NWU®

2019 Yearbook *Jaarboek*

FACULTY OF ENGINEERING
POSTGRADUATE

FAKULTEIT INGENIEURSWESE
NAGRAADS

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PLEASE MENTION YOUR UNIVERSITY NUMBER IN ALL CORRESPONDENCE.

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

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

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Prof DM Balia

Deputy Vice-Chancellor: Planning and Vaal Triangle campus operations

Prof L du Plessis

Deputy Vice-Chancellor: Assigned functions and Mafikeng campus operations

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Prof L Lalendle

Registrar

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Faculty of Education: Prof L Conley

Faculty of Engineering: Prof L van Dyk

Faculty of Health Sciences: Prof AF Kotzé

Faculty of Humanities: Prof P Maseko

Faculty of Law: Prof SPLR de la Harpe

Faculty of Natural and Agricultural Sciences: Prof E Ebenso

Faculty of Theology: Vacant

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Ms WC Steenkamp

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Prof QP Campbell

School of Electrical, Electronic and Computer Engineering
Prof G van Schoor

School of Mechanical and Nuclear Engineering
Prof WLR den Heijer

School of Industrial Engineering
Prof SE Terblanche

Unit for Energy and Technology Systems
Prof FB Waanders

Academic staff

Professor
Prof JA de Kock

Associate Professors
Prof DE Serfontein
Vacant
Vacant

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Dr HJ Marais
Dr MJ Grobler

Lecturers
Ms R Coetzee
Mr PJ Tolmay
Mr PvZ Venter
Mr JD Human

Junior Lecturers
Me C du Plessis
Mr JA Bezuidenhout

NRF Rated Researcher
Prof R Gouws

Student Representative
Miss I Guess (Chairperson Ingenium)

RESEARCH

Unit for Energy and Technology Systems
Prof FB Waanders

Centre of Excellence in Carbon Based Fuels

Prof FB Waanders

Centre for Research and Continued Engineering Development (Pretoria) (CRCED)
Prof EH Mathews

Centre of Competence - Hydrogen Energy

Dr DG Bessarabov

RESEARCH CHAIRS

DTI Chair in Nuclear Engineering

Prof CG du Toit

SARChI Chair in Coal Research

Prof JR Bunt

NRF Research Chair in Biofuels and Other Clean Alternative Fuels

Prof S Marx

Chair in Smart Grids

Prof APJ Rens

Eskom Powerplant Engineering Institute (EPPEI) Specialisation Centre for Emission Control

Vacant

RESEARCH GROUPS

Visit the website for more information on each subgroup: http://engineering.nwu.ac.za/

Aerodynamic Design and Aircraft Development Group

Dr AS Jonker

Bio-Fuels Research Group

Prof S Marx

Centre for Advanced Additive Manufacturing (CFAM)

Mr DB Vorster

Coal Research Group

Prof JR Bunt

DST-HySA (Hydrogen South Africa) Infrastructure Centre of Competence

Dr D Bessarabov

Energy Research Group (ERG)

Prof R Gouws

Engineering Management

Prof JH Wichers

Industrial Engineering

Prof SE Terblanche

Intelligent Systems

Prof AJ Hoffman

Materials, Vibration Analysis and Manufacturing

Dr CB Nel

McTronX

Prof G van Schoor

Multilingual Speech Technology Research (MuST)

Prof Marelie Davel

Nuclear Engineering and Neutronics

Prof DE Serfontein

Telenet Research Group

Prof AS Helberg

Thermal-Fluid Systems Group

Prof M van Eldik

Water Research Group

Prof Elvis Fosso-Kankeu

POSTGRADUATE PROGRAMME MANAGERS

Chemical and Minerals Engineering: Prof HWJP Neomagus

Electrical, Electronic and Computer Engineering: Dr M Ferreira

Development and Management: Prof WLR den Heijer

Industrial Engineering: Ms R Coetzee

Mechanical and Nuclear Engineering: Dr J Kruger

ENG.1 FACULTY RULES/ FAKULTEITSREËLS

ENG.1.1 AUTHORITY OF THE GENERAL RULES/ GESAG VAN DIE ALGEMENE REËLS

The faculty rules valid for the different qualifications, programmes and curricula of this faculty and contained in the faculty calendar are subject to the General Rules of the University, as determined from time to time by the Council of the University on recommendation by the Senate. The faculty rules should therefore be read in conjunction with these General Academic Rules.

The Manual for Masters and Doctoral students, with specific guidelines and procedures for masters and doctoral studies, as well as quality measures of research entities also apply.

ENG.1.2 FACULTY-SPECIFIC RULES/ FAKULTEIT SPESIFIEKE REËLS

Faculty specific rules and requirements regarding the different programmes presented in this faculty are specified in the language in which the programme is presented.

Requirements relating to a programme are specified in the yearbook at the different programme-specific requirements.

ENG.1.2.1 General Provisions

ENG.1.2.1.1 Application and interpretation of the General Academic Rules

a) General Academic Rules must be read with and applied subject to the Higher Education Act (101 of 1997), the Higher Education Qualifications Sub-framework (HEQSF) 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 Admissions Policy and all other related policies for the governance, management and administration of teaching, learning and research, as well as the schedule of payable fees as determined annually by the university.

b) General Academic Rules apply to all Senate-approved academic programmes that lead to formal qualifications listed in the Programme and Qualification Mix (PQM) of the university, regardless of the mode of delivery. Where applicable, the Rules distinguish between provisions that apply to programmes delivered by means of the contact and distance modes of delivery (referred to in these rules as “contact” and “distance” qualifications and programmes).

c) Faculty rules and processes described in the quality manual are aligned with the General Academic rules of the University.

d) The Glossary of Teaching-Learning Related Concepts and Designations contained in the Appendix determines the interpretation and application of these rules.

e) Where General Academic Rules require or allow the exercise of a discretion, the senate may review and substitute a decision taken in the exercise of such discretion.

f) 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 person or structure concerned to report on the performance of the function concerned 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 act or decision concerned.

g) All decisions made by executive deans or other persons in terms of these rules will be recorded appropriately by the responsible academic or administrative unit.

h) The executive dean may, in writing, delegate any power or function vested in him/her in terms of these rules to any faculty sub-committee, the deputy dean, an

academic director or deputy director. Any person aggrieved by the exercise of such a delegated power or function may, within a reasonable time, request the executive dean to reconsider a decision made in terms of such delegated authority, and the executive dean may confirm, replace or amend such a decision or refer it back to the person or committee to whom decision- making authority was delegated for reconsideration.

i) A person who demonstrates the intention to be associated with the university and faculty, by applying for admission, or being admitted to the university, for formal study, is subject to these rules.

ENG.1.2.1.2 The structure of qualifications

a) The HEQSF provides the basis and minimum requirements for the design, structure and quality assurance of all qualification types offered by the faculty.
b) Only those qualifications that form part of the PQM will be marketed, offered and conferred.
c) The internal qualification standards of the university are provided for in the rules of each degree or programme and published in the faculty postgraduate yearbook to ensure compliance with the HEQSF.
d) The senate may approve faculty rules with regard to specific programme requirements that allow for a maximum additional credit allocation of 20% more than the minimum required total credits for a qualification specified in the HEQSF.
e) The additional credit allocation contemplated in rule 1.2.4 may be exceeded in cases where it is required by a professional body competent to recognize or accredit a qualification.
f) Amendments to the credit structure, module outcomes or curriculum outlay of a programme leading to a qualification are subject to approval by the Institutional Committee for Academic Standards (ICAS).
g) In cases where an approved qualification undergoes a major change to its purpose, outcomes, field of study, or modules, application will be made via ICAS for the external approval of such changes.

ENG.1.2.1.3 Faculty rules

a) The faculty board will make proposals to the senate for the adoption of faculty rules with regard to the requirements for qualifications and programmes that are part of the PQM of the university and offered by the faculty.
b) In addition to matters provided for in General Academic rules, faculty rules will, where appropriate, provide for arrangements that may be necessary for the accommodation of programme-specific requirements and faculty-specific procedures and structures. Programme-specific requirements are specified at each programme in this yearbook, whilst faculty specific procedures are published in the relevant quality manual of the faculty.
c) The minimum and maximum duration of study for a qualification, the composition of the curricula of programmes, and the credit structure of programmes leading to a qualification, are set out in these faculty rules and are published in the postgraduate yearbook annually.
d) Where faculty rules are amended and approved by senate before the next version of the yearbook is published, reasonable steps will be taken to bring the amendments to the attention of all students in the faculty who are affected thereby. These steps may include electronic communication and changing information on the web page of the faculty.

ENG.1.2.1.4 Recognition as a student of the university

a) To be recognised as a student of the university (and faculty) for the purposes of these rules, a person must have been admitted and registered for a programme leading to the attainment of a qualification in the faculty.
b) In order to continue with studies, a returning student who has been admitted and registered at the university must register annually in accordance with these rules.

ENG.1.2.1.5 Application, selection and admission to the university

ENG.1.2.1.5.1 Application and admission

a) A prospective student applies for admission to the university (and faculty) by completing the prescribed application form, either on paper or electronically, and submitting it to the North-West University Higher Degrees Application Office, and according to the admissions procedure required by the university, together with the required additional application documentation and proof of payment of applicable fees for application and selection.
b) No student will be considered for selection if the formal application process has not been followed.
c) The general requirements for admission to all formal contact and distance qualifications and related programmes offered by the university, as well as the provisions for conditional exemptions, are set out in the Admissions Policy of the NWU as recommended by the Institutional Admissions Requirements Committee, adopted by Senate, and approved by Council (http://www.nwu.ac.za/content/policy_rules).
d) Programme-specific admission requirements are provided for in the postgraduate yearbook of the faculty and no application for admission may be accepted unless the applicant complies with both the general admission requirements and faculty-specific requirements where applicable.

ENG.1.2.1.5.2 Selection

a) The faculty reserves the right to set selection criteria, in addition to the minimum admission requirements, and apply such criteria to admit or refuse admission to specific qualifications and programmes, taking into consideration the university's targets for the size (total number of students) and shape (fields of study and diversity profile) of the student population, and the capacity available to the university to offer the qualifications and programmes concerned.
b) The allocation of a number for identification purposes to an applicant who meets the minimum admission requirements does not constitute or create a right to be admitted to the university as a student.
c) Selection will take place during the approved time schedules for each programme as indicated in the faculty's annual academic calendar.
d) Prospective students must consult the Faculty postgraduate website to help them identify a study leader. The study leader will then sign a study leader acceptance form, which must accompany the application form. Students will not be allowed to register unless a study leader has been confirmed.

ENG.1.2.1.6 Admission and advanced standing on grounds of recognition of prior learning

a) The executive dean will, by means of the recognition of prior learning (RPL) in accordance with the university's Recognition of Prior Learning Policy, grant a

student who does not meet the minimum admission requirements admission to a programme of a qualification.

b) Only proven informal or non-formal learning may be taken into consideration by means of RPL, the process of equivalence-setting between such learning and formal modules must be documented following the Faculty Standard for RPL Portfolio Template for the correct processes and procedures to be followed.

c) The outcome of the RPL evaluation will be recorded using a standardized evaluation report and the official student record.

d) Recognition of prior learning (RPL) applications will be endorsed at the faculty board.

ENG.1.2.1.7 Registration

ENG.1.2.1.7.1 Annual registration

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

b) A student is personally responsible to:

- ensure compliance with all the programme and module registration requirements and the completion and submission of the formal documents required for registration as specified in the postgraduate yearbook, and
- determine that there are no clashes in contact time tables or scheduled assessment opportunities between the modules registered for.

c) The faculty reserves the right to refuse or cancel the registration of a student where an applicant provides false, incorrect or incomplete information or documentation material to registration as a student, or where any other condition provided for in these rules is not satisfied.

d) The requirements for active participation by students in specific programmes will be set out in the applicable study guides and postgraduate yearbook and students may not register for modules in which they are unable to or intend not to actively participate.

e) In order to receive credits for a specific module a student must be registered for such module and pass it.

f) A registered student remains responsible to ensure that the University always has his/her latest personal details in order to be able to receive official communication from the University and faculty. Changes to personal details must be submitted on a prescribed form to the Department of the Chief Director: Student Academic Lifecycle Administration.

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

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

i) A student who registers electronically must complete and sign the registration form electronically, and after approval of the registration by the faculty concerned, an official proof of registration is issued electronically.

j) A registered student must promptly submit all relevant changes to personal details in the prescribed form to the Chief Director: Student Academic Lifecycle

Administration for the purposes of official communication by the university with the student.

k) Official correspondence with students may be addressed by the university to the postal addresses, email addresses and cell phone numbers supplied during registration, or as changed in accordance with Academic rule 1.10.1.11.

l) If a provisional postgraduate student fails to register during the determined registration cycle of the specific academic year, he/she must re-apply for admission to the University.

m) An existing postgraduate student who fails to re-register for any academic year, must apply for re-admission and continuation. Such student will be responsible for paying outstanding tuition fees of preceding year(s) as well.

ENG.1.2.1.7.2 Exemption from registration

Where a doctoral degree candidate is required to make minor changes to an examined thesis, such candidate does not have to register for a new academic year, provided that the required changes are made satisfactorily by the end of January of the year concerned or, if the registrar so directs, before the closure of the graduation list, and then the degree may be awarded at the autumn graduation ceremony of that year.

ENG.1.2.1.7.3 Submission to rules and resolutions

By signing and submitting either on paper or electronically the prescribed application and registration forms, the applicant or registered student agrees to be bound by the applicable rules, policies and resolutions of the university and the faculty until the registration of the student is terminated.

ENG.1.2.1.7.4 Active enrolment

a) A registered (contact or distance) student of the faculty must actively participate in the teaching, learning and assessment activities of every module for which such student is registered as indicated in the applicable study guide in order to be deemed to be an enrolled student of the faculty.

b) Students of the faculty registered for research degrees must be actively involved in the study guidance process as agreed with the supervisor/promoter as well as research activities of the applicable entity or project.

c) Sitting for an examination alone does not constitute proof of active enrolment.

d) The registration of a student who fails to participate satisfactorily in the activities referred to in Academic rule 1.10.3.1 is subject to review in accordance with the progression requirements provided for in Academic rule 1.16, or as specified in programme specific requirements in the postgraduate yearbook.

