Faculty of Engineering

# Undergraduate

Fakulteit Ingenieurswese

# Voorgraads

# 2025 Yearbook

NWU®

# YEARBOOK 2025

FACULTY OF ENGINEERING
UNDERGRADUATE

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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 General Academic Rules

**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.

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## NWU Office Bearers

https://www.nwu.ac.za/governance-and-management/institutional-management

## NWU Executive Deans

**Faculty of Economics and Management Sciences**
Prof B Surujlal

**Faculty of Education**
Prof LN Conley

**Faculty of Engineering**
Prof L van Dyk

**Faculty of Health Sciences**
Prof AF Kotzé

**Faculty of Humanities**
Prof D Moyo

**Faculty of Law**
Dr N Morei

**Faculty of Natural and Agricultural Sciences**
Prof DM Modise

**Faculty of Theolog**
Prof H Goede

**FACULTY BOARD**
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Prof L van Dyk (Executive Dean)

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Ms NT Leokaoke
**School of Electrical, Electronic and Computer Engineering**
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**School of Mechanical Engineering**
Prof A Jonker
**School of Industrial Engineering**
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Vacant

**Lecturers**
Dr F Moyo
Vacant

**Junior Lecturers**
Vacant
Vacant

**Student Representative**
Chairperson FENG SAC

**Faculty Administrator**
Mrs B Mackenzie

# ENG.1 GENERAL

The Faculty of Engineering of the North-West 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 of 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 and 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, while reducing manufacturing costs and/or optimising processes.

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

# ENG.1.1 THE ENGINEERING PROFESSION

## ENG.1.1.1 The Role of the Professional Engineer

Engineering refers to the branch of science and technology concerned, 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.

## ENG.1.1.2 Professional Ethics

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

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

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

## ENG.1.1.3 Registration as Professional Engineer

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.
- More information regarding the registration process is available on the website of the Engineering Council of South Africa at https://www.ecsa.co.za

## ENG.1.2 PROFESSIONAL STATUS

### ENG.1.2.1 ECSA Accreditation

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 among 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.
- Various engineering societies for membership. See school for more information.
- Other local and foreign universities (that enable access to postgraduate study).

### ENG.1.2.2 International Comparability

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 as indicated on the ECSA website.

The current signatories and the Graduate Attributes are available at
https://www.ieagreements.org/accords/washington/signatories/

# ENG.2 FACULTY RULES

## ENG.2.1 AUTHORITY OF THE GENERAL ACADEMIC RULES

The Faculty rules valid for the different qualifications, programmes and curricula of this Faculty and contained in this Faculty Calendar are subject to the General 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.

The following statutory body/bodies are relevant for the programmes offered by the Faculty of Engineering:

Engineering Council of South Africa (ECSA).

### ENG.2.1.1 General Provisions

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

These rules must be read with and applied subject to the Higher Education Act 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.

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 A-Rules 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).

## ENG.2.2 ACADEMIC LITERACY

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. Engineering students are required to complete ALDE112 (if TAG/Tall test is passed with a code 4/5) or ALDE111 & ALDE122, subject to Faculty Rules specified by the Faculty of Humanities. They have to pass this module/these modules before they can graduate. Detailed information on the registration of modules in academic literacy can be found here: https://humanities.nwu.ac.za/languages/academic-literacy

## ENG.2.3 WARNING AGAINST PLAGIARISM

Assignments are individual tasks and not group activities (unless explicitly indicated as group activities).

For further details see:
https://library.nwu.ac.za/copyright-and-plagiarism

## ENG.2.4 CAPACITY STIPULATION

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.

## ENG.2.5 PROTECTION OF PERSONAL AND EDUCATION-RELATED INFORMATION

https://www.nwu.ac.za/access-to-information-act

Refer to General Academic Rule 1.10
https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf .

## ENG.2.6 ADMISSION REQUIREMENTS FOR THE QUALIFICATION AND FACULTY

### ENG.2.6.1 General

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

The minimum admissions requirements for prospective students into any of the BEng programmes are based on the final Grade 12 NSC results and must be at least:

- 70% for Mathematics
- 70% for Science
- APS score of 34

In addition, the student must at least receive 60% for the language of instruction.

Students can get provisional acceptance into a BEng programme if they adhere to at least two of the three criteria stated above. Final acceptance is subjected to the final Grade 12 marks according to the minimum admissions requirements as set out above.

### ENG.2.6.2 Admission from BSc to BEng

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%.

By virtue of General Academic Rule 1.6 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.

### ENG.2.6.3 Joining from another university

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

## ENG.2.7 RECOGNITION OF PRIOR LEARNING

The requirements regarding recognition of prior learning are stipulated in General Academic Rule 1.5.3.

https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

### ENG.2.7.1 Amendment of curriculum and/or qualification

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.

## ENG.2.8 REGISTRATION

***i.*** **Annual registration**

Refer to General Academic Rules 1.9.1 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

For UG BEng students: A registered (contact or distance) student must actively participate in teaching, learning and assessment activities and due dates of every module for which such student is registered as provided for in the study guide, MOD, e-learning environment or teaching and learning manual to be deemed to be an enrolled student of the faculty (General Academic Rules 1.9.1.4).

***ii.*** **Module acceptances and exemptions**

General Academic Rules 1.6 apply - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

***iii.*** **Exemptions for a period and specific 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.

***iv.*** **Registration according to timetable**

General Academic Rule 1.9.1.2.2 applies to engineering - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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.

***v.*** **Simultaneous registration at more than one institution**

General Academic Rule 1.9.5.1 apply - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

***vi.*** **Simultaneous registration for more than one qualification**

General Academic Rule 1.9.6 apply - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

***vii.*** **Registration for additional 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 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

## ENG.2.9 ASSESSMENT

The rules concerning the assessment of undergraduate modules are stipulated in General Academic Rule 1.12 as well as General Academic Rule 2.6 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

***i.*** **Participation mark**

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 will be the weighted average of the different assessments as indicated in the study guide.

***ii.*** **Examination opportunities**

The number of examination opportunities is in accordance with General Academic Rule 1.12.5.

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.

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

Final year capstone module listed below are not subject to second examination opportunity. These modules include CEMI479, CEMI477, EERI474, MCTR474, INGM479, INEM472, INEM475, INGB472, INGB479 and all WIL/SL based modules. Note: This is not applicable to the modules listed as final year capstone modules.

For final additional examination or assessment, refer to General Academic Rule 1.12.7 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

### *iii.* Medical certificates for absence

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

Regarding absence from an assessment 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.

### *iv.* Use of e-devices during examinations

The following policy with respect to e-devices has been approved:

a) Prescribed e-devices may be used but are not supplied.
b) If the e-devices in question cannot be described adequately, the examiner must be present in person in order to check the e-devices.
c) The chief invigilator must, at the start of each examination session/test, direct the candidates' attention specifically to the requirement that only e-devices indicated on the examination paper may be used.
d) No student may borrow an e-device 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 e-devices during examinations, the following applies:

In exceptional cases, permission for the use of non-standard e-devices 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 e-devices before it is taken into the examination hall. On each examination paper, it must be stated whether a pocket e-device 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.

### *v.* Admission to examination

The requirements regarding undergraduate examination are stipulated in General Academic Rule 1.12.2 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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 1.12.2.1).

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 1.12.1.1).

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.

### *vi.* Relationship between credits, teaching periods and examination papers

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

The engineering curricula are put together with a view to the minimum period of four years (BEng degree). 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 an 8 or 12-credit module should normally (but not limited to) be two hours and for 16, 24 or 32 credit modules, three hours.

### *vii.* Moderating of modules, examination papers and answer papers

General Academic Rules 2.6.1 is applicable as well as Faculty rules where the requirements of Statutory Councils are stated.

The faculty rule on the external moderation of UG exit-level modules is as follows:

1. All modules at exit level as well as modules that have ECSA GA assessments at exit level are required to be subjected to external moderation.
2. Other assessment components that require external moderation are:
    a. All modules at exit level that make use of continuous assessment are required to make use of external moderation for all assessments that contribute more than 20% or more to the module mark.
    b. Also, all ECSA GA assessments on exit level are subjected to external moderation

### *viii.* Calculation of module mark

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.

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 should be indicated in the study guide. 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.

### *ix.* Pass requirements

Under General Academic Rule 1.12.3 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 2.6.2).

The final module mark is composed, in accordance with the Faculty rules, of the mark attained by the student for the summative assessment 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 is as indicated in the study guide, 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 1.12.3).

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 1.12.3 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.

### *x.* Access to marked examination work

General Academic Rule 1.12.8 applies -
https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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.

### *xi.* Repeating of modules

If a student does not pass either of the two examination opportunities following the achievement

of a participation mark for a relevant module, the module must be repeated in its entirety and a new participation mark accumulated. Class exemption is not granted.

Students who completed and passed practical work previously in a module refer to General Academic Rule 1.11.1 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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.

## ENG.2.10 ATTAINMENT OF AN UNDERGRADUATE QUALIFICATION

### ENG.2.10.1 Satisfaction of requirements

General Academic Rule 2.7.1 applies - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

### ENG.2.10.2 Awarding of a qualification with distinction

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 General Academic Rule 2.7.2.2 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, as determined by the official student information system.

## ENG.2.11 ASSUMED LEARNING-BASED PROGRESS IN A CURRICULUM

General Academic Rule 1.7 explains the principles of prerequisite and co-requisite modules - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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.

### ENG.2.11.1 Requirements with respect to assumed prior learning for BEng programmes

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 first-year core modules have been passed (General Academic Rule 2.4.1).

## ENG.2.12 MONITORING OF ACADEMIC PERFORMANCE

General Academic Rules 1.14 and 1.15 applies - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

## ENG.2.13 PROGRESSION REQUIREMENTS (GENERAL ACADEMIC RULE 1.15)

General Academic Rule 1.15 applies - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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 1.15.4 is final.

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

## ENG.2.14 TERMINATION OF STUDIES

General Academic Rule 1.17 applies - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

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

With regards to the monitoring of academic performance, a student in any BEng programme of the Faculty of Engineering is considered to be unsatisfactory in accordance with General Academic Rule 1.15.2 - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

# ENG.3 OTHER SPECIFIC FACULTY RULES

General Academic Rule 1.3 applies - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

## ENG.3.1 MINIMUM AND MAXIMUM DURATION

General Academic Rule 1.13.1.4 applies - https://www.nwu.ac.za/sites/www.nwu.ac.za/files/files/i-governance-management/policy/2023/7P/A-Rules-approved-by-Council-16-Nov-2023.pdf.

## ENG.3.2 MEDIUM OF INSTRUCTION

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.

## ENG.3.3 PRACTICAL TRAINING IN INDUSTRY DURING STUDY PERIOD

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.

Senior students (at the end of year level 3) must perform discipline-appropriate vacation work for a prescribed time. 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.

