderliggende wiskundige struktuur van toegepaste probleme te kan formuleer, en die betekenis van die wiskundige oplossing kan interpreteer.*

Module code: MTHS212	Semester 1	NQF Level: 6

Name: **Linear Algebra I /** *Naam***: *Lineêre Algebra I***

Module outcomes:

On completion of this module, the student will demonstrate a thorough and advanced knowledge of, and skill in the underlying principles, the methods, and the application of the theory regarding selected aspects of the following topics:

- Systems of linear equations and their solution(s), including geometrical interpretations where applicable;
- Matrices and their operations, including inverses of matrices;
- The vector spaces $\mathbf{R}^n$ and subspaces, including the column space and nullspace of a matrix, linear dependence and independence, bases, dimension and the rank and nullity of a matrix;
- Linear transformations, including geometrical interpretations in two dimensions;
- Determinants with applications such as Cramer's rule, the area of a parallelogram and volume of a parallelepiped;
- Eigenvalues and eigenvectors of matrices; and
- Applications to systems of linear differential equations.

Module uitkomste:
Na voltooiing van die module, sal die student 'n deeglike en geordende kennis van, en vaardigheid in die onderliggende beginsels, die metodes, en die toepassings van die teorie rakende geselekteerde aspekte van die volgende onderwerpe demonstreer:

- *Stelsels van lineêre vergelykings en hulle oplossing(s), insluitend meetkundige interpretasies waar toepaslik;*
- *Matrikse en hulle bewerkings, insluitende inverses van matrikse;*
- *Die vektorruimtes $\boldsymbol{R}^n$ en deelruimtes, insluitend die kolomruimte en nulruimte van 'n matriks, lineêre afhanklikheid en onafhanklikheid, basisse, dimensie en die rang en kerndimensie (nulheidsgraad) van 'n matriks;*
- *Lineêre transformasies, insluitend meetkundige interpretasies in twee dimensies;*
- *Determinante met toepassings soos Cramer se reël, die oppervlakte van 'n parallelogram en die volume van 'n parallelepipedum;*
- *Eiewaardes en eievektore van matrikse; en*
- *Toepassings op stelsels van lineêre differensiaalvergelykings.*

Module code: MTHS223	**Semester 2**	**NQF Level: 6**

Name: **Engineering Analysis I** *Naam*: ***Ingenieursanalise***

Module outcomes:
On completing this module, students should be able to demonstrate advanced knowledge of and insight into the application of:

- Vector fields, line integrals and the fundamental theorem of line integrals, Green's theorem, oriented surfaces and surface integrals, rotation and divergence, the theorems of Stokes and Gauss;
- Convergence criteria for sequences of real numbers and the monotone convergence principle, convergence of series, standard convergence tests, absolute and conditional convergence, introduction to power series, Taylor's theorem; and
- Definition of derivatives and contour integrals of complex functions, Laurent's theorem (as an extension of Taylor's theorem), algebraic manipulation of Laurent series, formal definition of the Z-transform and basic rules for Z-transforms, partial fraction method for computing inverse transforms, applications to difference equations.

Module uitkomste:
By voltooiing van die module, behoort studente gevorderde kennis en insig in die toepassing van die onderstaande kan demonstreer:

- *Vektorvelde, lynintegrale en die grondstelling van lynintegrale, Green se stelling, gerigte oppervlakke en oppervlakintegrale, rotasie en divergensie, die stellings van Stokes en Gauss;*
- *Konvergensie kriteria vir rye reële getalle en die monotoon konvergensiebeginsel, konvergensie van reekse, standaard konvergensie toetse, absolute en voorwaardelike konvergensie, inleiding tot magreekse, Taylor se stelling; en*
- *Definisie van afgeleides en kontoerintegrale van komplekse funksies, Laurent se stelling (as 'n uitbreiding van Taylor se stelling), algebraiese manipulasie van Laurent reekse, formele definisie van die Z-transform en basiese reels vir Z-transforms, die parsiele breuke metode om inverse transforms te bereken, toepassings op verskilvergelykings.*

Module code: MTHS224	Semester 2	NQF Level: 6

Name: **Applied Linear Algebra /** *Naam***: *Toegepaste Lineêre Algebra***

Module outcomes:

On completion of this module the student should:

- Demonstrate advanced knowledge of and insight into bases and linear independence of functions, and be able to use it in applications;
- Be able to use concepts like eigenvalues and eigenvectors in applications such as diagonalisation, discrete dynamical systems and systems of linear differential equations;
- Be able to use the concepts of inner product, length and orthogonality to find orthogonal bases and master their applications such as for example the least squares method and linear models; symmetric matrices and further applications; and
- Demonstrate problem-solving skills by analysing known and unknown problems and applications and applying the knowledge and techniques of linear algebra.

Module uitkomste:

By voltooiing van die module, behoort studente:

- *'n Deeglike kennis van en insig te toon in basisse en lineêr onafhanklikheid van funksies en in staat wees om dit in toepassings te gebruik;*
- *In staat te wees om begrippe soos eiewaardes en eievektore in toepassings soos diagonalisering, diskrete dinamiese stelsels en stelsels van lineêre differensiaalvergelykings te gebruik;*
- *In staat wees om die begrippe van inproduk, lengte en ortogonaliteit te gebruik om ortogonale basisse te vind en hulle toepassings te bemeester, soos byvoorbeeld die kleinste- kwadrate-metode en lineêre modelle, simmetriese matrikse en verdere toepassings; en*
- *Probleemoplossingsvaardighede te demonstreer deur bekende en onbekende probleme en toepassings te ontleed en die kennis en tegnieke van lineêre algebra te gebruik.*

Module code: NCHE111	Semester 1	NQF Level: 5

Name: **Introductory Inorganic and Physical Chemistry /**
*Naam***: *Inleidende Anorganiese en Fisiese Chemie***

Module outcomes:

After completion of the module NCHE111, the student should demonstrate:

- Fundamental knowledge of and insight into the properties of substances and compounds, intermolecular interaction, aqueous solutions, chemical equilibria, acids and bases, precipitation and electron transfer reactions; and the ability to apply this knowledge to write down and name chemical formulas;
- The ability to balance chemical reactions, use and apply stoichiometric and other calculations to find an unknown quantity;
- The ability to recognise and apply tendencies from the periodic table (main group elements);
- The ability to apply laboratory technique and safety rules;
- The ability to explain chemical phenomena, do calculations connected with the phenomena, report results scientifically and to better understand the applications of scientific results in the industry and the environment; and
- The ability to manage chemical reactions by calculating the enthalpy of reactions, determining the rate of reactions, equilibrium constants, and other aspects of aqueous equilibria such as buffer solutions and solubility products.