ENG.1.2.1.7.5 Amendment, cancellation and discontinuation of registration

a) Subject to university requirements and the applicable provisions regarding payable fees, any contact or distance student may apply in the prescribed manner and within the period indicated for that purpose on the annual university calendar, to amend, cancel or discontinue registration.

b) Registration may be cancelled for a programme or a module, and entails that a student withdraws from the programme or module before formal tuition or study guidance begins.

c) Timeous cancellation of registration will not reflect in a student's academic record

and a part of the registration fees, as well as the paid tuition fees, may be reimbursed by the university.

d) The faculty reserves the right to cancel any erroneous registration.
e) Discontinuation of registration entails that a student withdraws from a programme or module after the commencement of formal tuition or study guidance.
f) Discontinuation of registration will be reflected as such on the student's academic record and does not entitle the student to receive reimbursement of registration or tuition fees.

ENG.1.2.1.7.6 Simultaneous registration at more than one institution

a) A student registered at the faculty may not register concurrently for a qualification at another university except with the approval of the executive dean, who may grant such approval only if the student has met the minimum requirements of either one of the universities.
b) With the approval of the executive dean, a student may register for non-degree purposes at the faculty and as a student for a formal qualification at another university.

ENG.1.2.1.7.7 Simultaneous registration for more than one qualification at the university

The executive dean may in writing grant a student permission, subject to the limitation on credit load provided for in Academic rule 1.9, to register simultaneously for more than one qualification at the university.

ENG.1.2.1.7.8 Use of the university and faculty's facilities by registered students

Subject to specific exceptions granted by the Chief Director: Student Academic Lifecycle Administration, only registered students are entitled to utilise university and faculty's facilities and receive study guidance.

ENG.1.2.1.8 Protection of personal and education-related information

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

ENG.1.2.1.9 Avoidance of conflict of interest

The executive dean will, in consultation with academic directors concerned, ensure that the risk of conflict of interest is limited to the minimum when supervisors, promoters, examiners, and moderators are appointed.

ENG.1.2.1.10 Maximum duration of study

a) For full-time contact students, the maximum duration of study is as follows:

- Master's degrees: two years (with a possibility to apply for a third year if progress is satisfactory);
- Doctoral degrees: four years (with a possibility to apply for a fifth year if progress is satisfactory).

b) For part-time contact students, the maximum duration of study is as follows:

- Master's degrees: three years (with a possibility to apply for additional study years of up to three years if progress is satisfactory);
- Doctoral degrees: six years (with a possibility to apply for additional study years of up to seven years if progress is satisfactory).

ENG.1.2.1.11 Extension of period of study

a) The executive dean may, on the recommendation of the academic director concerned, extend a student's study period in accordance with the provisions of the applicable faculty quality manual following an application submitted before the end of the penultimate academic year by a student who does not expect to complete a programme within the maximum duration allowed for the study.

b) An application for extension of the study period must be supported by a recommendation by the academic director concerned, and endorsed at the relevant faculty committee.

c) An application for extension of the period of study for a master's degree must indicate:

- that the research topic is still relevant;
- what progress has been made by the applicant;
- what remains to be done to complete the study;
- what the time schedule for completion is, and
- whether the supervisor is still available.

d) The grant of an extension for the study contemplated in this rule is subject to the payment of a levy determined by the registrar.

ENG.1.2.1.12 Monitoring of academic performance

a) Subject to additional arrangements provided for in applicable programme specific requirements, a student whose academic performance is unsatisfactory may be given a written warning by the executive dean concerned, alerting the student to the implications of unsatisfactory academic progress for the completion of the study programme, and providing a basis for the programme manager concerned to review the unsatisfactory progress with the student, and for referral for appropriate support, including academic advice, supplemental instruction and study counselling.

b) Every school will monitor the academic progress of students who have received warning letters.

c) The supervisor or promoter of a postgraduate student must regularly, as required by the guidelines in the applicable quality manual of the faculty, submit a report on the progress made by a student on the research component of the programme concerned, and if such progress proves to be unsatisfactory, the student will be given a written warning by the executive dean.

ENG.1.2.1.13 Termination of studies

a) The executive dean may direct the registrar to terminate a student's registration if such student –
   - does not meet the requirements for annual registration as provided for in Academic rule 1.10.1;
   - does not meet the requirements for proof of active enrolment as provided for in Academic rule 1.10.3.1;
   - has received two warnings with respect to satisfactory academic performance from the executive dean as provided for in Academic rule 1.15.2 and fails for the third time to show satisfactory academic performance;
   - does not meet the minimum progression requirements set out in rule 1.16, or fails to submit a research proposal as contemplated in Academic rule 4.12.6 and 5.12.5;
   - does not obtain an extension of time as provided for in rule 1.17, and
   - fails, after having been granted an extension of time as provided for in Academic rule 1.17, to complete the study.

b) After every examination period the registrar will submit a report to senate on students whose studies have been terminated.

c) Notification of termination of study or the intention of termination of studies will be sent to students in sufficient time before the next registration period, or, where applicable, before the next semester.

d) A student whose studies have been terminated may, in accordance with the requirements set out in the applicable quality manual of the faculty, apply for admission to another study programme, but must in the course of the application mention the termination.

e) The executive dean may set reasonable conditions for admission to another study programme as contemplated in Academic rule 1.18.4, and must report such conditions to the registrar.

f) A postgraduate student whose studies have been terminated may not apply more than twice for admission to the university.

ENG.1.2.1.14 Readmission after interruption of studies

a) Where a student's study is interrupted for a year or longer, such a student must apply for re-admission by completing the relevant application and obtaining the written permission of the executive dean to be readmitted.

b) The executive dean has the discretionary authority to set reasonable conditions for such re-admission and must report such conditions to the registrar.

c) Irrespective of the number of modules passed or failed during years of study before readmission, previous years of study for a specific programme contribute to the maximum duration of study for that programme.

ENG.1.2.1.15 General Rule about student academic requests

No academic request will be approved without submission and processing of a formal student request form, which will be processed according to the guidelines outlined in the applicable faculty quality manual. No verbal approval will be given for any student request. All decisions will be confirmed and noted in the minutes of the relevant faculty committee meeting and recorded on the students' academic record

ENG.1.2.1.16 Examination

ENG.1.2.1.16.1 Submission of the research product for examination

a) The student must give notification (on the prescribed form) of his/her intension to submit for examination during the period set out for it in the annual University calendar.
b) A student who is not registered may not give notice to submit.
c) A student registered for a master's or doctoral degree must, with the written consent of the supervisor concerned, submit the dissertation, mini-dissertation, research report or other research product contemplated in Academic rule 4.4 for examination on or before the date determined for submission in the annual University calendar in order to qualify for graduation at the appointed graduation ceremony.
d) Where the supervisor withholds permission for the submission of a research product for examination, the academic director concerned may, after consultation with the supervisor and the student, recommend to the executive dean the granting of leave for submission.
e) The research product of a master's or doctoral degree study must comply with the technical requirements provided for in the Manual for Master's and Doctoral Studies and in the quality manual of the specific research entity.
f) Where it is required by the research entity that a research article must be submitted to an accredited journal as part of the requirements for the degree specified in programme specific requirements and/or the assessment methods of the research product, the candidate must provide evidence of such submission.
g) Where a candidate is allowed to submit the research product in the form of a research article or articles, such research product must be presented for examination purposes as an integrated unit, supplemented with a problem statement, an introduction and a synoptic conclusion as prescribed by the applicable quality manual of the faculty and/or research entity and the manuscript submission guidelines, or the url link to the manuscript guidelines, of the journal or journals concerned.
h) Where any research article or internationally examined patent to which the candidate for a master's or doctoral degree and other authors or inventors have contributed is submitted as the research product of a master's or doctoral degree programme, the candidate must obtain a written statement from each co-author and co-inventor in which it is stated that such co-author or co-inventor grants permission for the research product to be used for the stated purpose, and in which it is further indicated what each co-author's or co-inventor's academic contribution to the research product concerned was.
i) Where co-authors or co-inventors as contemplated in Academic rule 4.10.8 were involved in the development of the research product, the candidate must mention this fact in the preface, and must include the statement of each co-author or co-inventor immediately following the preface to the research product.
j) The higher degrees administration will make an electronic copy of the research product of a candidate for a master's or doctoral degree available for inspection by the university community for a period of at least 14 calendar days after it was dispatched to the examiners, and notice of such availability must be given in a suitable manner.
k) After its submission for examination a research product may not be withdrawn.
l) The university's policy regarding the classification of research must be taken into account in the process of examination of the research product of a master's or doctoral degree.

ENG.1.2.1.16.2 Recommendations relating to the examination of the research product in a master's degree or doctoral programme

a) An examiner may recommend that a research product –
   - be accepted unconditionally (Faculty rules makes provision for smaller typographical errors for instance typo errors, spelling errors, grammatical errors etc. can be included in this option);
   - be accepted on condition that specified revisions be made to the satisfaction of the supervisor. (Faculty rules makes provision for errors of a greater extent, for instance refining arguments and/or logical structuring or improving layout and technical finishing may be included in this option but that the research is scientifically in order and acceptable); or
   - be accepted on condition that specified revisions of a substantive nature be made to the satisfaction of the examiners or the academic director concerned. (Faculty rules require that feedback may be submitted to an examiner by means of a detailed rebuttal which focuses on the specific recommendations and/or required changes called for); or
   - not be accepted in its current format, in which case it is referred back to the candidate for revision, elaboration or amendment and resubmission for re-examination. (Faculty rules require that a final mark below 50% for a dissertation/mini-dissertation must be awarded, should this option be opted for. This option further entails that the research is scientifically not adequate or in order and should be expanded and/or revisited. Feedback may be submitted to the examiner during re-examination by means of a detailed rebuttal which focuses on the specific recommendations and/or required changes called for. The mini-dissertation/dissertation/thesis will be submitted to the examiner for re-examination unless it is decided otherwise by the Faculty Board or its delegates in which case the examiner will receive notification from the executive dean); or
   - not be accepted at all, in which case the candidate fails. (This option entails specifically that the research has failed in its totality, that it cannot be reworked or resubmitted and that the student has to start all over).

b) All comments received from the university community as contemplated in Academic rule 4.10.10 must be submitted to the executive dean before expiry of the period for which a research product is made available for inspection, who must forward such comments to the relevant faculty committee or other faculty structure concerned for evaluation together with the examiners' reports.

ENG.1.2.1.16.3 Revisions to and re-examination of the research product of a master's or doctoral degree

a) The supervisor of a research product must, within 14 calendar days after receipt of all the examiners' reports and in consultation with the academic director concerned, provide the candidate with a memorandum setting out the nature and extent of the revision or elaboration required as contemplated in Academic rules 4.11.5.1.2, 4.11.5.1.3 and 4.11.5.1.4.

b) In order to be recorded as a graduate in the academic year during which the research product was submitted for examination, a revised, amended or elaborated research product must be submitted before or on the submission date determined for that purpose in the annual university calendar of the year concerned.

c) Where a candidate is required to revise or elaborate a research product, the revised product must be submitted within 12 months after first submission date by

the candidate of the result as contemplated in Academic rule 4.11.7.1, but, if the candidate provides valid grounds in an application, the executive dean may grant an extension.

d) A research product may only be referred back to a candidate once and, after revision, be submitted once for re-examination.

e) The examiners who were appointed for the original examination are deemed also to have been appointed for the re-examination, but if considered necessary or expedient, other or additional examiners may be appointed by the executive dean.

ENG.1.2.1.17 Vagueness or differences regarding examination results

a) Where, in the case of a research product, the comments received by members of the university community in accordance with Academic rule 4.10.10 differ materially from the recommendations of the examiners, the executive dean must follow the procedures provided for in Academic rule 4.11.8.4 before taking the final decision regarding the outcome.

b) A material difference regarding the examination of a research product is deemed to exist if:

- the reports of the examiners differ on the question whether the research product may be accepted, with or without revisions, should be referred back for revision, or should be rejected;
- the marks awarded by the examiners differ by more than 15%, or
- comments that arise from the release of the research product for inspection by the university community in accordance with Academic rule 4.10.10 differ materially from the recommendations of the examiners.

c) The executive dean may, in consultation with the academic director concerned, seek clarification from the examiners or members of the university community who have submitted comments on the research product regarding anything that is not clear in their reports or comments relating to a coursework module or research product.

d) The executive dean will take steps to resolve the outcome of an examination where a material difference arises as contemplated in Academic rule 4.11.8.2, which may include

- inviting a knowledgeable external expert to participate in the deliberations of the relevant faculty committee or similar structure;
- the appointment of an additional external examiner to assess the research product, and to make a recommendation on the assessment result, and
- the appointment of an independent arbitrator to consider the various examiner's reports to make a recommendation regarding the assessment result.

e) The faculty board approves the final outcome of an examination after consideration of the recommendation of the relevant faculty committee or similar structure on the assessment result based on the outcome of the steps taken by the executive dean in accordance with Academic rule 4.11.8.4, and, if the faculty board is unable to resolve the matter, the executive dean must take a final decision.