## ENG.3.4 EQUIPMENT

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 is requires to have a Windows compatible laptop that adheres to the requirements as listed on the link below.

https://services.nwu.ac.za/sites/services.nwu.ac.za/files/files/information-technology/IT_Student_Orientation/2023/Laptop_Requirements_2023.pdf

## ENG.3.5 NETWORK SERVICES

It is expected of all students in the Faculty of Engineering to have full access to e-mail and Internet services to facilitate the completion of their studies. Access to these services will be supplied by the LAN and WiFi of the NWU under the supervision of the division of Information Technology.

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.

# ENG.4 SCHOOLS IN THE FACULTY OF ENGINEERING

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

The schools and the programmes (undergraduate) offered in each school are shown below:

| School | Programmes |
|---|---|
| School of Chemical and Minerals Engineering | • Chemical Engineering |
| School of Electrical, Electronic and Computer Engineering | • Electrical and Electronic Engineering<br>• Computer and Electronic Engineering<br>• Mechatronic Engineering |
| School of Mechanical Engineering | • Mechanical Engineering<br>• Electromechanical Engineering |
| School of Industrial Engineering | • Industrial Engineering |

# ENG.5 QUALIFICATIONS, PROGRAMMES AND CURRICULA

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

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

| FIRST BACHELOR'S DEGREES | | | | |
|---|---|---|---|---|
| **Qualification** | **Curriculum code** | **Qualification Programme Code** | **Method of Delivery** | **NQF Level** |
| Bachelor of Engineering in Chemical Engineering | I431P | 7CG K01 | Full-time | 8 |
| Bachelor of Engineering in Chemical Engineering with Minerals Processing (phased out 2023) | I432P | 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 Mechatronics Engineering | I401P | 7CR K01 | Full-time | 8 |
| Bachelor of Engineering in Mechanical Engineering | I426P | 7CJ K01 | Full-time | 8 |
| Bachelor of Engineering in Electromechanical Engineering | I425P | 7CL K01 | Full-time | 8 |
| Bachelor of Engineering in Industrial Engineering | I437P | 7CK K01 | Full-time | 8 |

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

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

- Chemical Engineering
- Electrical and Electronic Engineering
- Computer and Electronic Engineering
- Mechatronic Engineering
- Mechanical Engineering
- Electromechanical Engineering
- Industrial Engineering

These programmes, which are described in detail below, may be taken by full-time study only.
During their studies, students may, with the approval of the School Director, change from one programme to another.

## ENG.5.2 COMPOSITION OF THE CURRICULA

**Purpose of the qualification**

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.

**Qualification composition**

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.

### ENG.5.2.1 ECSA Graduate Attributes

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:

Attribute 1: Problem-solving;
Attribute 2: Application of scientific and engineering knowledge;
Attribute 3: Engineering design;
Attribute 4: Investigations, experiments and data analysis;
Attribute 5: Use of engineering tools;
Attribute 6: Professional and technical communication;
Attribute 7: The engineer and the world;
Attribute 8: Individual and collaborative teamwork;
Attribute 9: Independent learning ability;
Attribute 10: Engineering professionalism; and
Attribute 11: Project management and finance.

### ENG.5.2.2 Articulation possibilities

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 Diploma 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.

### ENG.5.2.3 Knowledge

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

### ENG.5.2.4 Skills

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

- Identify, assess, formulate and solve convergent and divergent engineering problems creatively and innovatively;
- Apply knowledge of mathematics, basic science and engineering sciences from first principles to solve engineering problems;
- Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes;
- Design and conduct investigations and experiments;
- Use appropriate engineering methods, skills and tools, including those based on information technology;

- Communicate effectively with engineering audiences and the community at large, both orally and in writing; and
- Understand and apply engineering management principles and economic decision-making to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

### ENG.5.2.5 Values

The following values are pursued:

- Critical awareness of the impact of engineering activity on the social, industrial and physical environment.
- Competence to work effectively as an individual, in teams and in multidisciplinary environments.
- Competence to engage in independent learning through well-developed learning skills.
- Critical awareness of the need to act professionally and ethically, and to exercise judgement and take responsibility within own limits of competence.

## ENG.5.3 PHASING IN AND OUT OF PROGRAMMES/CURRICULA

The directors of all applicable schools, in consultation with the subject chairs/programme managers, issue transitional rules where necessary 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 possible, adjustments will be made in such a manner that a student's study load is not increased.

# ENG.6 SCHOOL OF CHEMICAL AND MINERALS ENGINEERING

BEng programme, Chemical Engineering with diverse areas of interests not limited to Minerals Processing are offered in the school.

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

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

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

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

## ENG.6.1 CHANGING A PROGRAMME

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

## 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 (Phased out - 2023)

| 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 (Phased out - 2023)

| 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.6.3.1.2 BEng in Chemical Engineering (7CG K03 – I401P)

**Programme:** BEng in Chemical Engineering
**Qualification code:** 7CG K03 – I401P

| YEAR LEVEL 1 | | | |
|---|---|---|---|
| **First semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| ALDE112 | Academic Literacy Development | X | 12 |
| CMPG111 | Introduction to Computers and Programming | H | 12 |
| INGC112 | Introduction to Process Engineering | H | 8 |
| 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 |
| CMPG121 | Structured Programming | H | 12 |
| INGC121 | Thermodynamics | 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 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| INGC211 | Process Principles | H | 16 |
| 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 |
| INGC221 | Thermodynamics II | H | 16 |
| INGC222 | Transport Phenomena I | H | 16 |
| INGF221 | Engineering Communication | H | 8 |
| MTHS223 | Engineering Analysis | H | 8 |
| NCHE222 | Organic Chemistry II | H | 8 |
| STTK222 | Statistics for Industrial Engineering | H | 16 |

| YEAR LEVEL 3 | | | |
|---|---|---|---|
| First semester | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| INGB311 | Engineering Economics | H | 12 |
| INGC311 | Transport Phenomena II | H | 16 |
| INGC312 | Chemical Reactor theory I | H | 16 |
| INGC313 | Particle Systems | H | 16 |
| INGC314 | Separation processes | H | 16 |
| | | | |

| YEAR LEVEL 3 | | | |
|---|---|---|---|
| Second semester | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| FENG321 | Engineering in the South African and Global Context | H | 12 |
| INGC321 | Process Engineering Methods | H | 16 |
| INGC322 | Geology And Ore Dressing | H | 16 |
| INGC323 | Hydrometallurgy | H | 16 |
| INGC324 | Pyrometallurgy | H | 16 |
| INGC325 | Process Modelling for Control | H | 8 |

| YEAR LEVEL 4 | | | |
|---|---|---|---|
| First semester | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| FENG411 | Engineering Management | H | 8 |
| INGC411 | Biotechnology II | H | 16 |
| INGC412 | Chemical Reactor Theory II | H | 16 |
| INGC413 | Process Control | H | 16 |
| INGC414 | Sustainable Processing | H | 16 |

| YEAR LEVEL 4 | | | |
|---|---|---|---|
| Second semester | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| INGC471 | Vacation Training Seniors | H | 8 |
| INGC477 | Plant Design | H | 32 |
| INGC479 | Project | H | 32 |
| | | | |

| **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 | 80 | 68 | 80 | 76 | 84 | 72 | 72 |
| **Total: year level 1** | | **Total: year level 2** | | **Total: year level 3** | | **Total: year level 4** | |
| **148** | | **148** | | **160** | | **144** | |
| **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 Mechatronic Engineering are offered in this School.

**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.

**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.

**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.

## 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** |
| APPM211 | Dynamics I | H | 8 |
| APPM212 | Differential Equations | H | 8 |
| EERI215 | Electrotechnique II | H | 8 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| MTHS211 | Advanced Calculus I | H | 8 |
| MTHS212 | Linear Algebra I | H | 8 |
| NPHY211 | Electricity and Magnetism | H | 8 |
| REII211 | Algorithms and Optimisation | H | 8 |

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

| YEAR LEVEL 3 | | | |
|---|---|---|---|
| **First semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| EEII311 | Electrical Systems II | H | 16 |
| EERI313 | Electromagnetics | H | 16 |
| EERI318 | Electronics II | H | 16 |
| INGB311 | Engineering Economics | H | 12 |
| STTK312 | Engineering Statistics | H | 16 |
| | | | |

| 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 |
| EERI474 | Project | H | 24 |
| EERI471 | Vacation Training seniors | X | 8 |
| FENG421 | Engineering Professionalism | H | 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** |
| APPM211 | Dynamics I | H | 8 |
| APPM212 | Differential Equations | H | 8 |
| EERI215 | Electrotechnique II | H | 8 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| MTHS211 | Advanced Calculus I | H | 8 |
| MTHS212 | Linear Algebra I | H | 8 |
| NPHY211 | Electricity and Magnetism | H | 8 |
| REII211 | Algorithms and Optimisation | 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 |
| EERI224 | Linear Systems | H | 12 |
| INGF221 | Engineering Communication | H | 8 |
| MTHS223 | Engineering Analysis | H | 8 |
| MTHS224 | Applied Linear Algebra | H | 8 |
| REII222 | Embedded Systems | H | 12 |

| YEAR LEVEL 3 | | | |
|---|---|---|---|
| **First semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| EERI313 | Electromagnetics | H | 16 |
| EERI318 | Electronics II | H | 16 |
| INGB311 | Engineering Economics | H | 12 |
| REII312 | Network Fundamentals | H | 16 |
| 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 I | H | 16 |
| EERI324 | Principles of Measurement | H | 12 |
| EERI325 | Signal Theory II | H | 16 |
| FENG321 | Engineering in the South African and Global Context | X | 12 |
| REII323 | Embedded Operating Systems | H | 16 |
| REII327 | Computer Engineering Design | H | 16 |

| 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 |
| FENG411 | Engineering Management | H | 8 |
| REII414 | Databases and Web-programming | H | 16 |

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

| 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 |
| 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 (Year module) | 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 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| INGM212 | Engineering Materials I | H | 12 |
| MTHS211 | Advanced Calculus I | H | 8 |
| MTHS212 | Linear Algebra I | H | 8 |
| NPHY211 | Electricity and Magnetism | H | 8 |
| REII211 | Algorithms & Optimisation | H | 8 |

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

| YEAR LEVEL 3 | | | |
|---|---|---|---|
| **First semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| INGB311 | Engineering Economics | H | 12 |
| INGM313 | Strength of Materials II | H | 12 |
| MCTR311 | Dynamic Systems Modelling | H | 12 |
| REII312 | Network Fundamentals | H | 16 |
| 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 I | H | 16 |
| EERI324 | Principles of Measurement | H | 12 |
| FENG321 | Engineering in the South African and Global context | H | 12 |
| MCTR327 | Mechatronic Design | H | 16 |
| REII323 | Embedded Operating Systems | H | 16 |
| | | | |

| YEAR LEVEL 4 | | | |
|---|---|---|---|
| **First semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| EEII413 | Power Electronics | H | 16 |
| EERI418 | Control Theory II | H | 16 |
| FENG411 | Engineering Management | H | 8 |
| MCTR411 | Industrial Automation | H | 16 |
| REII414 | Databases and Web-programming | H | 16 |

| YEAR LEVEL 4 | | | |
|---|---|---|---|
| **Second semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| FENG421 | Engineering Professionalism | H | 8 |
| MCTR421 | Virtual Commissioning | H | 12 |
| MCTR471 | Vacation Training for Seniors | H | 8 |
| MCTR474 | Final Year Project | H | 24 |
| REII425 | Data Analytics and Machine Learning | H | 16 |

| **BEng in Mechatronic Engineering** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Qualification Programme code:** 7CR K01 – I401P | | | | | | | |
| **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 | 80 | 88 | 84 | 72 | 72 | 68 |
| **Total: year level 1** | | **Total: year level 2** | | **Total: year level 3** | | **Total: year level 4** | |
| **152** | | **168** | | **156** | | **140** | |
| **Total credits of programme: 616** | | | | | | | |