Module uitkomste:

Na voltooiing van die module NCHE111, behoort die student:

- *Fundamentele kennis en insig te demonstreer van die eienskappe van stowwe en verbindings, intermolekulêre wisselwerking, waterige oplossings, chemiese ewewigte, sure en basisse, neerslagvorming en elektronoordragreaksies en hierdie kennis te kan toepas om chemiese formules te skryf en te benoem;*
- *Reaksievergelykings te kan balanseer, stoïgiometriese en ander berekenings te gebruik om 'n onbekende grootheid te vind;*
- *Die bevoegdheid te hê om tendense en verbande uit die periodieke tabel (hoofgroepe) te verklaar;*
- *Vaardighede te demonstreer in die toepassing van laboratorium- en veiligheidsreëls;*
- *Bevoeg te wees om waargenome chemiese verskynsels te verklaar, berekenings in verband daarmee uit te voer, resultate wetenskaplik te kommunikeer en toepassings daarvan in die nywerheid en omgewing beter te kan begryp; en*
- *Die vermoë te hê om chemiese reaksies te bestuur deur die entalpie van reaksies te bereken, die tempo van reaksies te bepaal, ewewigskonstantes te bepaal en ander aspekte van waterige ewewigte soos bufferoplossings en oplosbaarheidsprodukte te bereken.*

Module code: NCHE121	**Semester 2**	**NQF Level: 5**

Name*:* **Introductory Organic Chemistry /** *Naam***:** ***Inleidende Organiese Chemie***

Module outcomes:

On successful completion of this module the student should be able to demonstrate:

- Knowledge and **informed understanding** of the concepts underpinning the subthemes of atomic structure, chemical bonding, molecular geometry, organic nomenclature, and intermolecular forces as well as the most important classes of organic compounds, including alkanes, alkenes, benzenes, haloalkanes, alcohols, amines, ethers, carboxylic acids, acyl halides, anhydrides, esters and amides;
- An ability to evaluate the structures of organic compounds and thereby identify suitable synthesis procedures with a **limited number of steps**;
- Conduct in the academic environment that adheres to the rules as stipulated by the North-West University code of conduct;
- Utilisation of **basic research skills**, such as sourcing and verifying information from various sources and using this information to construct a coherent body of knowledge; and communicate these discipline-specific ideas in writing in an accurate and coherent way while showing respect for conventions around copyright and plagiarism;
- The ability to apply the green chemistry approach to organic chemistry and to show the relation between our approach to chemistry and the long-term survival of the human race; and
- The ability to manage his or her learning and implement the discipline-specific learning strategies given in the NCHE 121 study guide to improve learning problems.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module, behoort die student die volgende te kan demonstreer:

- *Kennis en **ingeligte begrip** van die konsepte wat die volgende subtemas van organiese chemie onderlê: atoomstruktuur, chemiese binding, molekulêre geometrie, organiese nomenklatuur en intermolekulêre kragte, sowel as die belangrikste klasse van organiese verbindings, insluitende alkane, alkene, bensene, haloalkane, alkohole, amiene, eters, karboksielsure, asielhaliede, anhidriede, esters en amiede;*
- *Die vermoë om die strukture van organiese verbindings te evalueer en sodoende geskikte sinteseprosedures met 'n **beperkte aantal stappe** te identifiseer;*
- *Optrede in die akademiese omgewing wat voldoen aan die gedragskode van die Noordwes-Universiteit;*
- *Aanwending van **basiese navorsingsvaardighede**, soos insameling en verifikasie van inligting vanuit verskillende bronne en die gebruik van hierdie inligting om 'n koherente geheel saam te stel; en die vermoë om vakspesifieke idees skriftelik te kommunikeer op 'n koherente wyse met inagneming van die konvensies rakende kopiereg en plagiaat;*
- *Die vermoë om die groen chemie benadering toe te pas op organiese chemie en die verwantskap tussen ons benadering tot chemie en die langtermyn oorlewing van die mensdom aan te toon; en*
- *Die vermoë om sy of haar leeraktiwiteite te bestuur en vakspesifieke leerstrategieë, soos aangetoon in die **NCHE121** studiegids, te implementeer om leerprobleme te verbeter.*

Module code: NCHE211	**Semester 1**	**NQF Level: 6**

Name: Analytical Chemistry II / Naam: Analitiese Chemie II

Module outcomes:

After completion of the **NCHE211** module, the student should demonstrate:

- Integrated knowledge of the basic theories underlying types of errors occurring during chemical analyses, statistics applied on analytical results, taking and preparing samples, quality control, acid-base and complexometric titrations, gravimetry, surface characterisation techniques, atomic spectroscopy, liquid extraction, ion exchange and chromatography;
- Appropriate laboratory skills in order to conduct measurements associated with all of the above-mentioned theoretical aspects;
- The ability to demarcate and effectively solve problems associated with the theoretical and practical (experimental) aspects; and
- An understanding of the safe, ethical and professional conduct required of a professional analytical chemist.