ENG.1.2.1.17.1 Dispute resolution

a) A master's degree student who raises a substantive objection to the manner in which the examination of a research product was conducted, may declare, by means of a written notice lodged with the registrar within 14 days after communication to the student of the final decision regarding the assessment

outcome, a dispute with the university.

b) Within ten days of receiving the declaration of a dispute as contemplated in Academic rule 4.11.9.1, the registrar must obtain clarification from the executive dean whether the objection raised by the student is justified or not, cause remedial steps to be taken if necessary, and respond to the complainant accordingly.

c) If the complainant is not satisfied with the response of the registrar contemplated in Academic rule 4.11.9.2, the registrar must convene a panel consisting of at least two executive deans not previously involved in the matter to adjudicate the dispute within fourteen working days.

d) The findings of the panel established in accordance with Academic rule 4.11.9.3 may be that:

- the correct procedures were followed and that the dispute has no merit;
- the matter is referred back to the executive dean concerned to ensure that procedural shortcomings or errors that were found are corrected;
- the matter should be referred to an alternative dispute resolution process, or
- the matter be referred for arbitration.

e) If the complainant is not satisfied with the outcome or the panel finds that the matter should be dealt with by means of an alternative dispute resolution process in accordance with Academic rule 4.11.9.4.3 and the complainant agrees, the registrar must cause a panel of at least three persons expert in the field concerned or with wide experience in postgraduate examination to be appointed with the consent of the complainant to investigate the complaint and make recommendations for its resolution.

f) If the panel refers the matter for arbitration in accordance with Academic rule 4.11.9.4.4, the executive dean and the complainant must each, within three weeks, submit to the registrar the names and details of no more than three persons to be appointed as arbitrator or arbitration panel, all arbitrators being expert in the field concerned or with wide experience in postgraduate examination, and the complainant must agree in writing to bear or share the costs of the arbitration if such is the outcome as contemplated in Academic rule 4.11.9.8.

g) An arbitrator appointed in accordance with Academic rule 4.11.9.6 must be informed, or be prepared to become informed about the arbitration procedures contained in the latest edition of the Rules for the Conduct of Arbitrations of the Association of Arbitrators (Southern Africa) and to apply these rules for the purposes of settling the dispute.

h) The outcome of an arbitration process may include an award for specific performance, an interdict, damages, a fine, and a cost order, including costs regarding legal representation on an attorney-client scale or any other order the arbiter or arbitration panel considers to be appropriate in the circumstances.

ENG.1.2.1.17.2 Intellectual property in and publication of research products

a) The university (and faculty) is the owner of all intellectual property that may be created in the course of a master's degree study, which includes, but is not limited to intellectual property referred to in the Intellectual Property Rights from Publicly Financed Research and Development Act, 51 of 2008 and the regulations promulgated thereunder.

b) The university (and faculty) is entitled to physically or electronically multiply and distribute or make available any research product submitted in its final form by a master's degree candidate.

c) A master's degree graduate is required to undertake the publication of the results of the study within six months of conferral of the degree, but the university may,

if the graduate does not do so, undertake publication after notification of its intention to do so.

d) Publication by the university as contemplated in Academic rule 4.12.3 may be undertaken without the written permission of the graduate, but the name of the graduate concerned must be acknowledged as the first author, except where substantial processing of the text is undertaken by another person, or if the graduate expresses the wish in writing not so to be cited.

e) A master's degree student who is in terms of these rules required to, or otherwise wishes to submit a publication based on a research product of the study, must obtain the advice of the supervisor concerned regarding the scholarly quality of the research product, the selection of a suitable publication or publication medium, possible considerations of confidential classification, and the requirements and implications of Academic rules 4.12.7 and 4.12.8.

f) The supervisor concerned must record compliance with rule 4.12.5 in the report contemplated in Academic rule 1.15.4.

g) In a publication referred to in Academic rule 4.12.5 its foundation upon the master's degree study at the university (and faculty) must be acknowledged and the supervisor or supervisors must be cited.

ENG.1.2.2 Master's degrees

ENG.1.2.2.1 Manual for Master's and Doctoral Studies

Subject to the provisions of these rules, the Manual for Master's and Doctoral Studies, as approved and amended from time to time by the senate, regulates matters relating to the preparation for, progress, guidance, completion and termination of study towards a master's degree.

ENG.1.2.2.2 Purpose and structure of general and professional master's degrees

a) A master's degree is be aimed at educating and training researchers who can contribute to the development of knowledge at an advanced level.

b) Unless otherwise provided for in programme-specific requirements and statutory and professional body requirements, master's degrees consist of a total number of 180 credits.

c) The faculty may offer a master's degree in the form of –

- a research master's degree by dissertation with a minimum of 180 credits for research; and
- a master's degree by coursework and a dissertation with a minimum of 100 credits for research (currently only nuclear engineering).

ENG.1.2.2.3 Requirements for a master's degree

a) Subject to additional requirements that may be provided for in programme-specific requirements, the components of a general master's degree are –

- for a research master's degree by dissertation, a written dissertation or equivalent research product as provided for in Academic rules 4.2.3.1 and 4.4;
- for a master's degree by coursework and dissertation, coursework modules for which formative and summative assessments are required, and a dissertation or equivalent research product as provided for in Academic rules 4.2.3.2 and 4.4.

b) Programme-specific requirements may require a master's degree student to submit a research article to a journal to qualify for the award of the degree.
c) Where coursework modules are required in a master's degree programme, those modules must, subject to exceptions provided for in the specific quality manual of the faculty, be completed before the research component may be submitted for examination.

ENG.1.2.2.4 Supervision

a) A master's degree study must be registered within the academic scope of either a research entity or a school.
b) A student admitted to a master's degree programme works under the supervision of a supervisor appointed, subject to the approval of the faculty board, by the academic director concerned in terms stipulations in the applicable quality manual of the faculty.
c) To act as supervisor or co-supervisor of the research component of a master's degree, the supervisor and co-supervisor must at least be in possession of a master's degree in a cognate field of study.
d) A higher qualification than a master's degree may be required for the appointment of a supervisor or co-supervisor of a master's degree due to quality reasons determined and motivated by the research entity.
e) Notwithstanding the requirements determined by the faculty, the faculty board may in exceptional circumstances approve the appointment of a co-supervisor on the grounds of relevant technical expertise despite such a person not being in possession of a master's degree. Such applications will be motivated by the applicable research director, applicable research committee and recommended for approval by the executive dean.
f) A master's degree student may, before submitting a research product for examination, raise dissatisfaction with any aspect of the guidance provided by a supervisor or co- supervisors in writing to the executive dean, who must respond in writing to the student before the research product is submitted for examination.

ENG.1.2.2.5 Research proposal and title registration

a) The student must present a research proposal to a body determined by the faculty for approval, and a proposed title for registration not later than six months after the final date of registration as indicated by the annual University calendar in consultation with the supervisor (A Rule 4.9.1).
b) Every research proposal is subject to ethical clearance as provided for in the applicable quality manual of the faculty and relevant policies, and confirmation of ethics approval must be submitted to the relevant faculty committee.
c) If a student fails to present a research proposal as referred to above for approval in time, the study may, after due notification, be terminated by the faculty.
d) If a student failed to register a title as referred above, and there is valid reasons for not registering a title, the student may apply at the faculty board to reregister in the following academic year without a registered title on condition that the title must be registered within six months from the second registration.
e) The Faculty Board formalises the approval of all title registrations.

ENG.1.2.2.6 Examination

ENG.1.2.2.6.1 Appointment of examiners for the research component of a master's degree

a) The executive dean will appoint, with the approval of the relevant faculty committee concerned and in accordance with requirements set out in the applicable quality manual of the faculty, at least two examiners, of which at least one must be an external examiner, for the examination of the research product of every master's degree study.
b) The name of an examiner appointed in accordance with Academic rule 4.11.1.1 is not made known to the candidate before or during the examination, and after the examination only with the permission of the examiner concerned.
c) A person who was involved in any manner in the supervision of a master's degree student will not be appointed as an examiner.
d) Additional faculty requirements:
    - Two (2) uninvolved persons examiners, at least one (1) of which must be an external examiner;
    - There must not be any conflicting interests of persons;
    - Examiners who functioned as co-workers in the same project or article will not be appointed as examiners;
    - External examiners (if more than one is appointed) may not be attached to the same institution/department;
    - Examiners must have as minimum requirement a master's degree or equal qualification.
    - Recurrent usage of the same examiners should be avoided;
    - Persons who served as postgraduate student of a supervisor during the past 36 months will not be appointed as examiner for students of the same supervisor;
    - Extraordinary staff members are appointed as internal examiners;
    - Academics who were attached to the NWU and have since moved to a foreign university, may after a period of 36 months be appointed as external examiners.

ENG.1.2.2.6.2 Upgrade of master's degree study to doctoral study

a) The supervisor of a master's degree candidate may, with the concurrence of the candidate, submit a comprehensive motivation to the executive dean for the conversion of the study to a study for a general doctoral degree.
b) The executive dean will obtain the advice of an assessment panel consisting of at least one external disciplinary expert, the academic director concerned, and at least one full professor in the faculty concerned, before submitting
c) Approval of the conversion of a master's degree study to a doctoral study must be based on a significant change in the scope of the research project and its potential impact on knowledge production in the field of enquiry and can only be granted –
    - before the research product of the master's degree study is submitted for examination;
    - if the candidate has completed at least one year of registration for the master's degree;
    - if the intended study complies with all the rules and requirements of

these rules regarding a doctoral degree, and

- if the candidate registers for at least one additional year as a doctoral candidate.

d) Before any formal assessment of the research product of a study converted from master's to the doctoral level takes place, the candidate concerned may submit a written and motivated request to the executive dean to revert the study to the master's level.

e) Approval of a request contemplated in Academic rule 4.13.4 must be supported by the supervisor and the academic director concerned.

ENG.1.2.2.6.3 Attainment of the degree

ENG.1.2.2.6.3.1 Satisfaction of requirements

Taking into account Academic rules 1.3.3, 1.14, 1.17, 1.19.3 and 4.2, a master's degree is obtained when final verification and audit confirmation is given that a student has satisfied the requirements provided for in Academic rules 4.3 and 4.4.

ENG.1.2.2.8.8.2 Attainment of the qualification with distinction

a) A master's degree by research is awarded with a distinction where an average mark of 75% is obtained for a research product contemplated in Academic rule 4.4.

b) A master's degree by coursework is awarded with distinction where a weighted average of 75% is obtained for the coursework modules and the research component as prescribed in programme-specific requirements, and all coursework modules are passed on the first attempt.

ENG.1.2.3 Doctoral degrees

ENG.1.2.3.1 Manual for Master's and Doctoral Studies

Subject to the provisions of these rules, the Manual for Master's and Doctoral Studies, as approved and amended from time to time by the senate, regulates matters relating to the preparation for, progress, guidance, completion and termination of study towards a doctoral degree.

ENG.1.2.3.2 Purpose and structure of general and professional doctoral degrees

a) A doctoral degree is aimed at educating and training researchers who can contribute to the development of knowledge at the most advanced level.

b) Unless otherwise provided for in programme-specific requirements due to statutory and professional body requirements, doctoral degrees consist of a total number of 360 credits.

ENG.1.2.3.3 Completion requirements for a doctoral degree

Subject to additional requirements that may be provided for in programme-specific requirements, the sole component of a doctoral degree is a written thesis or equivalent research product, as provided for in Academic rule 5.4 with a minimum of 360 credits

ENG.1.2.3.4 Requirements for the research component of a doctoral degree

a) Subject to the exceptions provided for in Academic rules 5.4.2 and 5.4.3, the requirements for the research component of a doctoral degree are the successful submission and examination of a written thesis.
b) It may be required by the specific research entity in terms of quality specifications that full or partial compliance with the research component of a doctoral degree may take the form of one or more publishable or published research articles in a specified field, taking into account the requirements of Academic rules 5.10 and 5.12 and specifying the minimum number of research articles required in lieu of a thesis or the research component of a doctoral degree.

ENG.1.2.3.5 Supervision

a) A doctoral degree study must be registered within the academic scope of either a research entity or a school.
b) A candidate admitted to a doctoral degree programme works under the supervision of a promoter and co-promoter where applicable, appointed, subject to the approval of the faculty board, by the academic director concerned in terms of the stipulations in the applicable quality manual of the faculty.
c) To act as promoter or co-promoter of the research component of a doctoral degree, the promoter and co-promoter must be in possession of a doctoral degree in a cognate field of study.
d) A doctoral candidate may, before submitting a research product for examination, raise dissatisfaction with any aspect of the guidance provided by a promoter or co-promoter in writing to the executive dean, who must respond in writing to the candidate before the research product is submitted for examination.

ENG.1.2.3.6 Research proposal and title registration

a) The student must present a research proposal to a body determined by the faculty for approval, and a proposed title for registration not later than six months after the final date of registration in the first year of the academic programme as indicated by the annual University calendar in consultation with a possible promoter.
b) Every research proposal is subject to ethical clearance as provided for in the applicable quality manual of the faculty and relevant policies, and confirmation of ethics approval must be submitted to the relevant faculty committee.
c) If a student fails to present a research proposal as referred to above for approval in time, the study may, after due notification, be terminated by the faculty.
d) If a student failed to register a title as referred above, and there is valid reasons for not registering a title, the student may apply at the faculty board to reregister in the following academic year without a registered title on condition that the title must be registered within six months from the second registration.
e) The Faculty Board formalises the approval of all title registrations.

ENG.1.2.3.7 Examination

ENG.1.2.3.7.1 Appointment of examiners for the research component of a doctoral degree

a) The examiners of a thesis or any other research product are required to provide an assessment of the question whether the research contains proof that the candidate demonstrates insight into the field and has made a distinct and original scholarly

contribution to the knowledge base of the field, either by way of the pronouncement and dissemination of new facts or insights, or by means of the exercise of independent critical skills.

b) Every examiner submits a separate written report on the research product to the appropriate administrative component of the faculty, to be forwarded for processing and finalisation by the faculty committee concerned.

c) The promoter or co-promoter of a doctoral candidate does not communicate or negotiate with an examiner on any issues relating to the examination of the candidate's research product.

d) The relevant faculty committee or faculty structure responsible for the approval of the research component of doctoral degrees considers all examination reports relating to the research product of a doctoral degree study for recommendation to, and the final approval by the faculty board concerned, of the assessment outcome.

e) Subject to the provisions of Academic rule 5.11.8.3, the unanimous finding of the examiners that a doctoral candidate passes an examination is final.

f) The executive dean will appoint, with the approval of the relevant faculty committee concerned and in accordance with the applicable requirements set out in the applicable quality manual of the faculty, at least three examiners, of which at least two must be external examiners, for the examination of the research product of every doctoral degree study.

g) The name of an examiner appointed in accordance with Academic rule 5.11.1.1 is not made known to the candidate before or during the examination, and after the examination only with the permission of the examiner concerned.

h) A person who was involved in any manner in the supervision of a doctoral degree candidate may not be appointed as an examiner.

i) Additional faculty requirements:

- One (1) uninvolved person attached to the university will be appointed as internal examiner and (2) two external examiners, of which one must preferably be situated abroad or must be internationally accredited;
- There will not be any conflicting interests of persons;
- Examiners who functioned as co-workers in the same project or article will not be appointed as examiners;
- External examiners who are appointed may not be attached to the same institution/department;
- Examiners will have as minimum requirement a doctoral degree or equal qualification, and at least one examiner must have delivered students at the same qualification level before successfully;
- At least one examiner should have publications in the field within which the research has been completed;
- Recurrent usage of the same examiners will be avoided;
- Persons who served as postgraduate student of a supervisor during the past 36 months will not be appointed as examiner for students of the same promoter;
- Extraordinary staff members are appointed as internal examiners;
- Academics who were attached to the NWU and have since moved to a foreign university, may after a period of 36 months be appointed as external examiners.