# ENG.8 SCHOOL OF MECHANICAL ENGINEERING

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

**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.

**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.

## ENG.8.1 CHANGING A PROGRAMME

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

## 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 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| INGM212 | Engineering Materials | H | 12 |
| MTHS211 | Advanced Calculus I | H | 8 |
| MTHS212 | Linear Algebra I | H | 8 |
| REII211 | Algorithms & Optimization | H | 8 |

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

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

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

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

| YEAR LEVEL 4 | | | |
|---|---|---|---|
| **Second semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| FENG421 | Engineering Professionalism | H | 8 |
| INGM426 | Failure of Materials | H | 12 |
| INGM427 | Thermal-Fluid System Design | H | 16 |
| INGM428 | Thermal Machines | H | 12 |
| INGM479 | Project (Year Module) | H | 16 |

| **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 | 60 | 64 |
| **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 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| INGM212 | Engineering Materials | H | 12 |
| MTHS211 | Advanced Calculus I | H | 8 |
| MTHS212 | Linear Algebra I | H | 8 |
| REII211 | Algorithms & Optimisation | H | 8 |

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

| YEAR LEVEL 3 | | | |
|---|---|---|---|
| **First semester** | | | |
| **Code** | **Module name** | **C/F** | **Cr** |
| EERI311 | Electrical Systems II | H | 16 |
| INGM313 | Strength of Materials II | H | 12 |
| INGM315 | Systems Engineering | H | 12 |
| INGM316 | Machine Dynamics | H | 16 |
| NPHY211 | Electricity and Magnetism | H | 8 |
| STTK312 | Engineering Statistics | 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 |
| EEII413 | Power Electronics | H | 16 |
| FENG411 | Engineering Management | H | 8 |
| INGB311 | Engineering Economics | H | 12 |
| INGM413 | Fluid Machines | H | 12 |
| | | | |
| | | | |

| YEAR LEVEL 4 | | | |
|---|---|---|---|
| Second semester | | | |
| Code | Module name | C/F | Cr |
| EEII423 | Modern Power Systems | H | 16 |
| FENG421 | Engineering Professionalism | H | 8 |
| INEM471 | Vacation Training Seniors | X | 8 |
| INEM472 | Electromechanical Design (Year Module) | H | 32 |
| INEM475 | Final Year Project (Year Module) | H | 12 |
| INGM426 | Failure of Materials | H | 16 |

| 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.

## ENG.9.1 CHANGING A PROGRAMME

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

## 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 – 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 |
| 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 |
| INGB122 | Introduction to Industrial Engineering | H | 12 |
| 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 |

**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 |
| FENG211 | Understanding the World of Engineering | X | 12 |
| MTHS211 | Advanced Calculus I | H | 8 |
| MTHS212 | Linear Algebra I | H | 8 |
| REII211 | Algorithms and Optimisation | H | 8 |

| 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 Management | H | 8 |
| INGB413 | Quality Assurance | H | 12 |
| INGB417 | Facilities Design | H | 16 |
| INGB419 | Business Engineering | H | 12 |
| INGM315 | Systems Engineering | H | 12 |
| REII414 | Databases and Web-programming | H | 16 |

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

| **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 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.

| Faculty of Law module | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| LLAW221 | Introductory Labour Law | 12 | None |

| Faculty of Natural and Agricultural Sciences modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| APPM121 | Statics and Mathematical Modelling | 12 | MTHS111 and NPHY111 (40%) |
| APPM211 | Dynamics I | 8 | MTHS111 and MTHS121 and (APPM121 or APPM122) |
| APPM212 | Differential Equations | 8 | MTHS111 and MTHS121 |
| APPM221 | Dynamics II | 8 | APPM211 and APPM212 |
| APPM222 | Numerical Methods | 8 | APPM212 |
| APPM312 | Partial Differential Equations (Numerical) | 16 | APPM222 and MTHS211 and MTHS212 |
| APPM322 | Optimisation | 16 | MTHS211 and MTHS212 (APPM211 or APPM213 or MTHS224 or MTHS222) |
| CMPG111 | Introduction to Computing and Programming | 12 | None |
| CMPG115 | Programming for Engineers | 12 | None |
| CMPG121 | Structured Programming I | 12 | CMPG111or CMPG115 |
| CMPG322 | Decision Support Systems II | 16 | CMPG312 or REII211 and INGB223 |
| MTHS121 | Introductory Algebra and Calculus II | 12 | MTHS111 |
| MTHS211 | Advanced Calculus I | 8 | MTHS111 and MTHS121 |