Module uitkomste:

Na voltooiing van die module NCHE211, behoort die student die volgende te kan demonstreer:

- *Geïntegreerde kennis van die basiese teorieë onderliggend tot tipes foute wat tydens chemiese ontledings gemaak word, statistieke berekeninge op analitiese resultate, neem en voorbereiding van monsters, kwaliteitsbetuur, suur-basis en kompleksometriese titrasies, gravimetrie, oppervlakkarakteriseringstegnieke, atoomspektroskopie, vloeistof ekstraksie, ioonuitruiling en chromatografie;*
- *Toepaslike laboratorium vaardighede om metinge wat verband hou met al die bogenoemde teoretiese aspekte uit te voer;*
- *Die vermoë om probleme af te baken en doeltreffend op te los wat verband hou met die teoretiese en praktiese (eksperimentele) aspekte;*
- *'n Begrip van die veilige, etiese en professionele gedrag wat van 'n professionele analitiese chemikus verwag word.*

Module code: NCHE222	Semester 2	NQF Level: 6

Name*:* **Organic Chemistry II /** *Naam***:** ***Organiese Chemie II***

Module outcomes:

After completion of the module NCHE222, the student should demonstrate:

- Detailed knowledge and a clear understanding of models used to present atoms and molecules as well as the properties, reactions and mechanisms pertaining to aromatic chemistry;
- A clear understanding of prevalent schools of thought that determine the progress within the field of molecular models;
- The ability to select, implement and evaluate the correct mechanism to demonstrate the possible progression of specific aromatic based reactions;
- The ability to effectively use appropriate laboratory skills to synthesise and purify specific compounds;
- The ability to solve a multi-step reaction using suitable reagents and products to ensure the manufacture of the desired compound; and
- A sense of responsibility for fellow humans and the environment in scientific investigations while acting in accordance with the code of conduct relevant to chemistry.

Module uitkomste:

Na voltooiing van die module NCHE222, behoort die student die volgende te kan demonstreer:

- *'n Gedetaïlleerde kennis en 'n duidelike begrip van die modelle wat gebruik word om atome en molekules voor te stel, sowel as die einskappe, reaksies en meganismes wat van toepassing is op aromatiese chemie;*
- *'n Begrip van die huidige denkskole wat die ontwikkeling binne die veld van molekulêre modelle bepaal;*
- *'n Vermoë om die korrekte meganisme te kan kies, toe te pas en te evalueer om sodoende die moontlike progressie van spesifieke aromatiese reaksies weer te gee;*
- *'n Vermoë om toepaslike laboratoriumsvaardighede effektief te gebruik om spesifieke verbindings te vervaardig en te suiwer;*
- *'n Vermoë om 'n multi-stap reaksie te kan weergee deur die nodige reagense en produkte aan te dui om die vervaardiging van die korrekte produk te verseker; en*
- *'n Verantwoordelikheidsgevoel in sy/haar chemiese ondersoeke vir sy/haar medemens en die omgewing, terwyl hy/sy volgens die gedragskode van chemici optree.*

Module code: NPHY111	Semester 1	NQF Level: 5

Name: **Basic Physics 1 /** *Naam***:** ***Basiese Fisika I***

Module outcomes:

After completion of the module the student should demonstrate:

- Formal mathematical knowledge and informed understanding of the fundamental concepts underpinning the subthemes of physics, i.e., kinematics, Newtonian laws of motion, work and energy, momentum, rotation and rolling, equilibrium, gravity, fluid mechanics, simple harmonic motion, waves, the study of heat, and thermodynamics;
- An awareness of the development of physical measurements and theories that shaped the progress of physics;
- The ability and skills to explain certain parts of the theory by means of the basic differential and integral calculus, to solve a variety of natural science problems in the above-mentioned subthemes and to evaluate the answers and apply them to phenomena within a well-defined and familiar environment;
- Effective utilisation of basic research skills, such as conducting experiments, measuring basic observable quantities related to special and controlled cases of natural processes, and processing these data;
- The ability to reliably communicate these discipline-specific ideas by writing a report in an accurate and coherent way while showing respect for conventions related to copyright and plagiarism;
- The ability to manage his or her learning and implement the discipline-specific learning strategies given in the FSKS111 study guide to address learning problems;
- The ability to work in a group and make appropriate contributions and sharing resources to successfully complete the practical sessions and thereby taking co-responsibility for the attainment of the outcomes by the group; and
- Conduct in the academic environment that adheres to the rules as stipulated by the North-West University code of conduct.

Module uitkomste:

Na voltooiing van die module moet die student die volgende kan demonstreer:

- *Formele wiskundige kennis en ingeligte begrip van die fundamentele konsepte van die volgende subtemas van fisika, nl. kinematika, Newton se bewegingswette, arbeid en energie, momentum, rotasie en rolbeweging, ewewig, gravitasie, fluïdemeganika, enkelvoudige harmoniese beweging, golwe, warmteleer en termodinamika;*
- *'n Bewustheid van die ontwikkeling van fisiese waarnemings en teorieë wat die ontwikkeling van fisika gevorm het;*
- *Die vermoë en vaardigheid om sekere gedeeltes van die teorie met behulp van basiese differensiaal- en integraalrekene te beskryf, om 'n verskeidenheid van natuurkundige probleme in bogenoemde subtemas op te los sowel as die evaluering van die antwoorde en toepassing daarvan m.b.t. verskynsels binne 'n goed-gedefineerde en bekende omgewing;*
- *Aanwending van basiese navorsingsvaardighede, soos uitvoering van eksperimente, meting van basiese waarneembare groothede, en dataverwerking. Die vermoë om vakspesifieke idees skriftelik in 'n verslag te kommunikeer op 'n koherente, akkurate en betroubare wyse met inagneming van die konvensies rakende kopiereg en plagiaat;*