ENG.1.2.3.8 Examination and moderation

Only the examination materials, and not any additional summative assessment components, will be submitted for external moderation. If, in a specific module, the assessment methods call for external moderation, it will then be published in its study guide.

ENG.1.2.3.9 Attainment of the degree

Taking into account rules 1.3.3, 1.14, 1.17, 1.19.3 and 5.2, a doctoral degree is obtained when final verification and audit confirmation is given that a candidate has satisfied the requirements provided for in rules 5.3 and 5.4.

ENG.1.3 WARNING AGAINST PLAGIARISM

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

ENG.1.3.1 Academic misconduct

Academic misconduct includes plagiarism and academic dishonesty (copying from others during examinations). Dishonest academic conduct is a serious transgression, regardless of whether it takes place orally, by conduct or in writing, during examinations or in the context of other forms of evaluation such as assignments, theses, reports and publications. It is the policy of the University that no form of academic dishonesty will be tolerated, and should any such action be reported or observed and the transgressor be found guilty, s/he will be punished in terms of the University's disciplinary policies, rules and procedures. Hence there are two overarching types of academic misconduct, namely:

ENG.1.3.2 Plagiarism [1]

[1] *The author acknowledges with gratitude the work of the UK Centre for legal education, Pauline Ridley, University of Brighton, and the University if Pretoria's Plagiarism Prevention Policy on the topic of academic plagiarism.*

Plagiarism is the word attributed to a specific type of academic dishonesty – the repeating of somebody else's words, or even the offering of somebody else's train of thought as if it were one's own. Traditionally plagiarism is defined as the taking of the words, images, ideas, etc. of an author and presenting them as if they were one's own. This may manifest itself in a variety of ways and is not limited to students' writings of published articles or books. The cutting and pasting of web pages in itself is regarded in higher education as plagiarism if the web pages are not properly acknowledged and quoted. Whatever the source of the material or the intended outcome, plagiarism is cheating and is therefore unacceptable.

What then if one copies large portions of work **AND** uses quotation marks with accurate references, and one also links one's own opinion to them? Can one regard it as one's "own" work? On the level of higher education, it is expected of you to develop your **own** voice and opinions and to build on other people's work, rather than to hide behind it. It would therefore be regarded as bad academic practice but not as plagiarism.

Make sure that you fully understand plagiarism and that you are familiar with the policies and regulations that relate to plagiarism. Plagiarism is a serious academic transgression, but you are on the right track if you are clear, careful and honest. Do not let a fear of plagiarism prevent you from fully utilising the rich resources that are available. Turnitin.com and Research Resources provide a checklist for preventing plagiarism.

Learn how to write in the style of your discipline. Your writing must be **YOUR** writing.

Learn to think critically and independently. Readers are interested in **your** understanding of an idea. Writing is a valuable exercise that tests your ability to explain a subject. It is an important part of learning.

Always give the necessary acknowledgement for every reference you use in your writing. Any ethically responsible writer **always** acknowledges the contributions of others and the source of his/her ideas.

Any verbatim text of another author that is used must be placed in quotation marks and quoted accurately.

When you paraphrase and/or summarise the work of others, reflect the exact meaning of the other author's ideas or facts in your own words and sentence structure.

Responsible authors have an ethical responsibility towards readers and the authors from whom they borrow to respect the ideas and words of others and to acknowledge those from whom they borrow – and where possible to use their own words when they paraphrase.

It is **NOT** an excuse that you had not **MEANT** to commit plagiarism, or had not **KNOWN** that you were doing it.

ENG.1.3.2.1 Punishment for transgressions, which is not limited to the two instances discussed above, may include one or a combination of the following:

- expulsion from the University, with or without notice to all or specific other higher education institutions and appropriate occupational or professional bodies;
- suspension from the University for a period of time, subject to conditions which are justifiable on educational grounds and acceptable within the institutional culture of the University;
- permanent expulsion from a residence, or refusal of access to all or some of the buildings, land or services of the University or admission only subject to specific conditions;
- suspension from attending classes for a specific period, either totally or only in respect of specific course units;
- refusal of admission to any examination or test occasion, which includes forfeiture of any marks already obtained and the cancellation of any subject or course unit;
- imposition of a fine, which may not exceed an amount equal to the fees payable by the student for the particular year;
- refusal of readmission to the University for a specific period or permanently, with or without notice to all or specific higher education institutions;
- disallowing of specific privileges as a student, with or without conditions that are justifiable on educational grounds and acceptable within the institutional culture of the University;
- imposition of any other penalty, combination of penalties or suspended penalty that, from the educational point of view and in accordance with the institutional culture of the University, is reasonable and fair in the circumstances; or
- a severe admonition and caution.

ENG.1.4 CAPACITY STIPULATION

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

ENG.1.5 SCHOOLS OF THE FACULTY

Postgraduate academic programmes are presented within the Faculty of Engineering's four Schools and one off-campus centre. The Schools are responsible for the undergraduate and postgraduate academic training of students.

The Centre for Research and Continued Engineering Development (CRCED) provides training for postgraduate students in Pretoria.

The master's structured programme modules are presented and managed by the Schools. CRCED Pretoria offers supervision for master's students in some of the disciplines offered by the Faculty. In the coordination and presentation of postgraduate training programmes, the Directors of the Schools are assisted by Postgraduate Programme Managers and by the Higher Degree Administrator.

SCHOOLS
School of Chemical and Minerals Engineering
School of Electrical, Electronic and Computer Engineering
School of Industrial Engineering
School of Mechanical Engineering
Centre of Research and Continued Engineering Development (Pretoria)

ENG.1.6 QUALIFICATIONS, PROGRAMMES AND CURRICULA

POSTGRADUATE DIPLOMA				
Qualification	**Qualification Code**	**Mode of delivery**	**Campus**	**NQF level**
Postgraduate Diploma in Nuclear Science and Technology	**7AB D01**	Contact Distance	PC	8

MASTER'S DEGREES (Structured)					
Qualification	**Specialisation**	**Qualification Code**	**Mode of delivery**	**Campus**	**NQF level**
Master of Engineering in Nuclear Engineering ***(MEng)***		**702 104 (I803P)**	Contact Distance	PC	9
Master of Sciences in Engineering Sciences ***(MSc)***	Nuclear Engineering	**203 200**	Contact Distance	PC	9

MASTER'S DEGREES (Research)					
Qualification	**Specialisation**	**Qualification Code**	**Mode of delivery**	**Campus**	**NQF level**
Master of Engineering in Chemical Engineering		**7CE N01**	Contact Distance	PC	9
Master of Engineering in Computer and Electronic Engineering		**7CD N01**	Contact Distance	PC	9
Master of Engineering in Electrical and Electronic Engineering		**7CC N01**	Contact Distance	PC	9
Master of Engineering in Industrial Engineering		**7CP N01**	Contact Distance	PC	9
Master of Engineering in Mechanical Engineering		**7CB N01**	Contact Distance	PC	9
Master of Engineering	Development and Management Engineering	**7CF N01**	Contact Distance	PC	9
Master of Science in Engineering Sciences with ***(MSc) Engineering Sciences***	Chemical Engineering	**7CM N02**	Contact Distance	PC	9
	Computer and Electronic Engineering	**7CM N04**	Contact Distance	PC	9
	Electrical and Electronic Engineering	**7CM N03**	Contact Distance	PC	9
	Mechanical Engineering	**7CM N01**	Contact Distance	PC	9

DOCTORAL DEGREES					
Qualification	**Specialisation**	**Qualification Code**	**Mode of delivery**	**Campus**	**NQF level**
Doctor of Philosophy in Engineering	Chemical Engineering	**7CA R01**	Contact Distance	PC	10
	Computer Engineering	**7CA R03**	Contact Distance	PC	10
	Computer and Electronic Engineering	**7CA R02**	Contact Distance	PC	10
	Development and Management Engineering	**7CA R04**	Contact Distance	PC	10
	Electrical Engineering	**7CA R06**	Contact Distance	PC	10
	Electronic Engineering	**7CA R07**	Contact Distance	PC	10
	Electrical and Electronic Engineering	**7CA R05**	Contact Distance	PC	10
	Industrial Engineering	**7CA R11**	Contact Distance	PC	10
	Mechanical Engineering	**7CA R09**	Contact Distance	PC	10
	Nuclear Engineering	**7CA R10**	Contact Distance	PC	10

ENG.1.7 PROGRAMME OUTCOMES

DOCTOR OF PHILOSOPHY (*PhD*)	MASTER OF ENGINEERING (*MEng*)	MASTER OF SCIENCE IN ENGINEERING SCIENCES (*MSc*)
The programme outcomes have been achieved if the student has made an original contribution to knowledge in the chosen field as evidenced by a thesis with proper structure, style, and language that includes: • Identification and formulation of an original engineering research problem; • Critically engage with existing knowledge to compile a comprehensive and relevant exposition thereof, which also reveals the originality of the envisaged contribution; • Develop and execute appropriate and advanced research procedures to solve research problem and verify solution; • Assess, validate and conclude research results and solutions; and • Communicate and defend the research problem, research process, research results and the originality of the contribution.	**The programme outcomes have been achieved if the student demonstrates competence in applying research methodology as evidenced by a dissertation with proper structure, style, and language that includes:** • Identify and formulate an engineering research problem; • Critically engage with existing knowledge to compile a relevant literature survey; • Develop and execute appropriate research procedures to solve research problem and verify solution; • Assess, validate and conclude research results and solutions; and • Communicate the research problem, research process and research results.	**The programme outcomes have been achieved if the student demonstrates competence in applying research methodology as evidenced by a dissertation with proper structure, style, and language that includes:** • Identify and formulate a research problem within the context of engineering science; • Critically engage with existing knowledge to compile a relevant literature survey; • Develop and execute appropriate research procedures to solve research problem and verify solution; • Assess, validate and conclude research results and solutions; and • Communicate the research problem, research process and research results.

ENG.1.8 PROGRAMME ASSESSMENT CRITERIA

DOCTOR OF PHILOSOPHY (*PhD*)	**MASTER OF ENGINEERING (*MEng*)**	**MASTER OF SCIENCE IN ENGINEERING SCIENCES (*MSc*)**
Question existing knowledge boundaries and practices in the field related to research problem. Formulate complex, unfamiliar problems in the field of Engineering. Deal with complexity, lacunae and contradictions in the knowledge base of the field of Engineering to identify and formulate an original research problem.	Identify knowledge boundaries and practices in the field related to research problem. Within this context, formulate a research problem in the field of Engineering.	Identify knowledge boundaries and practices in the field related to research problem. Within this context, formulate a research problem in the field of Engineering science.
Demonstrate in-depth and critical knowledge and high levels of theoretical understanding in a complex and specialised area within the field of Engineering and/or across specialised or applied areas and expand or redefine existing knowledge in the field of Engineering. Show mastery of the literature and state of research in area related to the research problem.	Demonstrate knowledge and theoretical understanding in a specialised area within the field of Engineering. Synthesize existing knowledge in the field of Engineering. Show mastery of the literature and state of research area related to the research problem.	Demonstrate knowledge and theoretical understanding in a specialised area within the field of Engineering and/or across specialised or applied areas and expand or redefine existing knowledge in the field of Engineering. Show mastery of the literature and state of research in area related to the research problem.
Use intellectual independence and advanced research skills through the ability to apply sophisticated knowledge and research methodologies towards solving the research problem and to verify the solution.	Use appropriate research skills to apply appropriate knowledge and research methodologies towards solving the research problem and to verify solution.	Use appropriate research skills to apply appropriate knowledge and research methodologies towards solving the research problem and to verify solution.

Execute autonomous independent judgements about information and concepts at highly abstract levels and make evaluations of research results on the basis of independently generated criteria and confirm that the proposed solution solves the research problem.	Execute judgements and make evaluations to confirm that the proposed solution solves the research problem. Apply theoretical insights and research findings beyond the context of research process.	Execute judgements and make evaluations to confirm that the proposed solution solves the research problem. Apply theoretical insights and research findings beyond the context of research process.
Compile an appropriately structured and coherent written thesis to communicate and defend the research problem, research process, research results and originality of the contribution and to demonstrate accomplishments of all other outcomes. This may be presented in traditional monograph format, or as a thesis based on a series of journal articles authored by the candidate. Disseminate some research results by means of academic journals and/or conferences.	Compile an appropriately structured and coherent written dissertation to communicate the research problem, research process and research results and to demonstrate accomplishment of all the other outcomes.	Compile an appropriately structured and coherent written dissertation to communicate the research problem, research process and research results and to demonstrate accomplishment of all the other outcomes.

ENG.2 THE POSTGRADUATE DIMPLOMA

ENG.2.1 RULES FOR THE POSTGRADUATE DIPLOMA

ENG.2.1.1 Duration (minimum and maximum duration)

The minimum term of study is **one (1) year** and the maximum term of study is **two (2) years**.

ENG.2.1.2 Admission requirements for the qualification

- Three-year BSc degree (with Mathematics or Physics, at least at second year level)
- BTech (Engineering)

Enquiries with regard to these curricula should be directed to the School of Mechanical and Nuclear Engineering at (018) 299 2645.

ENG.2.1.3 Method of presentation

The modules are presented by means of a distance-contact method. The e-learning platform e-Fundi, with an interactive site for each module, enables students to participate in well-structured self-study learning activities prior to attending the contact lecture session.

Six to eight weeks, of which one week is a contact session, are scheduled for each module. Students may not register for more than two modules being presented simultaneously, except if it is for the Nuclear Engineering Project.

All lectures of a specific module are presented during one week. The other weeks are used for self-study, assignments and assessment. During this period students have access to a facilitator who will provide support as required.