| Faculty of Natural and Agricultural Sciences modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| MTHS212 | Linear Algebra I | 8 | MTHS111 and MTHS121 |
| MTHS223 | Engineering Analysis | 8 | MTHS211<br>(If student failed MTHS211 with ≤40% in the first semester, they can register for MTHS223)<br>* Only applicable in the same year, not over two or more years. |
| MTHS224 | Applied Linear Algebra | 8 | MTHS212 |
| NCHE111 | Introductory Inorganic and Physical Chemistry | 12 | None |
| NCHE121 | Organic Chemistry | 12 | None |
| NCHE211 | Analytical Chemistry II | 8 | NCHE111 and NCHE121 |
| NCHE222 | Organic Chemistry II | 8 | NCHE111 and NCHE121 |
| NPHY111 | Basic Physics I | 12 | None |
| NPHY121 | Basic Physics II | 12 | NPHY111 and MTHS111 |
| NPHY211 | Electricity and Magnetism | 8 | NPHY111 and NPHY121 and MTHS121 |
| STTK222 | Statistics for Industrial Engineering | 16 | MTHS121 |
| STTK312 | Engineering Statistics | 16 | MTHS121 |
| ALDE112 | Academic Literacy Development | 12 | ALDE111 |
| BIOT411 | Biotechnology II | 16 | CEMI315 / CEMI214 |
| CEMI112 | Materials and Corrosion<br>***Previous code: CEMI211*** | 8 | None |
| CEMI121 | Process Principles I | 16 | None |
| CEMI211 | Materials and Corrosion<br>***New code: CEMI112*** | 12 | None |
| CEMI213 | Electrotechnics for Chemical Engineers | 8 | NPHY121 / FSKS121 |
| CEMI214 | Biotechnology I | 8 | None |
| CEMI215 | Geology for Process Engineers | 16 | None |
| CEMI222 | Chemical Thermodynamics I | 16 | CEMI121 |
| CEMI224 | Process Principles II | 8 | CEMI121 |
| CEMI311 | Transport Phenomena I | 16 | CEMI224 |
| CEMI313 | Chemical Thermodynamics II | 16 | CEMI222 and CEMI224 |
| CEMI315 | Biotechnology | 8 | None |
| CEMI316 | Particle Systems | 16 | CEMI121 |
| CEMI321 | Transport Phenomena II | 16 | CEMI311 |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| CEMI322 | Separation Processes I | 16 | CEMI313 |
| CEMI323 | Chemical Reactor Theory I | 16 | CEMI313 |
| CEMI326 | Process Modelling for Control | 16 | CEMI224 and CEMI213 and APPM212 |
| CEMI328 | Plant Design I | 12 | Co-required: CEMI321 and CEMI323 |
| CEMI411 | Separation Processes II | 16 | CEMI313 and CEMI322 |
| CEMI415 | Chemical Reactor Theory II | 16 | CEMI313 and CEMI323 |
| CEMI417 | Process Control | 16 | CEMI326 |
| CEMI418 | Ore Dressing | 16 | CEMI316 and CEMI215 |
| CEMI419 | Pyrometallurgy | 16 | CEMI313 |
| CEMI471 | Vacation Training seniors | 8 | None |
| CEMI477 | Plant Design II | 32 | Student must be able to complete the degree in that year with all previous modules passed.<br>Curriculum control will be performed after the first semester and if the student is not able to complete the degree in that year, he/she will be deregistered for CEMI477. |
| CEMI479 | Project (Year module) | 28 | Student must be in final year and must be able to complete degree |
| EEII321 | Power Systems I | 16 | EERI311 |
| EEII327 | Electrical Design | 16 | EERI221 and EERI313 and EERI318<br>Co-Required: EERI321 |
| EEII413 | Power Electronics | 16 | EERI313 and EERI321 |
| EEII414 | Power Systems II<br>***Old code: EEII422*** | 16 | EEII321 |
| EEII422 | Power Systems II<br>***New code: EEII414*** | 16 | EEII321 |
| EEII423 | Power Systems II | 16 | EEII321 |
| EERI124 | Electrotechnique I | 8 | Co-Required: NPHY121 and MTHS121 |
| EERI215 | Electrotechnique II | 8 | EERI124 |
| EERI221 | Electrical Systems I | 16 | EERI215 |
| EERI222 | Signal Theory I | 16 | EERI215 and APPM212 / TGWN213 and MTHS212 / WISN212 |
| EERI223 | Electronics I | 16 | EERI124 |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| EERI224 | Linear Systems | 12 | EERI215 and MTHS212 / WISN212 |
| EERI311 | Electrical Systems II | 16 | EERI221 and APPM211 / TGWN211 |
| EERI313 | Electromagnetics | 16 | NPHY211 / FSKS211 and MTHS211 / WISN211 |
| EERI318 | Electronics II | 16 | EERI223 |
| EERI321 | Control Theory I | 16 | APPM212 / TGWN212 and EERI215 and MTHS212 / WISN212 and APPM222 / TGWN222 or INGB224 |
| EERI324 | Principles of Measurement | 12 | EERI215 and STTK312 |
| EERI325 | Signal Theory II | 16 | EERI222 |
| EERI414 | Signal Theory III | 16 | EERI325 |
| EERI415 | Telecommunication Systems | 16 | EERI222 |
| EERI418 | Control Theory II | 16 | EERI321 |
| EERI471 | Vacation Training seniors | 8 | None |
| EERI473 | Engineering Management<br>* Phased out | 8 | Student must be a final year and be able to complete the degree |
| EERI474 | Project (year module) | 24 | EEII327<br>Co-Required: EEII411 and EEII413 and EERI418 and FENG411 |
| FENG211 | Understanding the World of Engineering<br>***Previous code: WVTS211*** | 12 | None |
| FENG321 | Engineering in the South African and Global Context<br>***Previous code: WVIS321*** | 12 | FENG211 / WVTS211 |
| FENG411 | Engineering Management | 8 | Student must be a final year and be able to complete the degree |
| FENG421 | Engineering Professionalism | 8 | Student must be a final year and be able to complete the degree |
| INEM321 | Thermo-fluid Sciences | 16 | MTHS211 / WISN211 and APPM212 / TGWN213 |
| INEM471 | Vacation Training seniors | 8 | None |
| INEM472 | Electromechanical Design | 32 | INEM321 and INGM328 and EERI223 and EERI311 and EERI321<br><br>Student must be final year and must be able to complete degree. |
| INEM474 | Project | 24 | INEM 327<br>Student must be final year and must be able to complete the degree.<br>Co-required: EERI473 |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| INEM474 | Project | 24 | INEM 327<br>Student must be final year and must be able to complete the degree.<br>Co-required: EERI473 |
| INEM475 | Project | 12 | Student must be final year and must be able to complete the degree.<br><br>Co-required: INEM472 |
| INGB122 | Introduction to Industrial Engineering<br>***Previous code: INGB121*** | 12 | None |
| INGB222 | Operations Management for Engineers | 16 | None |
| INGB224 | Optimisation and Numerical Methods<br>***Previous code: INGB223*** | 16 | MTHS121 / WISN121<br>Co-requisites:<br>Must be registered for: MTHS211 and MTHS212 and REII211 |
| INGB311 | Engineering Economics | 12 | None |
| INGB314 | Operational Excellence | 12 | INGB222 |
| INGB317 | Simulation Modelling<br>***Previous code: INGB315*** | | CMPG115 / ITRW115 and MTHS211 / WISN211 and MTHS212 / WISN212 and APPM121 / TGWN121<br>Co-requisite: STTK312 or STTK222 |
| INGB318 | Supply Chain Management<br>***Previous code: INGB316*** | 12 | INGB222 |
| INGB321 | Advanced Optimisation | 16 | INGB224 / INGB223 |
| INGB322 | Statistical Learning for Engineers | 16 | INGB317 / INGB315 and (STTK312 or STTK222) |
| INGB413 | Quality Assurance | 12 | INGB317 / INGB315 |
| INGB417 | Facilities Design | 16 | INGB311 and INGB314 and INGB318 / INGB316 |
| INGB419 | Business Engineering<br>***Previous code: INGB427*** | 12 | Co-requisite: Student must have passed or be registered for INGB479 or INDE479 |
| INGB471 | Vacation Training seniors | 8 | Student should be registered for INGB479 or INDE479 |
| INGB472 | Decision Support Systems (yearmodule)<br>***Previous code: INGB421*** | 20 | INGB321 and INGB322 |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| INGB479 | Project (year module) | 40 | Co-requisite: Student must have passed or be registered for INGB413, INGB417, INGB419, INGB471, INGB472, REII414, FENG411, INGM315 |
| INDE479 | Project (year module)<br>***Previous code: INGB479*** | 32 | Co-requisite: Student must have passed or be registered for INGB413, INGB417, INGB419, INGB471, INGB472, REII414, FENG411, INGM315 |
| INGC112 | Introduction to Process Engineering | 8 | None |
| INGC121 | Thermodynamic | 12 | INGC112 |
| INGC211 | Process Principles | 16 | INGC112 and INGC121 |
| INGC221 | Thermodynamics II | 16 | INGC121 |
| INGC222 | Transport Phenomena I | 16 | MTHS121 and INGC211 |
| INGC311 | Transport Phenomena II | 16 | INGC222 |
| INGC312 | Chemical Reactor Theory I | 16 | INGC221 |
| INGC313 | Particle Systems | 16 | INGC211 |
| INGC314 | Separation Processes | 16 | INGC221 |
| INGC321 | Process Engineering Methods | 16 | INGC311 |
| INGC322 | Geology And Ore Dressing | 16 | INGC313 |
| INGC323 | Hydrometallurgy | 16 | INGC313 |
| INGC324 | Pyrometallurgy | 16 | INGC313 |
| INGC325 | Process Modelling for Control | 8 | APPM212 and INGC222 |
| INGC411 | Biotechnology | 16 | INGC312 |
| INGC412 | Chemical Reactor Theory II | 16 | INGC312 |
| INGC413 | Process Control | 16 | INGC325 |
| INGC414 | Sustainable Processing | 16 | None |
| INGC477 | Plant Design | 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 and if the student is not able to complete the degree in that year, he/she will be deregistered for INGC477. |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| INGC479 | Project (year module) | 32 | If the student does not have more than 2 outstanding modules up to 3rd year level, the student will be allowed to register for INGC479. |
| INGF221 | Engineering Communication | 8 | None |
| INGM111 | Engineering Graphics I | 12 | None |
| INGM121 | Engineering Graphics II | 12 | INGM111 Module mark >50% |
| INGM122 | Materials Science | 16 | None |
| INGM212 | Engineering Materials | 12 | INGM122 |
| INGM222 | Thermodynamics I | 12 | MTHS111 / WISN111<br>Co-required: The student should have passed or be enrolled for MTHS121 / WISN121 |
| INGM223 | Manufacturing Technology<br>***Previous code: INGM423*** | 12 | INGM122 |
| INGM225 | Strength of Materials I<br>***Previous code: INGM211*** | 12 | MTHS121 / WISN121 and APPM121 / TGWN121 |
| INGM311 | Thermodynamics II | 12 | INGM222 Module mark >40% |
| INGM313 | Strength of Materials II | 12 | INGM211 or INGM225 and APPM221 / TGWN221 |
| INGM315 | System Engineering<br>***Previous code: INGM417*** | 12 | None |
| INGM316 | Machine dynamics<br>***Previous code: INGM419*** | 16 | MTHS211 / WISN211 and MTHS212 / WISN212 and APPM212 / TGWN213 |
| INGM318 | Fluid Mechanics I<br>***Previous code: INGM312*** | 16 | MTHS223 / WISN225 (If student failed MTHS211 with ≤40% in the first semester, they can register for MTHS223) |
| INGM324 | Fluid Mechanics II<br>***Previous code: INGM321*** | 12 | INGM318 / INGM312 and INGM222 |
| INGM325 | Applied Computer Methods | 12 | INGM222 and INGM225<br><br>Module mark for INGM313 >40% |
| INGM328 | Machine Components | 16 | INGM313 |
| INGM371 | Vacation training<br>***Previous code: INGM471*** | 8 | None |
| INGM411 | Thermal Machines | 16 | INGM311 and INGM324 / INGM321 |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| INGM412 | Heat Transfe | 12 | INGM324 / INGM321 |
| INGM413 | Fluid Machines | 12 | INGM324 / INGM321 or INEM321 |
| INGM415 | Failure of Materials<br>***New code: INGM426*** | 16 | INGM212 |
| INGM417 | Systems Engineering | 12 | None |
| INGM419 | Machine Dynamic | 16 | MTHS211 / WISN211 and MTHS212 / WISN212 and APPM212 / TGWN213 |
| INGM421 | Machine Dynamics | 16 | APPM312 / TGWN312 |
| INGM425 | Aircraft Design<br>***Previous code: INGM416*** | 16 | INGM321 |
| INGM426 | Failure of Materials<br>***Previous code: INGM415/INGM424*** | 12 | INGM212 |
| INGM427 | Thermal-Fluid System Design | 16 | INGM311 and INGM318 / INGM312 and INGM412 and INGM413 |
| INGM428 | Thermal Machines<br>Previous code: INGM411 / INGM418 | 12 | INGM311 and INGM324 / INGM321 |
| INGM471 | Vacation Training seniors<br>***New code: INGM371*** | 8 | None |
| INGM479 | Project (Year module) | 16 | INGM315 and INGM324 / INGM321 and INGM328<br>Co-required: The student should not be registered for 1st or 2nd year modules and not have more than one 3rd year module per semester left to complete. |
| MCTR311 | Dynamic Systems Modelling | 12 | APPM212 / TGWN213 and EERI215 and MTHS212 / WISN212 and APPM222 / TGWN223 |
| MCTR327 | Mechatronic Design | 16 | MCTR311<br>Co-Required: EERI324 and EERI321 and REII323 and FENG321 |
| MCTR411 | Industrial Automation | 16 | REII312 and EERI321 and EERI324 and MCTR311 and MCTR327 and EERI418 |
| MCTR421 | Virtual Commissioning | 12 | MCTR411 |
| MCTR471 | Vacation Training for Senior | 8 | None |
| MCTR474 | Final Year Project | 24 | None |
| MEGI415 | Mechanical Systems Design | 16 | INGM315 / INGM417 and INGM328 |

| Faculty of Engineering modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| PPEP171 | Practical Engineering Practice | 8 | None |
| REII111 | Introduction to Digital Systems | 12 | None |
| REII121 | Introduction to Microcontrollers | 12 | REII111 and CMPG115 / ITRW115 |
| REII211 | Algorithms and Optimisation | 8 | CMPG115 / ITRW115 and MTHS121 / WISN121 and APPM121 / TGWN121 |
| REII222 | Embedded Systems | 12 | REII121 |
| REII312 | Network Fundamentals | 16 | REII211 |
| REII313 | Object-oriented Software Development | 16 | CMPG115 / ITRW115 and REII211 |
| REII323 | Embedded Operating Systems | 16 | REII312 and REII222 and REII313 |
| REII327 | Computer Engineering Design | 16 | Student must enrol for all 3rd year 2nd semester modules and have passed all previous engineering modules |
| REII414 | Databases and Web-Programming | 16 | REII313 and STTK312 |
| REII424 | Data Analysis<br>***New code: REII425*** | 12 | MTHS224 / WISN227 and REII211 and STTK312 |
| REII425 | Data Analysis<br>***Old code: REII424*** | 12 | MTHS224 and REII211 and STTK312 |

| Prescribed modules | | | |
|---|---|---|---|
| **Module code** | **Descriptive name** | **Cr** | **Prerequisites** |
| ALDE111/ | Introduction to Academic Literacy | 12 | TALL / TAG Test |
| ALDE112 | Academic Literacy /<br>***ALDE122 Presented in 2nd semester***<br>***ALDE112 Presented in 1st semester*** | 12 | ALDE111 |

# ENG.11 Module outcomes

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

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 indifferent Calendars (e.g., Faculty of Natural and Agricultural Sciences), the version in the Calendar of the Faculty that offers the module, will take precedence.