- *Die vermoë om sy of haar leeraktiwiteite te bestuur en vakspesifieke leerstrategieë, soos aangetoon in die FSKS111 studiegids, te implementeer om leerprobleme aan te spreek;*
- *Die vermoë om in 'n groep te kan werk en gepaste bydraes te maak en hulpbronne te deel om die praktiese sessies suksesvol af te handel, om sodoende mede-verantwoordelikheid te neem vir die bereiking van die uitkoms deur die groep; en*
- *Gedrag in die akademiese omgewing wat voldoen aan die gedragskode van die Noordwes-Universiteit.*

Module code: NPHY121	**Semester 2**	**NQF Level: 5**

Name: **Basic Physics II /** *Naam***:** ***Basiese Fisika II***

Module outcomes:

After completion of the module the student should demonstrate:

- Formal mathematical knowledge and informed understanding of the fundamental concepts underpinning the subthemes of physics, i.e., electricity, magnetism, optics and topics from the quantum, atom and nuclear physics;
- An awareness of the development of physical measurements and theories that shaped the progress of physics;
- Strengthening of his/her ability and skills to explain certain parts of the theory by means of the basic differential and integral calculus, to solve a variety of natural science problems in the above-mentioned subthemes and to evaluate the answers and apply them to phenomena within a well-defined and familiar environment;
- Effective utilisation of basic research skills, such as conducting experiments, measuring basic observable quantities related to special and controlled cases of natural processes, and processing these data;
- The ability to reliably communicate these discipline-specific ideas by writing a report in an accurate and coherent way while showing respect for conventions related to copyright and plagiarism;
- The ability to manage his or her learning and implement the discipline-specific learning strategies given in the FSKS121 study guide to address learning problems;
- The ability to work in a group and make appropriate contributions and sharing resources to successfully complete the practical sessions and thereby taking co-responsibility for the attainment of the outcomes by the group; and
- Conduct in the academic environment that adheres to the rules as stipulated by the North-West University code of conduct.

Module uitkomste:

Na voltooiing van die module moet die student die volgende kan demonstreer:

- *Formele wiskundige kennis en ingeligte begrip van die fundamentele konsepte van die volgende subtemas van fisika, nl. elektrisiteit en magnetisme, optika en onderwerpe uit die kwantum-, atoom- en kernfisika;*
- *'n Bewustheid van die ontwikkeling van fisiese waarnemings en teorieë wat die ontwikkeling van fisika gevorm het;*
- *Die versterking van sy/haar vermoë en vaardigheid om sekere gedeeltes van die teorie met behulp van basiese differensiaal- en integraalrekene te beskryf, om 'n verskeidenheid van natuurkundige probleme in bogenoemde subtemas op te los sowel as die evaluering van die antwoorde en toepassing daarvan m.b.t. verskynsels binne 'n goed-gedefineerde en bekende omgewing;*
- *Aanwending van basiese navorsingsvaardighede, soos uitvoering van eksperimente, meting van basiese waarneembare groothede, en dataverwerking;*

- *Die vermoë om vakspesifieke idees skriftelik in ’n verslag te kommunikeer op ’n koherente, akkurate en betroubare wyse met inagneming van die konvensies rakende kopiereg en plagiaat;*
- *Die vermoë om sy of haar leeraktiwiteite te bestuur en vakspesifieke leerstrategieë, soos aangetoon in die FSKS121 studiegids, te implementeer om leerprobleme aan te spreek;*
- *Die vermoë om in ’n groep te kan werk en gepaste bydraes te maak en hulpbronne te deel om die praktiese sessies suksesvol af te handel om sodoende mede-verantwoordelikheid te neem vir die bereiking van die uitkoms deur die groep; en*
- *Gedrag in die akademiese omgewing wat voldoen aan die gedragskode van die Noordwes-Universiteit.*

Module code: NPHY211	**Semester 1**	**NQF Level: 6**

Name: **Electricity and Magnetism /** *Naam*: ***Elektrisiteit en Magnetisme***

Module outcomes:

After completion of the module the student should demonstrate:

- Understanding and detailed knowledge of the fundamental concepts underpinning the subthemes of electricity and magnetism, i.e., the laws of electrostatics and magnetostatics in a vacuum and in matter as well as introductory electrodynamics, which includes the electromotive force and electromagnetic induction;
- A good understanding of prevalent schools of thought that determined the progress within the field of electricity and magnetism;
- The ability to evaluate, select and apply the correct laws to describe different phenomena in the context of electricity and magnetism;
- The ability to solve different problems by calculating electrostatic potentials and fields, magnetostatic fields as well as basic problems in electrodynamics such as the electromotive force and electromagnetic induction;
- The ability to use discipline-specific methods of scientific enquiry, decision-making and information gathering to execute practical work;
- The ability to analyse the results and produce an accurate and coherent written and/or oral account of the information using an appropriate discipline-specific format; and
- An understanding of the ethical implications of decisions and actions in this context.

Module uitkomste:

Na voltooiing van die module moet die student die volgende kan demonstreer:

- *In staat wees om begrip en gedetailleerde kennis van die fundamentele begrippe onderliggend aan die subtemas van elektrisiteit en magnetisme, nl. die wette van elektrostatika en magnetostatika in vakuum en in materie, te toon, sowel as inleidende elektrodinamika, insluitend elektromotoriese krag en elektromagnetiese induksie;*
- *’n Duidelike begrip hê van die denkrigtings, wat vooruitgang in die veld van elektrisiteit en magnetisme bepaal het;*
- *Die vermoë om die korrekte wette, wat verskillende verskynsels beskryf, te evalueer, selekteer en toe te pas, binne die konteks van elektrisiteit en magnetisme;*
- *Die vermoë om probleme op te los deur elektrostatiese potensiale- en velde en magnetostatiese velde te bereken, sowel as om basiese probleme in elektrodinamika, soos elektromotoriese krag en elektromagnetiese induksie, op te los;*
- *Gebruik van vakspesifieke metodes van wetenskaplike ondersoek, besluitneming en versameling van inligting, om praktiese werk uit te voer;*
- *Analisering van die resultate en saamstel van akkurate en koherente geskrewe en/of mondelingse aanbieding van die inligting deur gebruik te maak van toepaslike vakspesifieke formaat; en*
- *’n Begrip van die etiese implikasies van besluite en optrede binne hierdie konteks.*