ENG.2.2 POSTGRADUATE DIPLOMA IN NUCLEAR SCIENCE AND TECHNOLOGY

ENG.2.2.1 Curriculum: I501P

Qualification code: 7AB D01

Delivery mode: Distance-contact

This programme provides learners with:

- a wider and deeper knowledge of nuclear science;
- advanced training in the field of nuclear science and technology;
- problem-solving ability;
- integration of knowledge across fields;
- the ability to execute a project in the field of nuclear science and technology.

ENG.2.2.1.1 List of modules

Module code	Descriptive name	Prerequisites	Credits
NUCI 511	Nuclear Engineering I	-	16
NUCI 521	Introduction to Thermal-Fluid Sciences	-	16
NUCI 571	Mathematics for Nuclear Engineers	-	16
NUCI 572	Nuclear Reactor Technology	-	16
NUCI 573	Nuclear Reactor Safety	-	16
NUCI 574	Nuclear Engineering Project	-	16
NUCI 575	Nuclear Physics	-	16
NUCI 576	Radiation and the Environment	-	16

* The School reserves the right not to offer certain modules during a certain year.

ENG.2.2.2 Curriculum outcomes

The Postgraduate Diploma in Nuclear Science and Technology pursues knowledge and innovation in the field of nuclear power generation and develops and empowers graduates to think laterally and critically in this field.

ENG.2.2.3 Compilation of curriculum

The curriculum comprises 4 core modules, 3 fundamental modules and a project report. Together, all of these 16 credit modules, as well as the 16 module report accumulates to the diploma's total of 128 credits.

One credit represents 10 notional study hours, which suggests that a student should expect to spend at least 1280 study hours on the programme.

Information regarding the course is available from the School of Mechanical and Nuclear Engineering, at (018) 299 2645.

Components	Composition	Credits
Project Report	Core (Compulsory)	16
4 x Modules	Core (Compulsory)	16 ea.
3 x Modules	Fundamental (Compulsory)	16 ea.
Total credits for the curriculum		**128**

ENG.3 THE DEGREE MASTER OF ENGINEERING

ENG.3.1 RULES FOR THE DEGREE MASTER OF ENGINEERING

ENG.3.1.1 Duration

The minimum **full-time** term of study is **one (1) year** and the maximum is **two (2) years**.

For **part-time** study the minimum term is **one (1) year** and the maximum term is **three (3) years**, calculated from the beginning of the first year of registration for the relevant programme.

ENG.3.1.2 Admission requirement for the qualification

The student holds an applicable four (4) year bachelor degree (*ECSA-accredited*) in engineering or an equivalent qualification.

Candidates must hold an applicable BSc Honours Degree or an applicable four year Bachelor's degree. The relevant research director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications exceeds the limited capacity to the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

The School Director may, with notification to the Higher Degrees Committee, request students who do not comply with the abovementioned requirements to be provisionally registered for the MEng-degree on the grounds of knowledge and experience gained through prior learning, pending the Recognition of Prior Learning outcome (to be concluded within 6 months). Refer to ENG 1.2.2 in this Calendar with regards to RPL. The RPL-process has to be followed for consideration of non-provisional registration.

Programme-specific assumptions are, where applicable, indicated at each programme description.

ENG.3.1.3 Composition of the programme

The master's degree programme allows for two options, in this case with specific reference to Nuclear Engineering. These options allow different combinations of coursework and/or research that are based on an engineering problem leading to a synthesized solution based on engineering methods and designs.

Research		**Structured (Nuclear)**	
Description	**Credits**	**Description**	**Credits**
Dissertation	180	Dissertation	100
		3 x compulsory modules	16 ea.
		2 x elective modules	16 ea.
Total	**180**	**Total**	**180**

**** Note:** At least three (3) of the five (5) 16-credit structured course modules must be engineering technology modules within the chosen curriculum.*

ENG.3.1.4 Outcomes and assessment criteria

The programme outcomes have been achieved if the student is able to demonstrate competence in applying research methodology as evidenced by a dissertation with proper structure, style and language.

ENG.3.1.5 Requirements for a dissertation

Regarding technical requirements, a dissertation must comply with all requirements and outcomes prescribed by the Faculty. Also refer to the Manual for Master's and Doctoral Studies and the applicable General Academic Rules in this regard.

For presenting a dissertation in the form of a published research article(s) or (an) unpublished manuscript(s) in article format, see Rules 4.4.1 – 4.4.3 and the Manual for Master's and Doctoral Studies (Section 6.9).

ENG.3.1.6 Faculty-specific requirements

The title of the dissertation, the research proposal and the appointment of external examiners must be reviewed by the Higher Degrees Committee. Additional information regarding rules and procedures are contained in the Faculty-specific rules, General Academic Rules 4.9, 4.10 and 4.11, and also in the Manual for Master's and Doctoral Study Sections 2.5 and 3.

In addition to attaining the abovementioned outcomes, students are also required to:

- Participate in **at least one** formal colloquia and/or technical conference where aspects of their work are presented to an audience of peers;
- have at least one full-length research paper on aspects of the thesis submitted for review in an accredited journal **OR** have two papers accepted in accredited peer reviewed conference proceedings on aspects of the thesis before results are finalised. (Rules 4.10.4, 4.10.5).

ENG.3.1.7 Articulation possibilities

Rule 4.13, together with the following Faculty Rules apply:

- After successful completion of the MEng programme, graduates who have performed adequately may be allowed to continue with a doctoral programme in the core module/programme in which the qualification has been awarded.
- Credit will be awarded to modules passed at other faculties or higher education institutions, with final approval from the Faculty Board, provided that the student fully complies with the outcome and total credit requirements for this qualification/programme.
- The expertise that the graduate acquires with this qualification in one of the engineering disciplines will empower him/her to continue with further learning and research in various other specialized fields and at a variety of institutions.

ENG.3.1.8 List of modules

Although the research and research modules are managed by the Unit for Energy and Technology Systems, the structured course modules are managed by the respective Schools. Curricula are listed under the Schools or Units in which they are presented for easy reference.

To graduate with a MEng in Engineering, the student has to accumulate a total number of 180 credits. Each credit represents a nominal of 10 hours of study. The student registers for structures course modules relevant to a specific curriculum that enables him/her to obtain the relevant qualification. The approved structured course modules for the master's degree curricula in the Faculty of Engineering, are listed below.

UNIT FOR ENERGY AND TECHNOLOGY SYSTEMS		
Module code	**Descriptive name**	**Credits**
CEMI 871	Dissertation	180
EERI 871	Dissertation	180
INGB 871	Dissertation	180
MEGI 871	Dissertation	180
IIOB 871	Dissertation	180
SCHOOL OF MECHANICAL AND NUCLEAR ENGINEERING		
Module code	**Descriptive name**	**Credits**
NCEP 820	Nuclear Energy Policy and Business	16
NUCI 621	Introduction to Thermal-Fluid Sciences	16
NUCI 671	Mathematics for Nuclear Engineers	16
NUCI 811	Nuclear Engineering I	16
NUCI 874	Advanced Reactor Analysis I	16
NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	16
NUCI 877	High Temperature Reactor Fuels and Materials	16
NUCI 878	High Temperature Reactor Technology	16
NUCI 879	Nuclear Project Management	16
NUCI 882	Light Water Reactor Thermal-Hydraulics	16
NUCI 883	Nuclear Engineering II	16
NUCI 886	Pebble Bed Reactor Design	16
NUCI 887	Reactor Analysis	16
NUCI 888	Reactor Safety	16
NUCI 889	Pressurized Water Reactor Technology	16

Note: CRCED Pretoria offers supervision in a variety of the available study area

ENG.3.1.9 Course modules from other MEng and/or other curricula

A student may register for any postgraduate structured course module in any School in the Faculty of Engineering or for any complementary modules offered by any other Faculty **but only** after consultation with the appropriate Programme Manager and the student's supervisor, provided that:

- more than 50% of structured course modules are within the relevant curriculum;
- the complimentary structured course modules, available only from other Master's in Engineering curricula, are relevant to the proposed research project, with prior approval from the study leader, on a NQF level 9, with the appropriate credits; and
- the supervisor provided written approval for the student to register for other structured course modules.

ENG.3.2 MENG IN CHEMICAL ENGINEERING

ENG.3.2.1 Curriculum: I801P

Qualification code: 7CE N01

Delivery mode: Distance/Contact

ENG.3.2.2 Admission requirements for the programme

Candidates must hold an applicable BSc Honours Degree in engineering disciplines, subject to a RPL process or an applicable four year Bachelor's degree, accredited by ECSA. The relevant Research Director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications exceeds the limited capacity to the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Programme-specific assumptions are, where applicable, indicated at each programme description.

Enquiries with regards to these curricula can be directed to the School of Chemical and Minerals Engineering at 018 299 1991

ENG.3.2.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
CEMI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.3.3 MENG IN COMPUTER AND ELECTRONIC ENGINEERING

ENG.3.3.1 Curriculum: I801P

Qualification code: 7CD N01

Delivery mode: Distance/Contact

ENG.3.3.2 Admission requirements for the programme

Candidates must hold an applicable BSc Honours Degree or an applicable four year Bachelor's degree. The relevant research director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Programme-specific assumptions are, where applicable, indicated at each programme description.

Enquiries with regards to these curricula can be directed to the School of Electrical, Electronic and Computer Engineering at 018 299 4058

ENG.3.3.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
EERI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.3.4 MENG IN ELECTRICAL AND ELECTRONIC ENGINEERING

ENG.3.4.1 Curriculum: I801P

Qualification code: 7CC N01

Delivery mode: Distance/Contact

ENG.3.4.2 Admission requirements for the programme

Candidates must hold an applicable BSc Honours Degree or an applicable four year Bachelor's degree. The relevant research director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Programme-specific assumptions are, where applicable, indicated at each programme description.

Enquiries with regards to these curricula can be directed to the School of Electrical, Electronic and Computer Engineering at 018 299 4058

ENG.3.4.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
EERI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.3.5 MENG IN INDUSTRIAL ENGINEERING

ENG.3.5.1 Curriculum: I801P

Qualification code: 7CP N01

Delivery mode: Distance/Contact

ENG.3.5.2 Admission requirements for the programme

Candidates must hold an applicable BSc Honours Degree or an applicable four year Bachelor's degree. The relevant research director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Programme-specific assumptions are, where applicable, indicated at each programme description.

Enquiries with regards to these curricula can be directed to the School of Industrial Engineering at 018 299 1524

ENG.3.5.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
INGB 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.3.6 MENG IN MECHANICAL ENGINEERING

ENG.3.6.1 Curriculum: I801P

Qualification code: 7CB N01

Delivery mode: Distance/Contact

ENG.3.6.2 Admission requirements for the programme

Candidates must hold an applicable BSc Honours Degree or an applicable four year Bachelor's degree. The relevant research director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Programme-specific assumptions are, where applicable, indicated at each programme description.

Enquiries with regards to these curricula can be directed to the School of Mechanical and Nuclear Engineering at 018 299 4496

ENG.3.6.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
MEGI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.3.7 MENG IN NUCLEAR ENGINEERING

ENG.3.7.1 Curriculum: I803P

Qualification code: 702 104

Delivery mode: Distance/Contact

ENG.3.7.2 Admission requirements for the programme

Candidates are required to hold either a) BSc degree with Mathematics, Applied Mathematics or Physics at NQF level 7 or a BTech degree in engineering (Mechanical, Electrical or Chemical) plus b) a BSc Honours degree in Physics or Mathematics or Postgraduate diploma in Nuclear Engineering with an average of 65%. The Research Director, in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to the qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Nuclear Engineering modules are presented in a focussed contact mode of delivery. Instruction is provided as a series of continuous contact sessions, followed by assignments and examinations. This requires students to attend lectures for a number of consecutive days as specified per module.

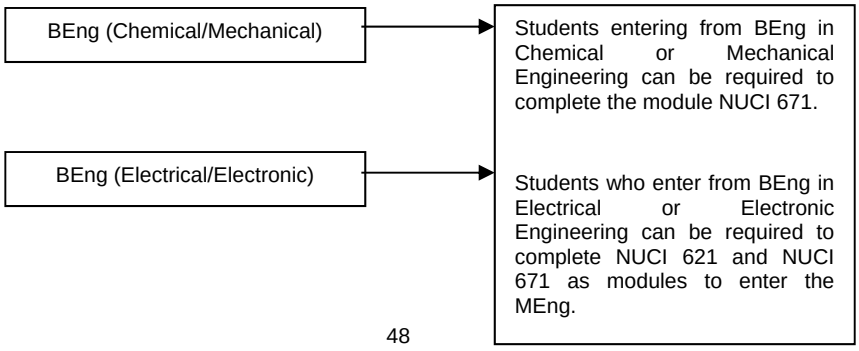
Enquiries with regards to these curricula can be directed to the School of Mechanical and Nuclear Engineering at 018 299 4496

ENG.3.7.3 Faculty-specific requirements

- Students holding either a **BEng** (***Mechanical***) or **BEng** (***Chemica*l**) degree are required to register for the bridging module Mathematics for Nuclear Engineers (**NUCI 671**).
- Students holding a **BEng** (***Electrical/Electronic***) are required to register for both the bridging modules Mathematics for Nuclear Engineers (**NUCI 671**) and Introduction to Thermal-Fluid Sciences (**NUCI 621**).

** The credits for the two bridging modules do not count towards the 180 credits for the master's degree.*

*** The required bridging modules are determined by discretion of the study leader.*



ENG.3.7.4 Composition of the programme

Module code	Descriptive name	Prerequisites	Cr
Core (Compulsory)			
NUCI 872	Dissertation	-	100
NUCI 811	Nuclear Engineering I	-	16
NUCI 883	Nuclear Engineering II	NUCI 811 NUCI 621* NUCI 671*	16
NUCI 887	Reactor Analysis	NUCI 883	16
Electives (Choose two – compulsory)			
NUCI 888	Reactor Safety	NUCI 883 NUCI 887	16
NUCI 889	Pressurized Water Reactor Technology	NUCI 883 NUCI 887	16
NUCI 874	Advanced Reactor Analysis I	NUCI 887	16
NUCI 878	High Temperature Reactor Technology	NUCI 883 NUCI 887	16
NUCI 879	Nuclear Project Management	-	16
Total credits for the curriculum			**180**

** The School reserves the right not to offer certain modules during a certain year.*

ENG.3.8 MENG WITH DEVELOPMENT AND MANAGEMENT ENGINEERING

ENG.3.8.1 Curriculum: I801P

Qualification code: 7CF N01

Delivery mode: Distance/Contact

ENG.3.8.2 Admission requirements for the programme

Candidates must hold an applicable BSc Honours Degree or an applicable four year Bachelor's degree. The relevant research director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Programme-specific assumptions are, where applicable, indicated at each programme description.