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**ACADEMIC LITERACY**

| **Module code: ALDE111** | **Semester 1** | **NQF Level: 5** |
|---|---|---|
| Name: **Introduction to Academic Literacy** | | |
| Module outcomes*:*<br>On completion of this module the student should be able to:<br>• 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;<br>• communicate effectively orally and in writing in an appropriate manner in an academic environment;<br>• 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<br>• listen, speak, read and write accurately, fluently and appropriately in an ethical framework. | | |
| **Module code: ALDE122** | **Semester 2** | **NQF Level: 5** |
| Name: **Academic Literacy** | | |
| Module outcomes*:*<br>On completion of this module, students should be able to:<br>• 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;<br>• 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<br>• 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 code: ALDE112** | **Semester 1** | **NQF Level: 5** |
| Name: **Academic Literacy** | | |
| Module outcomes*:*<br>On completion of this module, students should be able to:<br>• 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;<br>• 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<br>• 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 code: APPM121 | Semester 2 | NQF Level: 5 |
|---|---|---|

Name: **Statics and Mathematical Modelling**

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

- demonstrate fundamental knowledge of geometric vectors and their operational rules, vectors, forces, components, scalar and vector product, Cartesian forms, resultant of two- and three- dimensional systems of force through a point, the principle of 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 code: APPM211 | Semester 1 | NQF Level: 6 |
|---|---|---|

Name: **Dynamics 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 code: APPM212 | Semester 1 | NQF Level: 6 |
|---|---|---|

Name: **Differential Equations**

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 code: APPM221 | Semester 2 | NQF Level: 6 |
|---|---|---|

Name**: Dynamics II**

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

- Demonstrate fundamental knowledge of the theory of flexible cables, internal forces and deformation of simple beams, 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 code: APPM222 | Semester 2 | NQF Level: 6 |
|---|---|---|

Name: **Numerical Methods**

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 code: APPM312 | Semester 1 | NQF Level: 7 |
|---|---|---|

Name: **Partial Differential Equations (Numerical)**

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 code: BIOT411 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Biotechnology 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 code: CEMI112 | Semester 1 | NQF level: 5 |
|---|---|---|

Name: **Materials and Corrosion**

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 code: CEMI121 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Process Principles I**

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 code: CEMI211 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Materials and Corrosion**

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 code: CEMI213 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Electrotechnics for Chemical Engineers**

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 code: CEMI214 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Biotechnology 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 code: CEMI215 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Geology for Process Engineers**

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**

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

- 1st and 2nd law ofthermodynamics.

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 code: CEMI224 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: Process Principles 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 code: CEMI311 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Transport Phenomena 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 code: CEMI313 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Chemical Thermodynamics II**

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 code: CEMI315 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Biotechnology 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 code: CEMI316 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Particle Systems**

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 code: CEMI321 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Transport Phenomena 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 code: CEMI322 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Separation Processes I**

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 code: CEMI323 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Chemical Reactor Theory I**

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 code: CEMI326 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Process Modelling for Control**

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 code: CEMI328 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Plant Design 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 code: CEMI411 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Separation Processes 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 code: CEMI415 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Chemical Reactor Theory 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 code: CEMI417 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Process Control**

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 code: CEMI418 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Ore Dressing**

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 code: CEMI419 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Pyrometallurgy**

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 code: CEMI471 | Year module | NQF level: 8 |
|---|---|---|
| Name: **Vacation Training seniors** | | |
| **This is a compulsory attendance module for a period of six weeks during the vacation.** | | |

Module objective:
During vacation training, students are exposed to 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.

| Module code: CEMI477 | Semester 2 | NQF level: 8 |
|---|---|---|
| Name: **Plant Design 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 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 code: CMPG111 | Semester 1 | NQF Level: 5 |
|---|---|---|

Name: **Introduction to Computing and Programming**

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 code: CMPG115 | Semester 1 | NQF Level: 5 |
|---|---|---|

Name: **Programming for Engineers 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 code: CMPG121 | Semester 2 | NQF Level: 5 |
|---|---|---|

Name: **Structural Programming**

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 code: EEII321** | **Semester 2** | **NQF level: 7** |
|---|---|---|

Name: **Power Systems I**

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 code: EEII327** | **Semester 2** | **NQF level: 7** |
|---|---|---|

Name: **Electrical Design**

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 code: EEII414** | **Semester 1** | **NQF level: 8** |
|---|---|---|

Name: **Power Systems 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 code: EEII413 | Semester 2 | NQF level: 8 |
|---|---|---|

Name: **Power Electronics**

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 code: EEII423 | Semester 2 | NQF level: 8 |
|---|---|---|

Name: **Power Systems 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 code: EERI124 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Electrotechnique 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**

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**

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 code: EERI222 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Signal Theory 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 code: EERI223 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Electronics 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 code: EERI224 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Linear Systems**

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 code: EERI311 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Electrical Systems 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 code: EERI313 | Semester 1 | NQF level: 7 |
|---|---|---|

Name**: Electromagnetics**

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 code: EERI318 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Electronics I**

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 code: EERI321 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Control Theory 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 code: EERI324 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Principles of measurement**

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**

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

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

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

| Module code: EERI414 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Signal Theory 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 code: EERI415 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Telecommunication Systems**

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 code: EERI418 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Control Theory 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 code: EERI471 | Semester 2 | NQF level: 8 |
|---|---|---|

Name: **Vacation training 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.

| Module code: EERI473 | Year module | NQF level: 8 |
|---|---|---|

Name: **Engineering Management**

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

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

| Module code: EERI474 | Year module | NQF level: 8 |
|---|---|---|

Name: **Project**

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.

| 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.

| Module code: FENG321 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Engineering in the South African and Global Context**

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.

| Module code: FENG411 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Engineering Management**

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.

| Module code: FENG421 | Semester 2 | NQF level: 8 |
|---|---|---|

Name: **Engineering Professionalism**

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.

| Module code: INEM321 | Year module | NQF level: 7 |
|---|---|---|

Name: **Thermal-fluid science**

Module outcomes:

After completion of module INEM321, the student will demonstrate:

- integrated knowledge and critical understanding of thermodynamic concepts: mass and energy conservation, reversible processes, properties of real, ideal and perfect substances and how they interrelate.
- the implementation of appropriate procedures and methods in order to analyse power cycles;
- the implementation of appropriate procedures and methods in order to perform energy analysis of open and closed systems;
- coherent understanding of the general concepts of fluid mechanics;
- coherent understanding of incompressible viscous flow in pipes and ducts.
- the ability to apply basic knowledge and concepts of heat transfer, including conduction, external flow, flow inside pipes and thermal radiation to solve practical problems;

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

The student will prove that he/she has attained the outcomes of the INEM321 module when he/she can:

- The ability to solve thermodynamic problems
- 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.
- Solve basic heat transfer problems.

| Module code: INEM471 | Year module | NQF level: 8 |
|---|---|---|

Name: **Vacation Training seniors**

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

Module objective:
During vacation training, students are exposed to 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.

| Module code: INEM472 | Year module | NQF level: 8 |
|---|---|---|

Name: **Electromechanical Design**

Module outcomes:

After completion of this module, the student should demonstrate:

- the implementation of the appropriate procedures and methods related to an electromechanical engineering design in a project;
- the ability to evaluate the effect of implementing an electromechanical engineering project;
- the ability to effectively communicate the implementation and evaluation of an electromechanical engineering project to a panel.

After completion of this module, the student should be able to demonstrate:
The student will prove that he/she has attained the outcomes of the INEM472 module when he/she can:

- create designs using design software and produce manufacturing drawings;
- follow the Engineering Design process, and apply the systems engineering principles;
- realise the detail design aspects of their assigned project;
- implement and test the functionality of the developed solution (through software simulation);
- evaluate the suitability of the developed solution;
- successfully integrate both mechanical and electrical aspects into the design;
- incorporate reliability concepts into the developed solution and develop a maintenance plan;
- perform a costing analyses for the solution;
- document the design and evaluation of the solution, both through a report and drawings;
- successfully present the developed solution to a panel;
- The student will be assessed on his / her written report, as well as oral presentation, of the design project, and sufficient proof that the outcomes has been achieved.

| Module code: INEM474 | Year module | NQF level: 8 |
|---|---|---|

Name: **Project**

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.

| Module code: INEM475 | Year module | NQF level: 8 |
|---|---|---|

Name: **Project**

Module objective:
The student will prove that he/she has attained the outcomes of the INEM475 module when he/she can:

- Define the research problem and divide it into smaller problems;
- Synthesize, analyse and evaluate the possible solutions;
- Document the experimental procedures;
- Fabricate the experimental hardware;
- Perform the experiments;
- Collect information and perform a literature study by utilizing the library resources and/or internet;
- Report on the project both verbally and in writing; and
- Use project management software to manage progress on the project.
- The student will be assessed on his / her written report, as well as oral presentation, of the research project, and sufficient proof that the outcomes has been achieved.

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

- The ability to access, analyse and evaluate current research on appropriate topics and offer conclusions within a given context in the field of Electromechanical engineering;
- The ability to analyse and evaluate academic literature to demarcate a researchable problem within the field of Electromechanical engineering and specify an appropriate scientific methodology that can be used to address the identified problem;
- The ability to take measurements, process the data, present and summarize the data in the graphical format, and draw meaningful conclusions from the data.

**The ability to take measurements, process the data, present and summarize the data in graphical format, and draw meaningful conclusions from the data.**

| Module code: INGB122 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Introduction to Industrial Engineering**

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 code: INGB222 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Operations Management for Engineers**

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 andservice 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 code: INGB224 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Optimisation and Numerical Methods I**

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

- 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 code: INGB311 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Engineering Economics**

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 code: INGB314 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Operational Excellence**

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 code: INGB317 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Simulation Modelling**

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 code: INGB318 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Supply Chain Management**

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 code: INGB321 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Advanced Optimisation**

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 code: INGB322 | Semester 2 | NQF level: 7 |
|---|---|---|

Name: **Statistical Learning for Engineers**

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 code: INGB413 | Semester 1 | NQF level: 8 |
|---|---|---|
| Name: **Quality Assurance** | | |
| Module outcomes:<br>After successful completion of this module the student should be able to:<br>• Know and understand international quality management systems and the fundamental concepts of quality.<br>• Appreciate the interdependency of quality management and continuous improvement initiatives.<br>• Analyse performance and capability of a process by means of relevant statistical methods.<br>• Make use of statistical process control to analyse data.<br>• Understand the difference between statistical process control (SPC), engineering process control (EPC) and acceptance sampling. | | |

| Module code: INGB417 | Semester 1 | NQF level: 8 |
|---|---|---|
| Name: **Facilities Design** | | |
| Module outcomes:<br>After successful completion of this module the student should be able to:<br>• Appreciate the importance and impact of systematic planning and continuous redesign of facilities.<br>• Evaluate a complex and ill-defined facilities design problem to draw up a set of design requirements.<br>• Apply appropriate theory, principles, data and methods to design facilities that meet aset of design requirements.<br>• Design a solution using a structured and rigorous design process to solve a facilities design problem.<br>• Evaluate a proposed design solution against the design requirements.<br>• Comment on and discuss the implications of design solutions including costs, risks, change management and implementation.<br>• Identify the impact of design solutions on greater systems in which the proposed facility exists.<br>• Select and apply appropriate best practices of efficient flow planning, workstation design, materials handling, system design, ergonomics and visual management.<br>• Use algorithms, tools and techniques to optimise flow, capacity and layouts. | | |

| Module code: INGB472 | Year Module | NQF level: 8 |
|---|---|---|
| Name: **Decision Support Systems** | | |
| Module outcomes:<br>After successful completion of this module the student should be able to:<br>• Know and understand business analytics concepts: decision-making processes; analytics data and technology; and descriptive, predictive and prescriptive analytics, including modelling and optimisation; and<br>• 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 code: INGB419 | Semester 2 | NQF level: 8 |
|---|---|---|