Module code: PPEP171	Year module	NQF level: 5

Name: **Practical Engineering Practice** / *Naam:* ***Ingenieurspraktyk Prakties***

Module outcomes:

After successful completion of module PPEP171, students will have mastered the elementary practical use of basic hand tools and manufacturing equipment in a mechanical workshop, in particular:

- Constructing a fitting and turning project including working with a lathe, vernier, drill press, hack saw, spiral drill, tap and die set, height gauge, hand files and work bench with vice;
- Constructing a boiler-making project, including working with above-mentioned equipment together with a welding machine, guillotine and metal roller;
- Stripping and assembling an engine to have a better understanding of the working of an engine and its components; identifying and understanding the different materials of components; measuring and calculating the capacity of an engine; and understanding the function of timing, torque, carburettor and filters;
- Implementing all occupational health and safety principles provided in FIAP173;
- Fundamental understanding of occupational health and safety to work in a mechanical workshop, including general safety housekeeping, how to respond to an accident, safeguarding machinery, compressed-gas cylinders, electrical apparatus, personal protective equipment, fire prevention and protection, carbon monoxide, ladders, risk and hazard assessment.

Assessment criteria:

The student will prove that he/she has attained the outcomes of the PPEP171 module when he/she can:

- Construct a fitting and turning project, using several equipment in a mechanical workshop including, lathe, vernier, drill press, hack saw, spiral drill, tap and die set, height gauge, hand files and work bench with vice;
- Construct a boiler-making project, including working with the above-mentioned equipment as well as welding machine, guillotine and metal roller;
- Strip and assemble an engine in groups, to have a better understanding of the working of an engine and its components, identify and understand the different materials of components, measure and calculate the capacity of an engine, understand the function of timing, torque, carburettor and filters;
- Implement all the occupational health and safety principles provided in FIAP173; and
- Apply occupational health and safety when engaged in manufacturing in a mechanical workshop.

Module uitkomste:

Na suksesvolle voltooiing van die module PPEP171, sal studente die basiese praktiese gebruik van basiese handgereedskap en vervaardigingsapparatuur in 'n meganiese werkswinkel bemeester het, spesifiek:

- *Die bou van 'n pas-en-draaiprojek, insluitend werk met 'n draaibank, vernier, boorpers, haksaag, spiraalboor, kraan-en-merkstel, hoogtemeter, handlêers en werkbank met onderstel;*
- *Bou van 'n ketelmakersprojek, insluitend gebruik van voormelde toerusting, asook sweismasjien, guillotien, metaalrol;*
- *Om 'n enjin te stroop en op te bou, om die werking van 'n enjin en sy komponente beter te verstaan, die verskillende materiale van komponente te identifiseer en te verstaan, die kapasiteit van 'n enjin te meet en te bereken, en die funksie van tydsberekening, wringkrag, vergasser en filters te verstaan;*
- *Implementering van alle beroepsgesondheids- en veiligheidsbeginsels wat in FIAP173 voorsien word; en*

- *'n Fundamentele begrip van beroepsgesondheid en -veiligheid om in 'n meganiese werkswinkel te werk, insluitende algemene veiligheidshuishouding, hoe om te reageer op 'n ongeluk, die beveiliging van masjinerie, hoogdruk-gassilinders, elektriese toestelle, persoonlike beskermende toerusting, brandvoorkoming en beskerming, koolstofmonoksied, lere, risiko en gevaar assessering.*

Assesseringskriteria:
Die student sal bewys lewer dat hy/sy die uitkomste van die PPEP171-module bereik het wanneer hy/sy:

- *'n Pas-en-draaiprojek kan bou, met behulp van verskeie toerusting in 'n meganiese werkswinkel, insluitend draaibank, vernier, boorpers, haksaag, spiraalboor, kraan- en-merkstel, hoogtemeter, handlêers en werkbank met onderstel;*
- *'n Ketelmakersprojek kan bou, insluitende gebruik van voornome toerusting, sowel as sweismasjien, guillotien en metaalrol.*
- *'n Enjin in groepe kan stroop en opbou, om die werking van 'n enjin en sy komponente beter te verstaan, die verskillende materiale van komponente identifiseer en verstaan, die kapasiteit van 'n enjin kan meet en kan bereken, en die funksie van tydsberekening, wringkrag, vergasser en filters verstaan;*
- *In staat is om al die beroepsgesondheids- en veiligheidsbeginsels wat in FIAP173 voorsien is, te implementeer;*
- *In staat is om beroepsgesondheid en -veiligheid toe te pas wanneer hy/sy in 'n meganiese werkswinkel werksaam is.*

Module code: REII111	**Semester 1**	**NQF level: 5**

Name: **Introduction to Digital Systems /** *Naam:* ***Inleiding tot Digitale Stelsels***

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.

Module uitkomste:
Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- Beskik oor kennis van binêre rekene en oktale nommerstelsels, logiese hekke, Boolese algebra en vereenvoudiging, Karnaughkaart-vereenvoudiging, hekke en hulle tydseienskappe, asook kennis van verskeie kombinatoriese stroombane, soos byvoorbeeld, dekodering en enkodering en wiskundige stroombane, sinchrone bane, wipbane en hulle tydseienskappe, willekeurige kringloop tellerontwerpe, tyd-deelmultipleksering, A/D- en D/A- omsetters en koppeling, geheuestelsels en mikrorekenaarstrukture, busse en tydseine en kodes soos ASCII, Grey, EBCDIC; en
- Vertroud is met die teorie van analise, evaluering, simulasie, ontwerp, sintese en foutsporing van logiese stroombane en stelsels van stroombane.