Enquiries with regards to these curricula can be directed to the School of Mechanical and Nuclear Engineering at 018 299 4496

ENG.3.8.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
IIOB 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.4 THE DEGREE MASTER OF SCIENCE IN ENGINEERING SCIENCES

ENG.4.1 RULES FOR THE MASTER OF SCIENCE IN ENGINEERING SCIENCES

ENG.4.1.1 Duration

The minimum **full-time** term of study is **one (1) year** and the maximum is **two (2) years.**

For **part-time** study the minimum term is **one (1) year** and the maximum term is **three (3) years**, calculated from the beginning of the first year of registration for the relevant programme.

ENG.4.1.2 Admission requirements for the qualification

The MSc-degree in Engineering Science may follow on a

- BSc (*Hons*) degree;
- applicable four (4) year bachelor degree (*ECSA-accredited*) in engineering or the student has been allowed to that status;
- another recognized qualification that allows the student to attain equivalent status and which has approved by the Higher Degrees Committee.

The School Director may, with notification to the Higher Degrees Committee, request students who do not comply with the abovementioned requirements to be provisionally registered for the MSc-degree on the grounds of knowledge and experience gained through prior learning, pending the Recognition of Prior Learning outcome (*to be concluded within 6 months*). Refer to ENG 1.2.2 in this Calendar with regards to RPL. The RPL-process has to be followed for consideration of non-provisional registration.

Programme-specific assumptions are, where applicable, indicated at each programme description.

ENG.4.1.3 Composition of the programme

The master's degree programme allows for two options, in this case with specific reference to Nuclear Engineering. These options allow different combinations of coursework and/or research that are based on an engineering problem leading to a synthesized solution based on engineering methods and designs.

The two options can be summarized as follows:

Research		**Structured (Nuclear)**	
Description	**Credits**	**Description**	**Credits**
Dissertation	180	Dissertation	100
		3x compulsory modules	16 ea.
		2x elective modules	16 ea.
Total	**180**	**Total**	**180**

**** Note:** At least three (3) of the five (5) 16-credit structured course modules must be engineering technology modules within the chosen curriculum.*

ENG.4.1.4 Requirements for a dissertation

Regarding technical requirements, a dissertation must comply with all requirements and outcomes prescribed by the Faculty. Also refer to the Manual for Master's and Doctoral Studies and the applicable General Academic Rules in this regard.

For presenting a dissertation in the form of a published research article(s) or (an) unpublished manuscript(s) in article format, see Rules 4.4.1 – 4.4.3 and the Manual for Master's and Doctoral Studies (Section 6.9).

ENG.4.1.5 Faculty-specific requirements

The title of the dissertation, the research proposal and the appointment of external must be reviewed by the Higher Degrees Committee. Additional information regarding rules and procedures are contained in the Faculty Rules, General Academic Rules 4.9, 4.10 and 4.11, and also in the Manual for Master's and Doctoral Study Sections 2.5 and 3.

In addition to attaining the abovementioned outcomes, students are also required to:

- Participate in at least one formal colloquia and/or technical conference where aspects of their work are presented to an audience of peers;
- Have submitted at least one full-length research paper on aspects of the dissertation for review/publication in an accredited scientific journal before being allowed to submit the dissertation for examination (A.4.10.4, 4.10.5). (Not applicable for Chemical or Mechanical Engineering.)

ENG.4.1.6 Articulation possibilities

- After the successful completion of the MSc programme, graduates who have performed adequately may be allowed to continue with a doctoral programme in the core module/programme in which the qualification has been awarded.
- Credit will be given for modules passed at other faculties or institutes of higher education, with final approval from the Faculty Management Committee, provided the outcome and total credit requirements for this qualification/programme have been fully complied with.

The expertise that the graduate acquires with this qualification in one of the engineering disciplines will empower him/her to continue with further learning and research in various other specialized fields at a variety of institutions.

ENG.4.1.7 List of modules

Although the research and research modules are managed by the Unit for Energy and Technology Systems, the structured course modules are managed by the respective Schools. Curricula are listed under the Schools or Units in which they are presented for easy reference.

Note: CRCED Pretoria offers supervision in a variety of the available study areas

The total number of credits needed to obtain an MSc in Engineering Sciences degree is 180 credits. Each credit represents a nominal of 10 hours of study. Students choose one curriculum with certain structured course modules to be completed in order to obtain the relevant degree. The structured course modules approved as part of the master's degree curricula in the Faculty of Engineering are listed below.

UNIT FOR ENERGY AND TECHNOLOGY SYSTEMS		
Module code	**Descriptive name**	**Credits**
CEMI 871	Dissertation	180
EERI 871	Dissertation	180
INGB 871	Dissertation	180
MEGI 871	Dissertation	180
IIOB 871	Dissertation	180
SCHOOL OF MECHANICAL AND NUCLEAR ENGINEERING		
Module code	**Descriptive name**	**Credits**
NUCI 621	Introduction to Thermal-Fluid Sciences	16
NUCI 671	Mathematics for Nuclear Engineers	16
NUCI 811	Nuclear Engineering I	16
NUCI 874	Advanced Reactor Analysis I	16
NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	16
NUCI 877	High Temperature Reactor Fuels and Materials	16
NUCI 878	High Temperature Reactor Technology	16
NUCI 879	Nuclear Project Management	16
NUCI 882	Light Water Reactor Thermal-Hydraulics	16
NUCI 883	Nuclear Engineering II	16
NUCI 886	Pebble Bed Reactor Design	16
NUCI 887	Reactor Analysis	16
NUCI 888	Reactor Safety	16
NUCI 889	Pressurized Water Reactor Technology	16

ENG.4.1.8 Course modules from other MSc and/or other curricula

A student may register for any postgraduate structured course module in any School in the Faculty of Engineering or for any complementary modules offered by any other Faculty but only after consultation with the appropriate Programme Manager and the student's supervisor, provided that:

- more than 50% of structured course modules are within the relevant curriculum;
- the complimentary structured course modules, available only from other Master's in Engineering curricula, are relevant to the proposed research project, with prior approval from the study leader, on a NQF level 9, with the appropriate credits; and
- the supervisor provided written approval for the student to register for other structured course modules.

ENG.4.2 MSC (ENGINEERING) WITH CHEMICAL ENGINEERING

ENG.4.2.1 Curriculum: I801P

Qualification code: 7CM N02

Delivery mode: Distance/Contact

ENG.4.2.2 Admission requirements for the programme

Candidates must hold an applicable BTech Degree in engineering disciplines, subject to a RPL process or an applicable four year Bachelor's degree, accredited by ECSA. The relevant Research Director in consultation with the School Director, may deny admission to the qualification if the standard of competence previously attained by the prospective student in the subject(s) in which he/she wishes to continue his/her studies does not conform to this qualification's requirements. In the instance where the number of applications have the potential to increase capacity constraints on the qualification, the applicants who, in the opinion of the Research Director in consultation with the School Director, have the best chance of success will be selected. The background and potential of students will also be taken into account during this selection process.

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Enquiries with regards to these curricula can be directed to the School of Chemical and Minerals Engineering at 018 299 1991.

ENG.4.2.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
CEMI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.4.3 MSC IN COMPUTER AND ELECTRONIC ENGINEERING

ENG.4.3.1 Curriculum: I801P

Qualification code: 7CM N04

Delivery mode: Distance/Contact

ENG.4.3.2 Admission requirements for the programme

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Enquiries with regard to these curricula can be directed to the School of Electrical, Electronic and Computer Engineering at 018 299 4058.

ENG.4.3.3 Composition of programme

Module code	Descriptive name	Cr
Compulsory		
EERI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.4.4 MSC (ENGINEERING) WITH ELECTRICAL AND ELECTRONIC ENGINEERING

ENG.4.4.1 Curriculum: I801P

Qualification code: 7CM N03

Delivery mode: Distance/Contact

ENG.4.4.2 Admission requirements for the programme

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Enquiries with regard to these curricula can be directed to the School of Electrical, Electronic and Computer Engineering at 018 299 4058.

ENG.4.4.3 Composition of the programme

Module code		Descriptive name	Cr
	Compulsory		
EERI 871		Dissertation	180
Total credits for the curriculum			**180**

ENG.4.5 MSC (ENGINEERING) WITH MECHANICAL ENGINEERING

ENG.4.5.1 Curriculum: I801P

Qualification code: 7CM N01

Delivery mode: Distance/Contact

ENG.4.5.2 Admission requirements for the programme

Refer to the qualification and Faculty-specific information in this Calendar for information regarding admission requirements.

Enquiries with regard to these curricula can be directed to the School of Mechanical and Nuclear Engineering at 018 299 1317.

ENG.4.5.3 Composition of the programme

Module code	Descriptive name	Cr
Compulsory		
MEGI 871	Dissertation	180
Total credits for the curriculum		**180**

ENG.4.6 MSC IN ENGINEERING SCIENCES WITH NUCLEAR ENGINEERING

ENG.4.6.1 Curriculum: I803P

Qualification code: 203 200

Delivery mode: Distance/Contact

ENG.4.6.2 Admission requirements for the programme

Refer to the qualification, Faculty-specific information, and admission requirements in this Calendar for more information regarding admission requirements.

- BSc degree with Mathematics, Applied Mathematics or Physics to at least third year level ***plus*** a BSc Honours degree in Physics or Mathematics; or
- BTech degree in Engineering (*Mechanical, Chemical or Electrical*) ***plus*** a BSc Honours degree in Physics or Mathematics; or
- Postgraduate Diploma in Nuclear Science and Technology, with an average of 65%.

Nuclear Engineering modules are presented in a focussed contact mode of delivery. Instruction is provided as a series of continuous contact sessions, followed by assignments and examinations. This requires students to attend lectures for a number of consecutive days as specified per module.

Enquiries with regards to these curricula can be directed to the School of Mechanical and Nuclear Engineering at 018 299 4496

ENG.4.6.3 Faculty-specific requirements

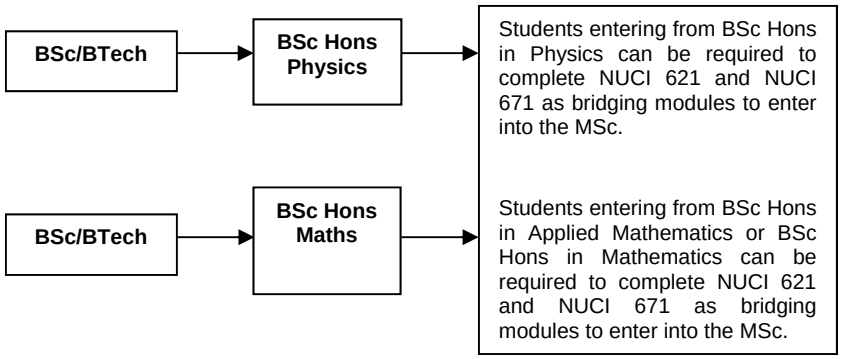
All MSc students must register for the two bridging modules, namely:

- **NUCI 621** – Introduction to Thermal-Fluid Sciences; and
- **NUCI 671** – Mathematics for Nuclear Engineers.

** This includes students entering via the Postgraduate Diploma route.*

*** The credits for the two bridging modules do not count towards the 180 credits for the master's degree.*

**** The required bridging modules are determined by discretion of the study leader.*



ENG.4.6.4 Composition of the programme

Module code	Descriptive name	Prerequisites	Cr
Core (Compulsory)			
NUCI 872	Dissertation	-	100
NUCI 811	Nuclear Engineering I	-	16
NUCI 883	Nuclear Engineering II	NUCI 811 NUCI 621* NUCI 671*	16
NUCI 887	Reactor Analysis	NUCI 883	16
Electives (Choose two – compulsory)			
NUCI 888	Reactor Safety	NUCI 883 NUCI 887	16
NUCI 889	Pressurized Water Reactor Technology	NUCI 883 NUCI 887	16
NUCI 874	Advanced Reactor Analysis I	NUCI 887	16
NUCI 878	High Temperature Reactor Technology	NUCI 883 NUCI 887	16
NUCI 879	Nuclear Project Management	-	16
Total credits for the curriculum			**180**

** The School reserves the right not to offer certain modules during a certain year.*

ENG.5 THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENGINEERING

ENG.5.1 RULES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENGINEERING

The purpose of this programme is to provide opportunity for original research by either uncovering new knowledge and/or by independent and critical analysis of existing information.

ENG.5.1.1 Duration

The minimum **full-time** term of study is **two (2) years** and the maximum is **four (4) years.**

For **part-time** study the minimum term is **two (2) years** and the maximum term is **six (6) years**, calculated from the beginning of the first year of registration for the relevant programme.

General Academic Rule 4.13 is applicable to students whose master's registration had been upgraded to doctoral registration.

ENG.5.1.2 Admission requirements for the qualification

- Master's degree in Engineering;
- MSc in Engineering Sciences; or
- Another recognized qualification that allows the student to attain equivalent status which is approved by the Faculty Higher Degrees Committee.

To gain admission to the PhD in Engineering, a student must hold a master's degree in the field of study in which the student intends to enrol. Alternatively, applicants must have the status of such a master's degree granted on request by the Senate, by attaining a level of competence which, in the opinion of Senate, on the recommendation of the Faculty, is adequate for the purposes of admission as a candidate for the degree. An applicant, for registration, must provide evidence of his/her attainments and education and complete such preliminary work as Senate may require, and must satisfy Senate as to the suitability of his/her subject.

An evaluation certificate as issued by the South African Qualifications Authority (SAQA) must be submitted if a previous qualification was obtained in a foreign country.