Name: **Business Engineering**

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 code: INGB471 | Semester 2 | NQF level: 8 |
|---|---|---|

Name: **Vacation training 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.

| Module code: INGB479 | Year module | NQF level: 8 |
|---|---|---|

Name: **Project**

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 code: INDE479 | Year module | NQF level: 8 |
|---|---|---|

Name: **Project**

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 code: INGC112 | Semester 1 | NQF level: 5 |
|---|---|---|

Name: **Introduction to Process Engineering**

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

- Basic knowledge and informed understanding of the chemical engineering profession.
- The ability to identify the principles of operation of the main processes and process equipment relevant to chemical engineering.
- To perform basic engineering calculations as applicable in the field of chemical engineering.
- The ability to distinguish and explain important process variables in chemical engineering.
- The ability to perform material balances on single unit processes.

| Module code: INGC121 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Thermodynamics**

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

- Basic knowledge and informed understanding of the fundamental principles to carry out basic calculations related to thermodynamics.
- The ability to identify, formulate, and solve engineering problems.
- Ability to describe and apply thermodynamics concepts.
- Ability to act professionally and ethically within the academic context.
- Ability to interact and collaborate effectively with others as part of a team.

| Module code: INGC211 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Process Principles**

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

- Basic knowledge of multiple material balances, recovery and bypass streams, reactive processes, combustion processes, along with single phase processes.
- Basic knowledge of energy balances, 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; as well as combustion of fuels.
- Understanding and applying the fundamentals of material balances to single and multiple unit processes with and without reactions taking place.
- Ability to solve energy balances on closed and open systems, with or without reactions taking place, whilst accounting for scenarios such as phase change, mixing and solutions.
- Ability to simultaneously solve material and energy balances on simple systems.

| Module code: INGC221 | Semester 2 | NQF level: 6 |
|---|---|---|
| Name: **Thermodynamics II** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Basic knowledge and informed understanding of phase equilibria.<br>• Basic knowledge and informed understanding of fugacity.<br>• Application of phase equilibria.<br>• Basic knowledge and informed understanding of chemical reaction equilibria. | | |
| **Module code: INGC222** | **Semester 2** | **NQF level: 6** |
| Na me: **Numerical methods for chemical engineers** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• A detailed knowledge of transport phenomena in the process engineering context.<br>• The ability to use mass, energy and momentum balances to describe fluid motion on both the macroscopic and microscopic levels.<br>• The ability to evaluate and determine the relevant solution strategy for transport phenomena problems.<br>• The ability to apply the basic theory of fluid machines.<br>• The ability to design and develop flow processes in Process Engineering. | | |
| **Module code: INGC311** | **Semester 1** | **NQF level: 7** |
| Na me: **Transport Phenomena II** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• An applied, detailed knowledge of conduction, convection, radiation, diffusion-mass transfer, and convective mass transfer.<br>• Knowledge and application of Fick's law.<br>• The ability to solve natural and forced convection problems.<br>• The ability to apply the laws of radiation on different systems.<br>• The ability to solve simultaneous heat and mass transfer problems. | | |
| **Module code: INGC312** | **Semester 1** | **NQF level: 7** |
| Name: **Chemical Reactor Theory I** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Knowledge of reaction kinetics and reaction rates for different reaction systems.<br>• Knowledge of the operation and functioning of different reactor types.<br>• Ability to derive operations and design equations from first principles for a variety of reactor types under isothermal and non-isothermal conditions.<br>• The processing and interpretation of results to reach meaningful conclusions. | | |

| Module code: INGC313 | Semester 1 | NQF level: 7 |
|---|---|---|
| Name: **Particle Systems** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Knowledge of the properties along with handling of dry particles and slurries.<br>• Knowledge of solid-liquid separation systems and the design of the appropriate equipment.<br>• Describe population of particles in terms of their physical and chemical properties, to classify particles in terms of size and or density.<br>• Design systems to store and convey particles.<br>• Describe slurries in terms of physical properties such as density and viscosity, while designing mixer tanks, piping systems and pumps to transport slurries, design and describe waste dumps.<br>• Use laboratory equipment to obtain information, experimentally for design and optimisation particulate systems. | | |
| **Module code: INGC314** | **Semester 1** | **NQF level: 7** |
| Name: **Separation Processes** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Basic knowledge and informed understanding of the basic mechanisms by which separation can be achieved.<br>• The ability to apply liquid-vapour phase equilibrium principles to multicomponent systems related to separation.<br>• Understand the distillation of binary mixtures.<br>• Understand absorption and stripping.<br>• Understand liquid-liquid extraction with ternary systems. | | |
| **Module code: INGC321** | **Semester 2** | **NQF level: 7** |
| Name: **Process Engineering Methods** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• A basic knowledge of the different types of equations encountered in chemical engineering studies, and what typically the origin of each is.<br>• An understanding of the theory and application of dimensional analysis and principles driving the scale-up of chemical processes.<br>• The ability to select and apply appropriate methods to solve homogeneous and inhomogeneous difference (and differential) equations.<br>• The ability to identify, evaluate and solve linear and non-linear first-order, second-order and higher-order differential equations.<br>• The ability to differentiate between different forms of partial differential equations (PDE's).<br>• A basic knowledge of the governing equations used in computational fluid dynamics.<br>• The ability to rewrite a system of algebraic equations in a form useful for a solution to be found through successive substitution and matrix algebra and to consequently find a solution.<br>• The use of computer software to generate a geometry of a chemical engineering system and to obtain typical flow patterns, temperature distribution and pressure distribution using a computational fluid dynamics platform. | | |

| Module code: INGC322 | Semester 2 | NQF level: 7 |
|---|---|---|
| Name: **Geology and Ore Dressing** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Integrated knowledge and critical understanding of, as well as an ability to correctly evaluate and apply fundamental geological, mineral liberation and concentration concepts to different areas within the field of chemical and physical minerals processing.<br>• Advanced ability to identify and analyse minerals and rocks to evaluate the implications on minerals liberation and concentration processes.<br>• An ability to evaluate the effect of the minerals process units and the industry on minerals economics and the environment in South Africa.<br>• The implementation of an appropriate procedure to design and evaluate comminution circuits based on the ore comminution and mineral liberation principals.<br>• The implementation of an appropriate procedure to design and evaluate the minerals concentration unit processes based on the principles of mineral separation.<br>• Advanced ability to effectively use laboratory minerals processing equipment and basic laboratory analysis techniques. | | |
| **Module code: INGC323** | **Semester 2** | **NQF level: 7** |
| Name: **Hydrometallurgy** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Basic knowledge and informed understanding of hydrometallurgy within the field of chemical and minerals engineering.<br>• Understand how metal ion solutions are applied in hydrometallurgical separation processes.<br>• Understand chemical equilibrium in hydrometallurgical reactions.<br>• Understand leaching and leaching kinetics applicable to hydrometallurgical processes.<br>• Understand the basic principles of precipitation and be able to apply these processes to practical problems.<br>• Understand the basic principles of liquid extraction.<br>• Understand the basic principles of ion exchange and adsorption.<br>• Understand the basic principles of electrowinning and electrorefining. | | |
| **Module code: INGC324** | **Semester 2** | **NQF level: 7** |
| Name: **Pyrometallurgy** | | |
| Module outcomes:<br>After completion of this module, the student will demonstrate:<br>• Integrated knowledge and critical understanding of, as well as an ability to correctly evaluate and apply fundamental pyrometallurgical concepts to different areas within the field of metals production.<br>• Advanced ability to identify and analyse metallurgical processing routes and evaluate the implications on process development.<br>• An ability to apply the concepts and methods of metallurgical thermodynamics to process units and evaluate the effect of process conditions on the characteristics of these units.<br>• An ability to apply the concepts of slag properties and chemistry to process units and evaluate the effect of slag properties on the interaction between slag and metal interface.<br>• Advanced ability to identify and analyse applications of refractories and evaluate the implications on furnace design and construction.<br>• Advanced ability to identify and analyse metal extraction by smelting, conversion, and refining process units and evaluate the effect of process conditions on process efficiency.<br>• Advanced ability to effectively use laboratory pyrometallurgical equipment and basic laboratory analysis techniques. | | |

| Module code: INGC325 | Semester 2 | NQF level: 7 |
|---|---|---|
| Name: **Process Modelling for Control** | | |

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

- A basic overview-knowledge of the discipline of process control.
- Knowledge in symbols, letters, icons and line types used in constructing a piping and instrumentation diagram (P&ID).
- The use of an integrated knowledge of mass-, energy- and component balances, as obtained from modules in the first and second years of study, to model and describe dynamic (or transition) states in chemical process.
- A thorough analysis of the behaviour of first- and higher-order processes through employing behavioural analysis techniques.
- The use of mathematical skills to linearise non-linear dynamic process models, to obtain transfer functions useful in control theory and to determine the stability of linear (or linearised) processes.
- A thorough understanding of the behaviour of complex process models, including interactive processes, multivariable processes, time delay (dead time) and the significance of a capacitance.
- The application of an empirical (statistical) approach to model the dynamic behaviour of chemical processes.

| Module code: INGC411 | Semester 1 | NQF level: 8 |
|---|---|---|
| Name: **Biotechnology** | | |

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

- 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.
- Ability to select suitable microorganisms and appropriate bioreactors for a biological process and recognize the growth phase required to achieve maximum yield while manipulating operating conditions to ensure improved performance of the microorganisms.
- Ability to establish and control physical and chemical conditions necessary for effective performance of the enzymes.
- Ability to model microbial-growth-kinetics and predict the behaviour of microorganisms under specific conditions in a batch or chemostat system.
- Recognize the bioreactor instruments and scale consideration suitable for effective monitoring and control of the chemical and physical environment.
- Ability 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.
- The ability to use mathematical analyses to predict the performance of bioreactor systems.

| Module code: INGC412 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Chemical Reactor Theory II**

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

- Basic knowledge of reactors and their operation.
- Knowledge of complex rate equations of heterogeneous catalysed reactions from the fundamental steps.
- Knowledge and insight to use residence time distribution for reactor diagnosis and reactor modelling.
- Ability to correlate rate equations with reaction mechanism and vice versa.
- Ability to design reactors for reactions with de-activating and poisoned catalysts.
- Understand advanced reactor models and use these models in the design of non-ideal reactors.
- The understanding the various reaction regimes under which reactions can occur.
- The understanding of the importance of diffusion limitations in reactor design.
- Ability to design biological reactors.

| Module code: INGC413 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Process Control**