Module code: REII121	Semester 2	NQF level: 5

Name: **Introduction to Microcontrollers /** *Naam:* ***Inleiding tot Mikrobeheerders***

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;
- Has 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.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort studente oor die volgende te beskik:

- *Kennis en begrip om die verskil tussen versonke mikroverwerkers en algemene 8-bis mikroverwerkers, asook die verskil tussen von Neumann en Harvard argitekture, te identifiseer en te evalueer;*
- *Die vermoë om versonke hardeware te kan spesifiseer en ontwerp vir 'n gegewe taak en die gepaardgaande versonke sagteware te ontwerp en kodeer vir 'n gegewe taak in saamsteltaal of C++;*
- *Die vermoë om gebruik te maak van Inset en Uitset koppelvlakke op die spesifikasie, ontwerp en programmeer vlak;*
- *Die vermoë om sagteware te ontwikkel vir beide gepolsde en onderbrekingsgedrewe stelsels;*
- *Die vermoë om adresruimte optimaal te benut met inagneming van beide spasie en spoed kriteria in mikroverwerkers; en*
- *Kennis en begrip van analise, evaluasie, simulasie, ontwerp, sintese en foutsporing van mikroverwerkers op stelselvlak.*

Module code: REII211	Semester 1	NQF level: 6

Name: **Algorithms and Optimisation /** *Naam:* ***Algoritmes en Optimering***

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; and
- Solve different engineering problems by using the above techniques.

Module uitkomste:

Na suksesvolle voltooiing van hierdie module behoort 'n student te kan demonstreer dat hy/sy:

- *In-diepte kennis en begrip van wiskundige modellering het en die vermoë het om wiskundige modelle met behulp van 'n programmeertaal te simuleer;*
- *Kennis en begrip van datastrukture (insluitend vektore, matrikse, geskakelde lyste, stapels en toue) het;*

- *Metodes kan gebruik om abstrakte datatipes vir die bostaande datastrukture te skep;*
- *Oor die vermoë beskik, om komplekse algoritmes met behulp van bostaande datastrukture op te stel en te manipuleer; en*
- *Verskillende ingenieursprobleme kan oplos, deur van die bostaande tegnieke gebruik te maak.*

Module code: REII222	**Semester 2**	**NQF level: 6**

Name: **Embedded Systems /** *Naam:* ***Versonke Stelsels***

Module outcomes:

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

- Has fundamental knowledge of 16- and 32-bit processor architectures;
- Understands electrical requirements of these processors and signal integrity issues to be aware of;
- Understands memory interfaces, specifically various types of RAM, ROM, FLASH, and the importance of address decoding and DMA;
- Understands common communication busses (I2C, I2S, RS232, RS485, USB, 1-Wire, SPI);
- Understands the challenges of programming for embedded systems, specifically pertaining to safety and security considerations when dealing with embedded systems;
- Can apply his/her knowledge to solve engineering problems by low-level C programming of embedded systems; and
- Can design a basic microcontroller based embedded system.

Module uitkomste:

Om dié module suksesvol af te handel behoort die student te kan demonstreer dat hy/sy:

- *Oor fundamentele kennis beskik van 16-bis en 32-bis verwerker-argitekture;*
- *Die elektriese vereistes van hierdie verwerkers en sein-integriteit kwessies waarvan kennis geneem moet word, verstaan;*
- *Geheue-koppelvlakke verstaan, spesifiek verskillende tipes RAM, ROM, FLASH, en die belang van adresdekodering en DMA;*
- *Die mees algemene kommunikasie busse (I2C, I2S, RS232, RS485, USB, 1-Wire, SPI) verstaan;*
- *Die uitdagings van programmering vir komplekse verskanste stelsels verstaan, spesifiek m.b.t. die veiligheids- en sekuriteit-oorwegings by verskanste stelsels;*
- *Sy/haar kennis kan toepas om ingenieursprobleme op te los deur lae-vlak C-programmering van verskanste stelsels; en*
- *'n Basiese mikroverwerker kan ontwerp, gebaseer op 'n verskanste stelsel.*

Module code: REII312	**Semester 1**	**NQF level: 7**

Name: **Network Fundamentals /** *Naam:* ***Grondbeginsels van Netwerke***

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 and quality of service;
- Link: Media access, error correction, protocols;
- Channel: Capacity, transmission media, line coding, modulation;
- Applications: GSM, VoIP; and

- Upon completion of the module, the student should be able to describe IP and the OSI 7-layer structure, be able to program simple data compression and cryptography algorithms, to derive network models and apply 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.

Module uitkomste:

Ten einde hierdie module suksesvol te voltooi, moet die student 'n grondige kennis van die bogenoemde tegnologieë kan bewys. Meer spesifiek moet die student kan demonstreer dat hy/sy telekommunikasie en data netwerke vanuit die volgende perspektiewe verstaan:

- *Histories: In terme van standaarde;*
- *Die gebruiker: Basiese inligtingsteorie, seinkodering en data saampakking;*
- *Sekuriteit: Kriptografiese algoritmes, inkripsie en dekripsie;*
- *Netwerk: Topologieë, modelle en dimensionering, internet-netwerke, komponente, protokolle, kwaliteit van diens;*
- *Skakel: Media-toegang, foutkorreksie, protokolle;*
- *Kanaal: Kapasiteit, transmissie media, lynkodering, modulering;*
- *Beplanning: Netwerk argitektuur, bepaling van gepaste tegnologie en ontwerp;*
- *Na suksesvolle voltooiing van die module behoort die student in staat te kan wees om IP- en die OSI 7-laagstruktuur te beskryf, om gepaste netwerk tegnologieë te kan identifiseer, om eenvoudige datasamepakking en kriptografie te programmeer, om netwerkmodelle af te lei en toe te pas in dimensionering, om roetering-algoritmes toe te pas, om foutkorreksiekodes te implementeer, media te karakteriseer, ingenieursberekeninge en simulasies op data-tempo's, kongestie in netwerke, optimale buffergroottes en invloed van outomatiese herstuur, te doen.*

Module code: REII313	**Semester 1**	**NQF level: 7**

Name: **Object-oriented Software Development /**
Naam: ***Objek-georiënteerde Sagteware Ontwikkeling***

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;
- Is 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; and
- 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.