The School Director may, with notification to the Higher Degrees Committee, request students who do not comply with the abovementioned requirements to be provisionally registered for the PhD-degree on the grounds of knowledge and experience gained through prior learning, pending the Recognition of Prior Learning outcome (*to be concluded within 6 months).* Refer to ENG 1.2.2 in this Calendar with regards to RPL. The RPL-process has to be followed for consideration of non-provisional registration.

ENG.5.1.3 Faculty-specific requirements

The title of the thesis, the research proposal and the appointment of external examiners must be reviewed by the Higher Degrees Committee.

In addition to attaining the abovementioned outcomes, students are also required to:

- take part in at least two formal colloquia and/or technical conferences where aspects of their work are presented to an audience of established researchers and peers;

- have at least one full-length research paper on aspects of the thesis submitted for review in an accredited journal **OR** have two papers accepted in accredited peer reviewed conference proceedings on aspects of the thesis before results are finalised.

ENG.5.1.4 Requirements for a thesis

Regarding technical requirements, a dissertation must comply with all requirements and outcomes prescribed by the Faculty. Also refer to the Manual for Master's and Doctoral Studies and the applicable General Academic Rules in this regard.

For presenting a dissertation in the form of a published research article(s) or (an) unpublished manuscript(s) in article format, see Rules 5.4.1 – 5.4.3 and the Manual for Master's and Doctoral Studies (Section 6.9).

ENG.5.1.5 Outcomes and assessment criteria

The programme outcomes have been achieved if the student has made an original contribution to knowledge in a chosen field as evidenced by a thesis with proper structure, style and language.

ENG.5.1.6 Articulation possibilities

With the basic and applied expertise and the research skills that the graduate acquires with this qualification in one of the engineering disciplines, the graduate will be empowered, with further learning and research, to pursue other specialized fields at a variety of institutions, both nationally and internationally.

ENG.5.1.7 Doctoral Programmes

DOCTORAL				
Qualification	**Qualification and Qualification Code**	**Curriculum Code**	**Method of delivery**	**NQF level**
Doctor of Philosophy in Engineering (***PhD***)	Chemical Engineering	**7CA R01**	Full-time Part-time	10
	Computer Engineering	**7CA R03**	Full-time Part-time	10
	Computer and Electronic Engineering	**7CA R02**	Full-time Part-time	10
	Development and Management Engineering	**7CA R04**	Full-time Part-time	10
	Electrical Engineering	**7CA R06**	Full-time Part-time	10
	Electronic Engineering	**7CA R07**	Full-time Part-time	10
	Electrical and Electronic Engineering	**7CA R05**	Full-time Part-time	10
	Industrial Engineering	**7CA R11**	Full-time Part-time	10
	Mechanical Engineering	**7CA R09**	Full-time Part-time	10
	Nuclear Engineering	**7CA R10**	Full-time Part-time	10

** Note: CRCED Pretoria offers supervision in a variety of the above study areas. More information: (012) 809 0412/ 653.*

ENG.6 MODULE OUTCOMES

CEMI 875	NQF level: 9
Title: Fluid-Phase Equilibrium	
Module outcomes: After completion of this module, the student should be able to: • use statistical thermodynamics theory for the determination of thermodynamic characteristics of fluids; • establish the thermodynamic equilibrium by means of molecular modelling methods; and • use advanced thermodynamic theory for the development of separation processes such as membrane separation, supercritical extraction and relative distillation.	
Method of delivery: The module is presented as follows: • Approximately 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes; and • Approximately120 hours of self-study and preparation of assignments.	

CEMI 876	NQF level: 9
Title: Separation Processes	
Module outcomes: After completion of this module, the student should be able to: • select membrane processes for the separation of fluids as well as for water purification; • develop and model membrane- and membrane processes for mainly fluid separation; • develop and model thermodynamically for mainly petro-chemical substances, supercritical extraction processes; and • develop and model reactive distillation systems for low temperature reactions with homogenous and heterogeneous catalysts.	
Method of delivery: The module is presented as follows: • Approximately 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes; and • Approximately 120 hours of self-study and preparation of assignments.	

CEMI 877	NQF level: 9
Title: Coal Technology I	
Module outcomes: After completion of this module, the student should be able to: • use coal properties to determine conversion processes such as combustion, gasification and hydrogenation; • quantify the burning and gassing characteristics by means of experimental investigations; and • model fluidized bed combustion and gasification for design purposes.	

Method of delivery:
The module is presented as follows:

- Approximately 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes; and
- Approximately 120 hours of self-study and preparation of assignments.

CEMI 878	**NQF level: 9**

Title: Coal Technology II

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

- apply coal properties for benefaction on coal samples from various mines;
- evaluate economic aspects of coal benefaction;
- understand the most important South African coal reserves;
- compare and analyse the South African context of coal production in respect of international competition;
- describe, evaluate and calculate processes for various separation technologies of international importance; and
- undertake research on the relevant problems of coal mining, beneficiation and stockpiling.

Method of delivery:
The module is presented as follows:

- Approximately 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes; and
- Approximately 120 hours of self-study and preparation of assignments.

CEMI 879	**NQF level: 9**

Title: Bioreactors and Bioprocess Technology

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

- define biotechnology and the use of cell culture fermentation biotechnology to make useful products;
- understand the principles of bioprocess technology and be knowledgeable about features of various types of bioreactors, bioreactor design and oxygen mass transfer;
- describe the selection, preparation and operation of bioreactors and be able to do calculations relevant to bioreactors;
- describe the difference between various upstream and downstream processes during bioprocess;
- understand and be able to apply the principles of cell and enzyme immobilization and biotransformation;
- demonstrate the application of biotechnology in engineering with theoretical and practical aspects.

Method of delivery:
The module is presented as follows:

- Approximately 50 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes;
- Approximately 70 hours contact time with the lecturer in the form of assignments and formal workshops; and
- Approximately 40 hours in the form of practical laboratory sessions.

CEMI 881	NQF level: 9

Title: Bio-ethanol Process Technology

Module outcomes:

After completion of this module, the student should:

- have a working knowledge of the cultivation of crops for bio-ethanol production;
- have a working knowledge of the enzymes and yeasts used in the production of bio-ethanol;
- know and understand the different production routes for the production of bio-ethanol from a variety of biomass sources;
- have a good understanding of the unit operations involved in the production of bio-ethanol from biomass;
- have a working knowledge of the by-products from a bio-ethanol production plant;
- be able devise a production route for the production of bio-ethanol from different biomass sources;
- have a working knowledge of the standards applicable to bio-ethanol in South Africa;
- know and understand the legislation and strategies that govern bio-ethanol production in South Africa;
- understand the role bio-ethanol plays in South Africa's energy supply chain;
- be conversant with properties of bio-ethanol;
- be able to identify and appreciate barriers of market penetration of bio-ethanol in some developing countries.

Method of delivery:

The module is presented as follows:

- Approximately 30 hours contact time with the lecturer in the form of interactive lectures and discussion groups; and
- Approximately 130 hours of self-study.

CEMI 882	NQF level: 9

Title: STS and Renewable Energy

Module outcomes:

After completion of this module, the student should:

- understand and know the concepts pertaining to science, technology and society (STS) in context of renewable energy;
- be able to describe from an STS viewpoint the basic operation of traditional energy generation technologies;
- understand renewable and sustainable energy;
- evaluate different technologies with regard to renewability and sustainability;
- understand and appreciate the impact of biofuels production on the environment and the society;
- understand the balance between social need and technology developments;
- understand the socio-economic dynamics involved of biofuels production in rural communities in South Africa;
- understand and appreciate the issues surrounding biofuels production and food security.

Method of delivery:
This module is presented over 160 hours as follows:

- Approximately 8 hours contact time with the lecturer in types of formal lectures;
- Approximately 30 hours of contact time with the lecturer in a type of formal seminar, where primarily higher order intellectual reasoning skills and topical debates are presented;
- Approximately 72 hours of preparation and self-study for the seminars; and
- Approximately 50 hours for a community project and meetings.

CEMI 883	**NQF level: 9**

Title: Introduction to Renewable and Sustainable Energy

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

- have a working knowledge of wind energy;
- have a working knowledge of thermal solar energy;
- have a working knowledge of photovoltaic solar energy;
- have a working knowledge of hydro-energy;
- have a working knowledge of geothermal energy;
- have a working knowledge of fuel cells;
- have a working knowledge of energy storage systems;
- have a working knowledge of bio-ethanol processes;
- have a working knowledge of biodiesel processes;
- have a working knowledge of bio-butanol processes;
- know and understand the application field of renewable technologies.

Method of delivery:
This module is presented as follows:

- Approximately 20 hours contact time with the lecturer in the form of formal lectures;
- Approximately 15 hours of contact time with the lecturer in the form of formal workshops;
- Approximately 8 hours contact time with the lecturer in the form of a formal practical demonstration; and
- Approximately 117 hours of self-study and preparation of workshops and practical demonstration models.

CEMI 884	**NQF level: 9**

Title: Biodiesel Process Technology

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

- have a working knowledge of the cultivation of crops for biodiesel production;
- be able to devise and/or design an extraction process for the extraction of oil from various oil rich biomass sources;
- have a working knowledge of oil refining and polishing steps to prepare oils for the production of biodiesel;
- have a working knowledge of the different catalysts used in the esterification reaction;
- understand the basic steps in the production of biodiesel;
- have a working knowledge of the technologies available for recovery of the catalysts from the esterification reaction mixture;

- be able to devise a production route for the production of biodiesel from various feedstock's;
- be able to conduct an economic analysis for a biodiesel production scheme;
- have a working knowledge of the standards applicable to biodiesel in South Africa;
- know and understand the legislation and strategies that govern biodiesel production in South Africa;
- understand the role biodiesel plays in South Africa's energy supply chain;
- be conversant with the properties of biodiesel;
- be able to identify and appreciate barriers of market penetration of biodiesel fuels in some developing countries.

Method of delivery:
This module is presented as follows:

- Approximately 30 hours of contact time with the lecturer in the form of interactive lectures and discussion groups; and
- Approximately 130 hours of self-study and preparation of assignments.

EEII 881	**NQF level: 9**

Title: Data Mining and Knowledge Extraction

Module outcomes:
Motivation for the application of data mining and knowledge extraction, discussion of the typical application and purpose of techniques, requirements for the process of data collection and storing, pre-processing and improvement of data integrity, exploratory searches with regard to patterns in data, distinguishing between various behavioural patterns in data, extraction of rules and/or models which present underlying behaviour, classification of behavioural patterns, cause and effect analysis, prediction of future behaviour, practical examples, complex industrial processes, financial markets, logistics processes, communication networks, client behaviour as part of CRM, and the detection of fraud.

EEII 882	**NQF level: 9**

Title: Electrical Power Quality

Module outcomes:
Basis concepts, sources of harmonics and waveform distortion in a power system, effects and symptoms to utility and end-user, mathematical analysis of three-phase non-sinusoidal waveforms, penetration of harmonics in power systems, power theory, power definitions and PQ indices, computer simulations and case studies.

EEII 883	**NQF level: 9**

Title: Advanced Protection Systems

Module outcomes:
The module offers the student insight and exposure to the most important types of electrical protection systems, their design, application and behaviour. Basic fault calculations, instrument transformers, overcurrent and earth fault protection, motor, cable, transformer, overhead line and generator protection are focused on. Recent developments in SCADA and ICAP systems are also covered. Students get the opportunity during practical's to test their designs and set-point values on real machines with a variety of relays.

EEII 884	NQF level: 9
Title: Advanced Signal Processing	
Module outcomes: This module concentrates on digital signal processing methods. Signal processing methods can be classified into two groups, namely transform-oriented and other (e.g. heuristically oriented). The student is introduced to the digitizing process and accuracy of numerical algorithms. Concepts such as vector spaces and orthogonal decomposition of signals are taught, with specific focus on the frequency (Fourier) and time-frequency (wavelet) transforms. Image processing techniques for both the recognition of objects and image enhancement are taught. Fractals, solutions and chaos are discussed from a topological framework.	
EEII 885	**NQF level: 9**
Title: Information Systems for e-trade and e-logistics	
Module outcomes: The role of e-trade and e-logistics in the modern economy, supporting role of information systems in the operation of e-trade and e-logistics, functional requirements of information systems, automated data collection, transaction processing, store of data, making data available, processing and decision support, architecture of a typical information system for e-trade and e-logistics, international technology standards for information systems, e-trade markets and requirements for successful e-collaboration, interdependency between e-trade markets and logistic planning systems, support of the effectiveness of logistic operations with information systems, decision support and performance management based on business intelligence systems.	
EEII 886	**NQF level: 9**
Title: Information Security: Strategies and Techniques	
Module outcomes: This module presents the theoretical and practical aspects of information security, from basic principles, risk analysis, to management aspects. On successful completion of the module the student should: • be able to identify and apply the principles of information security; • understand and determine information risk; • be able to select appropriate technologies to secure information and understand their limitations; • be able to apply information security; and • know what to do in case of a security breach.	
EEII 887	**NQF level: 9**
Title: Kalman Filters	
Module outcomes: This module presents the theoretical aspects of random signal analysis and the minimum-mean-square-error filtering with emphasis on applications. On successful completion of the module the student should: • understand the concepts of probability and random variables; • be able to handle the mathematical description of random signals; • be able to calculate the response of linear systems to random inputs; • be able to apply Wiener filtering to stochastic data; and • be able to develop and apply discrete Kalman Filters.	

EEII 888	NQF level: 9

Title: Power System Dynamics

Module outcomes:

The module introduces students to the dynamic interaction that various power system elements have on each other during transition conditions. The dynamic interaction is described in both electrical and mechanical comparison terms. Specific attention is given to induction motors and synchronous machines and their control systems FACTS elements that can stabilize the power system are investigated and their interactions with other power systems are studied. During practical's, students are offered the opportunity to improve the transition stability of a generator with various control systems.

EEII 889	NQF level: 9

Title: Compensation of Distortion in Power Systems

Module outcomes:

Basic definitions and characteristics of power quality in power systems. Measurement of power quality phenomena. Analysis of power quality phenomena. Power quality improvement methods. Characteristics of power quality improvement equipment. Design of power quality improvement equipment. Evaluation of power quality improvement equipment. Specification of power quality improvement equipment.