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

- A detailed knowledge of measuring equipment (sensors) and actuators (valves, conveyor belts etc), where these fit into the control loop and how to select equipment for efficient control.
- A thorough understanding of feedback control theory, stability criteria and loop tuning techniques.
- A thorough understanding and knowledge of advanced control strategies, including feed forward control, model-based controllers, statistical control, inference control, cascade control, time-delay compensation, override control, self-adapting control and control of non-linear systems.
- Knowledge and understanding of control strategies and techniques applicable to multivariable systems.
- Knowledge in assessing, designing and implementing plant-wide control strategies.
- Skills to implement both feedback controllers and advanced controllers on existing process models in a selected software package.
- Mathematical and computer literacy to perform a frequency response analysis on process models and closed-loop control systems and to efficiently use this information in designing control systems.
- The ability to work as an individual.

| Module code: INGC414 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Sustainable Processing**

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

- Integrated knowledge and informed understanding of the principles of sustainable processing.
- Working knowledge with respect to energy policy and the integration of various energy resources for a sustainable future.
- Application of existing chemical/minerals engineering knowledge and skills to identify, select and design suitable energy solutions.
- Application of techno-economic principles to evaluate cost effective and sustainable energy solutions.
- Fundamental understanding and application of the principles of Environmental Engineering.
- Fundamental understanding and application of the principles of Chemical Process Safety & Loss Prevention.

| Module code: INGC477 | Year Module | NQF level: 8 |
|---|---|---|

Name: **Plant Design**

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

- integrated knowledge and a critical understanding of, as well as an ability to correctly evaluate and apply process engineering plant design to different areas of specialization within the field of chemical and minerals processing.
- ability to solve complex and unfamiliar problems through the creation of new knowledge and understanding within the field of (specify for module context).
- an ability to evaluate the effect of implementing process design strategies and levels of input specifications on the process plant design.
- the implementation of heuristics for process synthesis and to evaluate the measure of effectiveness of the implementation.
- the implementation of simulation to assist in process creation and to evaluate the measure of effectiveness of the implementation.
- an ability to evaluate the effect of heat and power integration on the process plant design.
- an ability to evaluate the profitability of a process plant conceptual design by means of a techno-economic evaluation.
- an ability to evaluate possible process units and select, specify, and design these units by following procedural and non-procedural equipment design methods.
- the implementation of process safety and loss prevention principals on a conceptual design to evaluate the measure of plant safety improvement after the implementation.
- an ability to evaluate the waste management strategies and general site considerations on the conceptual plant design.

| Module code: INGC479 | Year Module | NQF level: 8 |
|---|---|---|

Name: **Final Year Project**

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

- Knowledge of available sources of information (e.g. the library) to obtain relevant information for the successful completion of the research project.
- Knowledge of the life-cycle of a research project and to plan accordingly for the successful execution of such a project
- Knowledge in the specific field of the research project, both through textbook knowledge and searches in available literature in the field.
- Knowledge of ethical and professional behaviour and knowledge of his/her own limits of competence.
- Skills in designing the experimental plan, equipment and (if necessary) to perform an experimental design to collect data.
- Skills in data collection and processing and (where necessary) engineering modelling.
- Skills in technical writing for a final report to be compiled using the correct approach in technical writing.
- Skills in compressing a technical report's information into a one-page poster using only the most important information.
- Skills in oral communication, both in a formal presentation and questions-and-answers session, to convince the audience of the acquired knowledge in the specific field of study.

| Module code: INGF221 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Communication for Engineers**

Module outcomes:
After successful completion of this module, students should be able to do the following:

- Plan, compose and revise technical reports by applying discipline-specific genre-principles relating to content, structure, style, grammar, vocabulary, punctuation and visual presentation.

| Module code: INGM111 | Semester 1 | NQF level: 5 |
|---|---|---|

Name: **Engineering Graphics 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 code: INGM121 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Engineering Graphics 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 code: INGM122 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Materials Science I**

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

- Identify and classify different materials based on chemical composition and materials properties;
- Suggest possible materials properties based on chemical bonding, crystal structure and microstructural defects;
- Explain materials properties, behaviour and performance using atomic bonding, chemical composition, and microstructural defects;
- Suggest and describe mechanical testing of materials and relate results to materials properties, performance, and potential application.
- Propose potential application of materials and highlight limitations of certain materials in given service environments and loading patterns.

| Module code: INGM212 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Engineering Materials**

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

- Classify alloys given chemical composition, phase chemistry and/or alloy number;
- Suggest potential application of materials in mechanical designs based on materials properties, availability, cost and impact on the environment;
- Identify design limiting properties of materials, and recommend how they may be improved, or else suggest suitable alternatives;
- Demonstrate the ability to make logical, informed decisions in selecting material for a given application cognisance of materials cost, possibility of failure, and impact of materials processing on performance and on the environment;
- Demonstrate the ability to use metals handbooks, standards, codes and similar resources to inform and justify material selection.

| Module code: INGM222 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Thermodynamics 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 code: INGM223 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Manufacturing Technology**

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 code: INGM225 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Strength of Materials 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 code: INGM311 | Semester 1 | NQF level: 7 |
|---|---|---|
| Name: **Thermodynamics II** | | |
| Module outcomes:<br>After successful completion of the module the student should be able to:<br>• Analyse power and refrigeration cycles;<br>• Do an energy analysis on open and closed systems;<br>• Use variables such as: dry bulb temperature, relative humidity and specific humidity in analysing processes performed on air;<br>• Apply the First Law on processes performed on air;<br>• Use the Psychrometric Chart in the calculation and analysis of processes performed in the conditioning of air;<br>• 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<br>• Use thermodynamic relations to calculate the value of internal energy, enthalpy and entropy for components used in thermodynamic systems. | | |
| **Module code: INGM313** | **Semester 1** | **NQF level: 7** |
| Name: **Strength of Materials II** | | |
| Module outcomes:<br>After successful completion of this module, the student should be able to apply fundamental knowledge of:<br>• Stress and strain transformation;<br>• Failure criteria;<br>• Analysis of shaft for failure;<br>• Deflection of beams;<br>• Euler struts;<br>• Energy methods; and<br>• Thick-walled cylinders | | |
| **Module code: INGM315** | **Semester 1** | **NQF level: 7** |
| Name: **Systems Engineering** | | |
| Module outcomes:<br>After successful completion of this module, the student should be able to:<br>• Define a user requirement in engineering terms, do a functional analysis of the system and creatively generate system concepts and evaluate them;<br>• Break a system down into sub-systems and components, assign applicable technical performance measures to it, and design according to the specifications;<br>• Communicate in writing with technical audiences by means of reports; and<br>• Work in a group. | | |

| Module code: INGM316 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Machine Dynamics**

Module objective:
To equip the student with basic knowledge of machine dynamics, vibration and condition monitoring. The module builds on the knowledge gained in dynamics and serves as a basis to identify and understand typical problems found in practice.

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

- 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 code: INGM318 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Fluid Mechanics 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 code: INGM324 | Semester 2 | NQF level: 7 |
|---|---|---|
| Name: **Fluid Mechanics II** | | |
| Module objective:<br>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 INGM318 Fluid Mechanics I and serves as further preparation for the modules in Heat Transfer and Thermal-Fluid System Design.<br><br>Module outcomes:<br>Attain engineering science knowledge about a wide variety of fluid mechanics. After successful completion of this module, the student should be able to:<br>• Apply the basic knowledge and principles of compressible flow and boundary layer theory to solve problems;<br>• Use the applicable engineering tools such as the software package EES; and<br>• Analyse and interpret results obtained from assignments and practical experiments. | | |
| **Module code: INGM325** | **Semester 2** | **NQF level: 7** |
| Name: **Applied Computer Methods** | | |
| Module outcomes:<br>After successful completion of this module, the student shall be able to:<br>• Identify and interpret fluid dynamic flow and strength of materials problems;<br>• Plan and develop simulations to solve complex fluid and structural engineering problems;<br>• Design and analyse flow problems using NX Flow; and<br>• Design and solve basic structural problems using NX NASTRAN. | | |
| **Module code: INGM328** | **Semester 2** | **NQF level: 7** |
| Name: **Machine Components** | | |
| Module outcomes:<br>After successful completion of this module, the student should achieve the following outcomes:<br>• Have the ability to design individual mechanical components.<br>• Have the ability to integrate these components into a mechanical system.<br>• Have the ability to define boundary conditions for design.<br>• Have the ability to communicate design to a third party.<br>• Show basic understanding and knowledge of the characteristics and use of different oils, lubricants and fuels. | | |
| **Module code: INGM412** | **Semester 1** | **NQF level: 8** |
| Name: **Heat Transfer** | | |
| Module outcomes:<br>After successful completion of this module, the student should be able to:<br>• Apply basic knowledge and concepts of heat transfer, including conduction, external flow, flow inside pipes and thermal radiation to solve practical problems;<br>• Design a basic heat exchanger by integrating the knowledge gained on different heat transfer methods into a solution strategy;<br>• Use engineering software tools, like Excel and EES, to solve heat transfer problems; and<br>• Analyse and interpret results obtained from practical experiments. | | |

| Module code: INGM413 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Fluid Machines**

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 code: INGM426 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Failure of Materials**

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.

| Module code: INGM427 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Thermal-Fluid System Design**

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 code: INGM428 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Thermal Machines**

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

| Module code: INGM471 / INGM371 | Year module | NQF level: 8/7 |
|---|---|---|

Name: **Vacation Training seniors**

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

Module objective:
During vacation training, students are exposed to 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.

| Module code: INGM479 | Year module | NQF level: 8 |
|---|---|---|

Name: **Project**

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 code: MEGI415 | Semester 1 | NQF level: 8 |
|---|---|---|

Name: **Mechanical Systems Design**

Module outcomes:

- Learn how to design a mechanical system to meet client specifications.
- Adhere to design specifications, regulations, standards, codes, and good engineering practices.
- Learn how to apply an integrated design approach where all parameters of the system are numerically modelled and considered simultaneously.

The student will prove that he/she has attained the outcomes of the MEGI415 module when he/she can:

- Identify, formulate, analyse, and solve the complex engineering problem given, creatively and innovatively.
- Create and optimize designs using design software and numerical models.
- Follow the engineering design process and apply the systems engineering principles in order to reach design specifications.
- Implement and test the functionality of the developed solution (through software simulation).
- Evaluate different concepts.
- Document the design of the system and evaluation of the solution, both through a technical report and manufacturing drawings.