Module code: REII323	Semester 2	NQF level: 7

Name: **Embedded Operating Systems /** *Naam:* ***Versonke Bedryfsstelsels***

Module outcomes:

To successfully complete this module, the student should be able to demonstrate that he/she:

- Understands the detail concepts of 32-bit architectures;
- Can describe the low-level functionality of 32-bit microcomputers;
- Understands challenges associated with embedded operating systems;
- Is able to deploy an embedded operating system; and
- Can develop appropriate engineering solutions within an embedded environment.

Module uitkomste:

Om hierdie module suksesvol te voltooi, moet die student in staat wees om te demonstreer dat hy/sy

- *Die detailkonsepte van 32-bis-argitekture verstaan;*
- *Die laevlak-funksionaliteit van 32-bis-mikrorekenaars kan beskryf;*
- *Uitdagings i.v.m. verskanste bedryfstelsels verstaan;*
- *In staat is om 'n verskanste bedryfstelsel te ontplooi; en*
- *Toepaslike ingenieursoplossings binne 'n geïntegreerde omgewing kan ontwikkel.*

Module code: REII327	Semester 2	NQF level: 7

Name: **Computer Engineering Design /** *Naam:* ***Rekenaaringenieurswese Ontwerp***

Module outcomes:

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

- Understands the systems engineering process;
- Can apply design guidelines and constraints;
- Can interpret a development specification and the allocation of requirement;
- Apply a customised systems engineering process on a complex engineering project;
- Can successfully work as an individual and in groups; and
- Can use appropriate CAD, simulation and other relevant engineering software tools during the design process.

Module uitkomste:

Om hierdie module suksesvol te voltooi, moet die student demonstreer dat hy/sy:

- *Die stelselingenieursproses verstaan;*
- *Ontwerpriglyne en beperkinge kan toepas;*
- *'n Ontwikkelingspesifikasie en die toekenning van vereiste kan interpreteer;*
- *'n Doelgemaakte stelselingenieursproses op 'n komplekse ingenieursprojek kan aanwend;*
- *Suksesvol as 'n individu en in groepsverband kan werk; en*
- *Gepaste CAD, simulasie en ander relevante ingenieur sagteware-gereedskap tydens die ontwerpproses kan gebruik.*

Module code: REII414	Semester 1	NQF level: 8

Name: **Databases and Web-programming /** *Naam:* ***Databasis en Web-programmering***

Module outcomes:

To successfully complete this module, the student should be able to demonstrate that he/she:

- Understands database definitions and terms;
- Can design and implement databases, and store, alter and delete information in databases;
- Can use basic and advanced SQL to manipulate databases;
- Can identify problems associated with concurrent access and repair of databases after failure;
- Can implement interfaces to the database;

- Understands the challenges of web-based programming;
- Clearly understands the differences between procedural, object-oriented and web-programming;
- Can successfully use software tools to implement web-based software;
- Can evaluate the applicability of rapid application development tools for developing web-based software; and
- Can apply all the above to solve an engineering problem.

Module uitkomste:
Om dié module suksesvol af te handel, behoort die student te kan demonstreer dat hy/sy:

- *Databasis definisies en terme verstaan;*
- *Databasisse kan ontwerp en implementeer;*
- *Data in databasisse kan stoor, verander en uitwis;*
- *Databasisse kan manipuleer deur middel van basiese en gevorderde SQL instruksies;*
- *Web gebaseerde toepassings wat deur databasisse gerugsteun word kan ontwerp en ontwikkel;*
- *Probleme geassosieer met gelyktydige toegang en herstel van databasisse na faling kan identifiseer; en*
- *Koppelvlakke na databasisse kan implementeer.*

Module code: REII424	**Semester 2**	**NQF level: 8**

Name: **Data Analysis /** *Naam:* ***Data-Analise***

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

- Can estimate required sampling rate, data type and transmission rate of sensor data;
- Can calculate the effect of multiple sensor nodes on network performance;
- Can develop a database capable of handling multiple sensor nodes;
- Can develop software for administration of the system;
- Can apply applicable data mining principles to utilise acquired data;
- Understands the planning, documentation and testing of these types of systems; and
- Can apply all the above to a distributed sensing system.

Module uitkomste:
Om hierdie module suksesvol te voltooi, moet die student in staat wees om te demonstreer dat hy/sy:

- *Die vereiste monstertempo, data tipe en transmissietempo van sensordata kan skat;*
- *Die effek van verskeie sensornodes op die netwerk-werkverrigting kan bereken;*
- *'n Databasis wat verskeie sensornodes kan hanteer kan ontwikkel;*
- *Sagteware vir administrasie van die stelsel kan ontwikkel;*
- *Toepaslike data-ontginningsbeginsels kan aanwend om verkreë data te benut;*
- *Die beplanning, dokumentasie en toetsing van hierdie tipe stelsels kan verstaan; en*
- *Al bogenoemde op 'n verspreide sensorstelsel kan toepas.*

New module EII425

Module code: REII425	**Semester 2**	**NQF level: 8**

Name: **Data Analytics and Machine Learning /** *Naam:* ***Data-Analise en Masjien Leer***

Module outcomes:
To successfully complete this module, the student will demonstrate:

- The ability to acquire, store, and manipulate bid data sets;
- Application of suitable data analytics techniques on big data problems;
- Capacity to compare and contrast various machine learning algorithms as it pertains to big data problems;
- Application of selected machine learning algorithms to big data problems;
- Visualise the result of data analytics in a suitable manner.

Module code: STTK222	Semester 2	NQF level: 6

Name: **Statistics for Industrial Engineering /** *Naam:* ***Statistic vir Bedryfsingenieurswese***

Module outcomes:

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

- Thorough knowledge and clear understanding of random variables and their probability distributions;
- Detailed knowledge of the following probability distributions, which are of practical and theoretical importance: binomial, geometric, negative binomial, hypergeometric, Poisson, exponential and normal distributions;
- Knowledge and skills to mathematically calculate important quantities from probability distributions, specifically probabilities of events and expected values;
- Understanding of dependence between random variables in terms of their joint distributions, and related concepts including independence, conditional probability and conditional expectation;
- Understanding of statistical hypothesis testing, along with the knowledge and ability to calculate the necessary test statistics, critical values and p-values, and the insight to correctly interpret and communicate the test results;
- Understanding of correlation and regression analysis of bivariate data, and the insight to interpret estimated regression coefficients and model fit statistics;
- Practical skills to do statistical calculations (involving the above fundamental concepts) using a computer programming language;
- Knowledge and understanding of Monte Carlo experiments and its usefulness in analysing the behaviour of a random mechanism, and its usefulness in solving real-life problems which are too complex to solve analytically;
- The ability to design an appropriate Monte Carlo simulation procedure with a view to analyse and solve problems that had been previously encountered and problems that are new and unfamiliar;
- The ability to effectively implement a standard or custom simulation procedure using a computer programming language;
- The ability to effectively implement analytical or simulation techniques to solve real-world problems;
- The ability to communicate methods, solutions and conclusions as an individual and/or part of a group, orally and in writing in an ethical, responsible and acceptable way.

Module uitkomste:

Na die suksesvolle voltooiing van hierdie module, moet die student in staat wees om te demonstreer dat hy/sy:

- *Deeglike kennis en duidelike begrip van stogastiese veranderlikes en hul waarskynlikheidsverdelings het;*
- *Gedetailleerde kennis het van die volgende waarskynlikheidsverdelings, wat van beide praktiese en teoretiese belang is: binomiaal-, geometriese, negatief binomiaal-, hipergeometriese, Poisson-, eksponensiële en normaalverdelings;*
- *Kennis en vaardigheid het om belangrike groothede vanuit waarskynlikheidsverdelings te bereken, in die besonder waarskynlikhede en verwagte waardes;*
- *Begrip het van afhanklikheid tussen stogastiese veranderlikes in terme van hul gesamentlike verdelings, asook verwante begrippe, insluitend onafhanklikheid, voorwaardelike waarskynlikheid en voorwaardelike verwagting;*
- *Begrip het van statistiese hipotesetoetsing, tesame met die kennis en vermoë om die nodige toetsstatistieke, kritieke waardes en p-waardes te bereken, asook om hierdie resultate korrek te interpreteer en te kommunikeer;*
- *Begrip het van korrelasie- en regressieontleding van bivariate data, en die insig om die beraamde regressiekoëffisiënte en passingstatistieke te interpreteer;*
- *Praktiese vaardighede het om statistiese berekenings (met betrekking tot die bogenoemde fundamentele begrippe) met behulp van 'n rekenaar uit te voer;*

- *Kennis en begrip het van Monte Carlo-eksperimente en die nut daarvan om die gedrag van 'n kansmeganisme te ontleed, asook die bruikbaarheid daarvan om werklike probleme op te los wat te ingewikkeld is om analities op te los;*
- *Die vermoë het om 'n geskikte Monte Carlo-simulasieprosedure te ontwerp met die doel om bekende of nuwe probleme te ontleed en op te los;*
- *Die vermoë het om doeltreffend 'n standaard of pasgemaakte simulasieprosedure met behulp van 'n rekenaarprogrammeringstaal te implementeer;*
- *Die vermoë het om doeltreffende analitiese of simulasie-tegnieke te implementeer om lewensgetroue probleme op te los;*
- *Die vermoë het om individueel of in groepsverband metodes, oplossings en gevolgtrekkings sinvol te interpreteer en te kommunikeer, mondelings en skriftelik, op 'n etiese, verantwoordelike en aanvaarbare wyse.*

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

Name: **Engineering Statistics /** *Naam:* ***Ingenieursstatistiek***

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, make scatter plots, calculate correlation coefficients, fit lines to data and work with multivariate data, explain 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, calculate point and interval estimates, perform hypothesis testing procedures, perform analysis of variance calculations, propose an experimental design in specific cases and use inferential methods in regression and correlation.

Module uitkomste:

Na suksesvolle afhandeling van hierdie module behoort die student in staat te wees om fundamentele kennis van die volgende statistiese konsepte te demonstreer:

- *Onsekerheid en variasie, 'n verdeling, sekere kontinue en diskrete verdelings, numeriese opsommende maatstawwe, bi- en meerveranderlike data en verdelings, metodes om data te verkry, waarskynlikheid en steekproefverdelings, kwaliteit en betroubaarheid, punt- en intervalberamers, toetsing van statistiese hipoteses, die analise van variansie, eksperimentele ontwerp- en inferensiemetodes in regressie en korrelasie;*
- *Sy/haar vermoë om grafiese voorstellings van die data te interpreteer, die konsep van 'n verdeling te verduidelik, met sekere kontinue en diskrete verdelings te werk, maatstawwe van sentraliteit, verspreiding en variante te bereken, spreidiagramme te maak, korrelasiekoëffisiënte te bereken, lyne aan data te pas en met multivariate data te werk, verskillende steekproefmetodes en meetsisteme te verduidelik, basiese konsepte in waarskynlikheidsteorie en die beskrywing van steekproefverdelings te verduidelik, metodes gebruik in kwaliteit en betroubaarheid te verduidelik, punt- en intervalafskattings te bereken, hipotesetoetsing-prosedures te doen, analise van variansie-berekeninge te doen, 'n eksperimentele ontwerp in spesifieke gevalle voor te stel deur gebruik van inferensie-metodes in regressie en korrelasie.*