The student will be assessed on his / her written report of the system design, with evidence that the system specifications have been obtained.

| Module code: MCTR411 | Semester 1 | NQF Level: 8 |
|---|---|---|

Name: **Industrial Automation**

Module outcomes:

To successfully complete this module, the student should be able to demonstrate that he/she:

- Understands and can explain what industrial automation is and what its applications are in different sectors of South Africa's and global industries;
- Knows the different implications of industrial automation on industry profitability, national GDP, societal socio-economic and environmental conditions as articulated by NDP and SDGs;
- Understands the design and operation of Field devices (plant, sensors and actuators), control loops and communication networks and protocols;
- Appreciates network and data security issues associated with industrial communications and possible interventions;
- Understands basic operations, design and programming of PLCs and DCS systems;
- Understands principles, design and implementation of SCADA systems;
- Is able to use relevant software tools in the design and implementation of industrial automation systems;
- Is familiar with relevant quality, programming, reliability etc. standards and regulations applicable to industrial automation.

| Module code: MCTR421 | Semester 2 | NQF Level: 8 |
|---|---|---|

Name: **Virtual Commissioning**

Module outcomes:

To successfully complete this module, the student should be able to demonstrate that he/she:

- Understands the complete system/process design lifecycle, and how virtual commissioning can save both time and money while improving quality and agility;
- Understand and apply concepts of digital twins and it's appropriate abstractions for industrial automation;
- Develop automation logic (logical twin modes) and associated PLC control implementations;
- Use both HiL and SiL to virtually commission automation systems and follow with code generation needed for real commissioning;
- Integrate different virtual commissioning software tools through interoperability communication protocols to achieve a full virtual representation of industrial systems;
- Critically interrogate and improve existing virtual commissioning methods towards industry acceptance.

| Module code: MTHS111 | Semester 1 | NQF Level: 5 |
|---|---|---|

Name: **Introductory Algebra and Analysis 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 code: MTHS121 | Semester 2 | NQF Level: 5 |
|---|---|---|

Name**: Introductory Algebra and Analysis 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 code: MTHS211 | Semester 1 | NQF Level: 6 |
|---|---|---|

Name**: Advanced 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 code: MTHS212 | Semester 1 | NQF Level: 6 |
|---|---|---|

Name: **Linear 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 aparallelogram and volume of a parallelepiped;
- Eigenvalues and eigenvectors of matrices; and
- Applications to systems of linear differential equations.

| Module code: MTHS223 | Semester 2 | NQF Level: 6 |
|---|---|---|

Name: **Engineering Analysis**

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 code: MTHS224 | Semester 2 | NQF Level: 6 |
|---|---|---|
| Name: **Applied Linear Algebra** | | |
| Module outcomes:<br>On completion of this module the student should:<br>• Demonstrate advanced knowledge of and insight into bases and linear independence of functions, and be able to use it in applications;<br>• Be able to use concepts like eigenvalues and eigenvectors in applications such as diagonalisation, discrete dynamical systems and systems of linear differential equations;<br>• 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<br>• Demonstrate problem-solving skills by analysing known and unknown problems and applications and applying the knowledge and techniques of linear algebra. | | |

| Module code: NCHE111 | Semester 1 | NQF Level: 5 |
|---|---|---|
| Name: **Introductory Inorganic and Physical Chemistry** | | |
| Module outcomes:<br>After completion of the module NCHE111, the student should demonstrate:<br>• 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;<br>• The ability to balance chemical reactions, use and apply stoichiometric and other calculations to find an unknown quantity;<br>• The ability to recognise and apply tendencies from the periodic table (main group elements);<br>• The ability to apply laboratory technique and safety rules;<br>• 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<br>• 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 code: NCHE121 | Semester 2 | NQF Level: 5 |
|---|---|---|
| Name*:* **Introductory Organic Chemistry** | | |
| Module outcomes:<br>On successful completion of this module the student should be able to demonstrate:<br>• 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;<br>• An ability to evaluate the structures of organic compounds and thereby identify suitable synthesis procedures with a **limited number of steps**;<br>• Conduct in the academic environment that adheres to the rules as stipulated by the North- West University code of conduct;<br>• 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;<br>• 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<br>• 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 code: NCHE211 | Semester 1 | NQF Level: 6 |
|---|---|---|
| **Name: Analytical Chemistry II** | | |
| Module outcomes:<br>After completion of the **NCHE211** module, the student should demonstrate:<br>• 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;<br>• Appropriate laboratory skills in order to conduct measurements associated with all of the above-mentioned theoretical aspects;<br>• The ability to demarcate and effectively solve problems associated with the theoretical and practical (experimental) aspects; and<br>• An understanding of the safe, ethical and professional conduct required of a professional analytical chemist. | | |
| **Module code: NCHE222** | **Semester 2** | **NQF Level: 6** |
| Name*:* **Organic Chemistry II** | | |
| Module outcomes:<br>After completion of the module NCHE222, the student should demonstrate:<br>• 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;<br>• A clear understanding of prevalent schools of thought that determine the progress within the field of molecular models;<br>• The ability to select, implement and evaluate the correct mechanism to demonstrate the possible progression of specific aromatic based reactions;<br>• The ability to effectively use appropriate laboratory skills to synthesise and purify specific compounds;<br>• The ability to solve a multi-step reaction using suitable reagents and products to ensure the manufacture of the desired compound; and<br>• 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 code: NPHY111** | **Semester 1** | **NQF Level: 5** |
| Name: **Basic Physics 1** | | |
| Module outcomes:<br>After completion of the module the student should demonstrate:<br>• 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;<br>• An awareness of the development of physical measurements and theories that shaped the progress of physics;<br>• 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;<br>• 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;<br>• 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;<br>• 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;<br>• 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 code: NPHY121** | **Semester 2** | **NQF Level: 5** |
|---|---|---|

Name: **Basic Physics 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 code: NPHY211** | **Semester 1** | **NQF Level: 6** |
|---|---|---|

Name: **Electricity and Magnetism**

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 code: PPEP171 | Year module | NQF level: 5 |
|---|---|---|

Name: **Practical Engineering Practice**

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 code: REII111 | Semester 1 | NQF level: 5 |
|---|---|---|

Name: **Introduction to Digital Systems**

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 code: REII121 | Semester 2 | NQF level: 5 |
|---|---|---|

Name: **Introduction to Microcontrollers**

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 code: REII211 | Semester 1 | NQF level: 6 |
|---|---|---|

Name: **Algorithms and Optimisation**

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 code: REII222 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Embedded Systems**

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 code: REII312 | Semester 1 | NQF level: 7 |
|---|---|---|
| Name: **Network Fundamentals** | | |
| Module outcomes:<br>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:<br>• Historical: In terms of standards;<br>• The user: Information theory, signal coding and compression;<br>• Security: Cryptography and algorithms;<br>• Network: Topologies, switching, models and dimensioning, internet networks, components, protocols and quality of service;<br>• Link: Media access, error correction, protocols;<br>• Channel: Capacity, transmission media, line coding, modulation;<br>• Applications: GSM, VoIP; and<br>• 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 code: REII313** | **Semester 1** | **NQF level: 7** |
| Name: **Object-oriented Software Development** | | |
| Module outcomes:<br>To successfully complete this module, the student should demonstrate that he/she:<br>• Understands the difference between classical and object-oriented software engineering;<br>• Mastered the principles of object-oriented programming, namely objects, classes, inheritance and polymorphism;<br>• Is acquainted with programming methods applicable in certain problem-solving techniques, e.g., simulation and modelling, by the development of object-oriented programmes;<br>• Understands and is able to apply the principles of graphical user interfaces and event driven programming;<br>• Is able to design and develop object-oriented computer programs to solve engineering problems;<br>• Is able to develop software according to best programming practice;<br>• Understands various phases in software engineering: requirements and analysis, specification, design, implementation, integration and maintenance; and<br>• 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** | | |
| Module outcomes:<br>To successfully complete this module, the student should be able to demonstrate that he/she:<br>• Understands the detail concepts of 32-bit architectures;<br>• Can describe the low-level functionality of 32-bit microcomputers;<br>• Understands challenges associated with embedded operating systems;<br>• Is able to deploy an embedded operating system; and<br>• Can develop appropriate engineering solutions within an embedded environment. | | |

| Module code: REII327 | Semester 2 | NQF level: 7 |
|---|---|---|
| Name: **Computer Engineering Design** | | |
| Module outcomes:<br>To successfully complete this module, the student should demonstrate that he/she:<br>• Understands the systems engineering process;<br>• Can apply design guidelines and constraints;<br>• Can interpret a development specification and the allocation of requirement;<br>• Apply a customised systems engineering process on a complex engineering project;<br>• Can successfully work as an individual and in groups; and<br>• Can use appropriate CAD, simulation and other relevant engineering software tools during the design process. | | |
| **Module code: REII414** | **Semester 1** | **NQF level: 8** |
| Name: **Databases and Web-programming** | | |
| Module outcomes:<br>To successfully complete this module, the student should be able to demonstrate that he/she:<br>• Understands database definitions and terms;<br>• Can design and implement databases, and store, alter and delete information in databases;<br>• Can use basic and advanced SQL to manipulate databases;<br>• Can identify problems associated with concurrent access and repair of databases after failure;<br>• Can implement interfaces to the database;<br>• Understands the challenges of web-based programming;<br>• Clearly understands the differences between procedural, object-oriented and web-programming;<br>• Can successfully use software tools to implement web-based software;<br>• Can evaluate the applicability of rapid application development tools for developing web-based software; and<br>• Can apply all the above to solve an engineering problem | | |
| **Module code: REII424** | **Semester 2** | **NQF level: 8** |
| Name: **Data Analysis** | | |
| Module outcomes:<br>To successfully complete this module, the student should be able to demonstrate that he/she:<br>• Can estimate required sampling rate, data type and transmission rate of sensor data;<br>• Can calculate the effect of multiple sensor nodes on network performance;<br>• Can develop a database capable of handling multiple sensor nodes;<br>• Can develop software for administration of the system;<br>• Can apply applicable data mining principles to utilise acquired data;<br>• Understands the planning, documentation and testing of these types of systems; and<br>• Can apply all the above to a distributed sensing system. | | |
| **Module code: REII425** | **Semester 2** | **NQF level: 8** |
| Name: **Data Analytics and Machine Learning** | | |
| Module outcomes:<br>To successfully complete this module, the student will demonstrate:<br>• The ability to acquire, store, and manipulate bid data sets;<br>• Application of suitable data analytics techniques on big data problems;<br>• Capacity to compare and contrast various machine learning algorithms as it pertains to big data problems;<br>• Application of selected machine learning algorithms to big data problems;<br>• Visualise the result of data analytics in a suitable manner. | | |

| Module code: STTK222 | Semester 2 | NQF level: 6 |
|---|---|---|

Name: **Statistics for Industrial Engineering**

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 code: STTK312 | Semester 1 | NQF level: 7 |
|---|---|---|

Name: **Engineering Statistics**

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

- Demonstrate fundamental knowledge of the following statistical concepts: uncertainty and variation, a distribution, certain continuous and discrete distributions, numerical summary measures, bivariate and multivariate data and distributions, methods for obtaining data, probability and sampling distributions, quality and reliability, point estimation and statistical intervals, testing statistical hypotheses, the analysis of variance, experimental design and inferential methods in regression and correlation;
- Demonstrate his/her ability to interpret graphic illustrations of the data, explain the concept of a distribution, work with certain continuous and discrete distributions, calculate measures of centre, spread and variants thereof, 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.