EEII 891	NQF level: 9

Title: Advanced Electronic Development and Design

Module outcomes:

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

- perform an operational analysis of her/his specific system in order to define a system concept (preliminary development);
- perform a functional analysis at preliminary design level (advanced development);
- allocate requirements to a system or product (advanced development);
- perform a preliminary system synthesis and evaluation;
- draw up a development specification for her/his specific system or product; and
- draw up design guidelines and constraints (requirements) for detail design.

EEII 892	NQF level: 9

Title: Advanced Power Electronics

Module outcomes:

After completion of the module, the student should:

- be able to demonstrate knowledge and skills pertaining to a wide range of direct current to direct current converters, an be able to design such converters;
- have a sound knowledge of the concept of hard and soft switching of transistors;
- have a sound knowledge of the design of high frequency magnetic components such as transformers and inductors; and
- successful design and implementation of a converter.

EEII 893	NQF level: 9

Title: Advanced Electrical Machines

Module outcomes:

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

- derive and apply generalized machine comparisons to induction motors and synchronized machines;
- design, model and analyse electrical isolation systems of machines;
- design, model and analyse the magnetic circuits of machines;
- measure, calculate and analyse the factors influencing the performance of machines; and
- process and interpret the results of the various stat monitoring techniques.
-

EERI 877	NQF level: 9

Title: Digital Control Systems

Module outcomes:

Advanced control systems used in typical industrial environments. Aspects covered include time-discrete systems and the Z-transform, sample collection and reconstruction, multi-changing systems, open cycle and closed cycle stability, design of controller applications in multi-changing systems, condition changing formulations, minimizing of cost functions, optimal controllers, realizing of digital control systems, system simulation and modern control software.

ERIE 874	NQF level: 9

Title: Neural Networks

Module outcomes:

Neural networks find their inspiration in the structure of the human nervous system. Artificial neural networks have a unique advantage above traditional computer programmes in that they have the ability to learn from examples. This advantage makes neural networks suitable to solve various difficult problems. This module focuses on different types of neural networks, the ways in which they can be trained, as well as the application of neural networks on a variety of types of problems.

- *Training*: Data analysis and visualization, generalization capacity, optimizing, algorithms, error functions.
- *Topologies*: Memory, grouping algorithms and networks, linear networks, multi-layer progress networks, radial base function networks, neural networks with feedback, multi-network systems, fuzzy logic and neural networks.
- *Application*: Pattern recognizing, neural networks in control systems, neural networks and regression.

ERIE 875	NQF level: 9

Title: Fuzzy Logic Systems

Module outcomes:

Introduction to Fuzzy systems. Description and analysis of fuzzy logic systems. Training of fuzzy logic systems using back-propagation, orthogonal least squares and nearest neighbourhood clustering is discussed. Application of Fuzzy Logic Systems in system identification is an important component of the subject.

ERIE 876	NQF level: 9
Title: Process Modelling and Identification	
Module outcomes: The application of different approaches to process modelling and identification to industrial processes, such as the determination of models from basic physics, with emphasis on bond diagram techniques and fitting of model coefficients by using neural networks. The successful student should be able to write computer code to do modelling from a menu with components.	

EXPL 871	NQF level: 9
Title: Process Modelling and Identification	
Module outcomes: The application of different approaches to process modelling and identification to industrial processes, such as the determination of models from basic physics, with emphasis on bond diagram techniques and fitting of model coefficients by using neural networks. The successful student should be able to write computer code to do modelling from a menu with components.	

IIOB 881	NQF level: 9
Title: Project Management	
Module outcomes: After successful completion of the module the student should have knowledge and skills pertaining to the theory, concepts, processes, tools and techniques of project management. He/she will have applied it to a real life study project. The student should further have the capability and confidence to professionally manage projects in the work environment, and he/she should be proficient in the use of project management tools and techniques. Broadly arranged in terms of the following content: • Project management in perspective; • Project management theory; • Project management tools; • Human factors in project management; and • Risk management factors in project management.	

IIOB 882	NQF level: 9
Title: Maintenance Management	
Module outcomes: The objective of the module is to teach students the underlying theoretical knowledge and principles of maintenance management in its broadest sense and to equip them with practical know-how of applied maintenance management in industry, thus enabling them to function effectively in this environment. After successful completion of the module the student should have knowledge of: • Systems Engineering (SE) principles with emphasis on maintainability and reliability; • the role of maintenance and its management in the SE “bigger picture” with special reference to plant availability; • reliability engineering and general failure mechanisms;	

- Reliability Centred Maintenance (RCM) and its application in industry;
- maintenance theory and its application in today's high tech environment, including maintenance process re-engineering;
- Computerized Maintenance Management Systems (CMMS) and its application;
- maintenance information and how to maximize its use;
- maintenance life cycle costing and the cost of maintenance; and
- maintenance management theory at top academic level and knowledge of its application and management on plant and equipment level.

IIOB 883	**NQF level: 9**

Title: Corporate Career Skills

Module outcomes:

The objective of this module is to enhance and accelerate the engineering graduate's effectiveness and productivity in his employment situation in general, by equipping him with relevant and essential knowledge, skills and values, as these apply to the corporate industrial sector of the economy. After successful completion of the module the student should have knowledge of:

- the global situation and trends that will and should influence the behaviour of the industrial corporate now and into the future;
- the meaning and impact of the global economy;
- who the corporate stakeholders are, how they interact and how their interests are and should be balanced;
- how the corporate reports to its stakeholders;
- how it is held accountable by its stakeholders;
- the management structure of the industrial corporate, with associated levels of responsibilities and built-in checks and balances;
- the strategic process dictating the direction in which the industrial corporate develops;
- key performance areas that drive the success of the industrial corporate;
- key risks that may negatively influence the corporate well-being, e.g. HIV/AIDS;
- the operational processes that supports the above (budgets, marketing and sales, the supply chain, product development, human resources, environmental and social responsibilities, financial accounting and reporting);
- the legal environment within which the corporate operates (the tax system, HR development legislation, environmental and safety legislation, etc.);
- the physical and psychological impact that the work environment places on staff;
- how these should be managed to cope effectively as an individual and employee; and
- self-insight in how the student fits into all of the above – how to optimize your contribution to your employer, while at the same time developing your career and personal well-being.

IIOB 884	NQF level: 9

Title: Production Optimization Management

Module outcomes:

After successful completion of the production optimization management module the student should have demonstrated mastery of basic knowledge and skills pertaining to the theory, concepts, processes, tools and techniques of production optimization.

Special focus are given to the following methodologies:

- Lean manufacturing;
- Theory of Constraints; and
- Material Requirement Planning (MRP).

He/she will have applied the abovementioned to a case study.

IIOB 885	NQF level: 9

Title: Entrepreneurial Career Skills

Module outcomes:

After successful completion of the module the student should have knowledge of:

- the various legal persons that you can choose from when launching your entrepreneurial career and their attributes;
- the roles and services offered by various funding institutions and their associated cost structures;
- your responsibilities towards SARS, and how you should manage these;
- how to minimize your personal risks and protect your personal assets against business risks;
- how to manage the two most important business drivers: your marketing drive and your business cash flow; and
- the business power that cyberspace offers.

After successful completion of the module the student should be able (have the skills) to:

- pick the winning opportunities and assess their risks and sustainability characteristics;
- compile your own management accounts and financial statements and deal with other financial and taxation matters;
- manage a business through liquidation;
- manage yourself through sequestration and not lose the personal assets you built up during the good times;
- to start again and to manage the consequences of your previous business failure; and
- identify, design, capitalize, launch and manage a business.

After the successful completion of the module the student should understand an appreciate that:

- one should have a broader perspective of the joys and hardships of entrepreneurial life;
- one should appreciate that business failure does not mean personal failure; and
- one will have been coached to face a competitive, tough and unforgiving business world and make a success of your entrepreneurial career.

IIOB 886	NQF level: 9

Title: System Engineering

Module outcomes:

After successful completion of the module the student should have knowledge and skills pertaining to the theory, concepts, processes tools and techniques of systems engineering. He/she will have applied it to a real life study project. The student should further have the capability and confidence to use the systems engineering approach to solve problems in the work environment and he/she should be proficient in the use of systems engineering tools and techniques.

The module is broadly arranged in terms of the following content:

- Requirement formulation;
- System engineering;
- Software engineering;
- Integrated logistic support;
- Acquisition management; and
- System management.
-

IIOB 887	NQF level: 9

Title: Quality Management in Engineering Projects

Module outcomes:

The objective of the module is to provide an opportunity for graduate engineers to learn to work in a safety critical project environment with the capability and confidence to contribute appropriate quality management strategies in a multidisciplinary project team.

After completion of the module in project quality management the student should be able to demonstrate an understanding and knowledge of the main tenets of the subject in a written and/or verbal discourse in the company of professional peers.

The student should:

- demonstrate and understanding of quality as it applies to project management in the context of the quality cycle;
- be able to explain project quality management in the context of a safety critical project;
- be able to identify the applicable requirements of quality management for a specific safety critical project;
- be able to develop a quality management plan applicable to a safety critical project;
- be able to identify the required components of quality planning, quality assurance and quality control;
- demonstrate interpersonal skills as appropriate to project quality management; and
- be able to implement an appreciation of human factors of quality management in a safety critical project.

More specifically, as a summative assessment of learning, the learner should demonstrate skill in the application of the above aspects of project quality management by applying it to a relevant study project and presenting and defending this to a panel of professional peers.

MEGI 874	NQF level: 9

Title: Computational Fluid Mechanics I

Module outcomes:

This module presents the theoretical and practical aspects of the solution of flow problems encountered in engineering science using Computational Fluid Dynamics (CFD).

On successful completion of the module the student should:

- understand the capabilities and limitations of CFD;
- be able to generate various types of computational grids;
- be able to derive the conservation equations for flow problems and recognize the various formulations for the conservation equations and understand turbulence and the mechanisms which form the basis of various turbulence models;
- understand the various discretization techniques, formulate the finite difference discretization of the Poisson heat equation for various boundary conditions and obtain the numerical solution;
- be able to perform the finite volume discretization of a general conservation equation on an two-dimensional orthogonal grid, assemble the global coefficient matrix understanding the influence of the convective and diffusion terms and apply the boundary values on boundary control volume;
- understand staggered and collocated grids, velocity-pressure decoupling and the SIMPLE (R/C/N) algorithms for the Navier-Stokes equations; and
- be able to generate the computational grid, set up a problem and compute the solution using a commercial code.

MEGI 875	NQF level: 9

Title: Computational Fluid Mechanics II

Module outcomes:

The module presents the more advanced theoretical and practical aspects of the solution of flow problems encountered in engineering science using Computational Fluid Dynamics (CFD).

On successful completion of the module the student should:

- understand the advantages and disadvantages of CFD and its industrial applications;
- understand and apply grid transformations;
- be able to derive the various transient finite volume discretization, derive the transient coupled velocity-pressure algorithms (SIMPLE and PISO) for incompressible flow on non-orthogonal unstructured grids, understand the finite volume discretization for unstructured non-orthogonal 3D grids, understand higher-order spatial discretization and understand the effect of the various techniques on the convergence and accuracy of solutions;
- understand the theory underlying unbound solutions;
- be able to recognize various types of models for two-phase flow problems and understand the limitations of the various models; and
- understand the solution algorithms for compressible flow problems.

MEGI 876	NQF level: 9

Title: Finite Element Methods

Module outcomes:

This module presents the theoretical and practical aspects of the solution of second- and fourth-order differential equations encountered in engineering science using the finite element method.

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

- derive the weak formulation and obtain the Galerkin finite element formulation for one- and two-dimensional problems;
- discretize the computational domain, compute the contributions from the elements to assemble the global equations, apply the boundary conditions, solve the equations and post-process the results; and
- extend the method to solve systems of differential equations, non-linear problems and problems with various constraints.

MEGI 877	NQF level: 9

Title: Finite Element Methods for Flow

Module outcomes:

This module presents the theoretical and practical aspects of the solution of the Navier-Stokes equations using the finite element method. On successful completion of the module the student should be able to:

- derive the weak formulation and obtain the Galerkin finite element formulation for the Navier-Stokes equations in one and two dimensions;
- distinguish between and implement the fully coupled classical velocity-pressure and the penalty function approaches and employ Petrov-Galerkin upwinding;
- distinguish between and implement the segregated SIMPLE, SIMPLER and SIMPLEST algorithms; and
- extend the method to include non-isothermal flow problems.

MEGI 878	NQF level: 9

Title: Energy Management

Module outcomes:

Introduction to energy management, overview of energy audit process, energy accounts, economic analysis and life-cycle costs, lighting, refrigeration and air-conditioning, combustion processes and use of industrial waste, steam generation and distribution, control systems, maintenance, insulation, process energy management, alternative energy sources, water management.

MEGI 879	NQF level: 9

Title: Advanced Engineering Thermodynamics

Module outcomes:

- Energy and its use in open and closed systems;
- Exergy analysis of simple and complex systems;
- The time value of money; and
- The use of Exergy in thermo-economic analysis.

MEGI 884	NQF level: 9
Title: Advanced Strength of Materials	
Module outcomes: • *Linear tension and distortion*: Tension transformations, Mohr circle for tension and distortion, tension-distortion of isotropical and orthotropical materials; • *Non-elastic material behaviour*: Tension distortion behaviour (elastic and plastic), application of load-deflection relationships, failing criteria and safety aspects; • *Non-symmetric bending of straight flanges*: Maximum tensions, deflections and orientation of the neural axis under non-symmetrical burden, complete plastic burden under non-symmetrical bend; • *Tension concentrations*: Neuber nomogram, theoretical tension concentration factors (Shigley), sensitivity; • *Fatigue*: Design according to Goodman, Gerber and DE elliptical criteria; and • *Contact tensions*: Analysis of point and line contact tensions. •	

MEGI 889	NQF level: 9
Title: Materials Selection for Design	
Module outcomes: The design process, engineering and its properties, performance and selection indices, materials selection charts, material selection and selection strategies, materials selection – case studies, selection of material and shape, shape – case studies, multiple constraints and compound objectives, case studies: multiple constraints and compound objectives, materials processing and design, case studies: process selection, modern data sources, case-studies: use of data sources, ferrous alloys, non-ferrous alloys, polymers, ceramic composites, materials, aesthetics and industrial design.	

MEGI 894	NQF level: 9
Title: Composite Materials	
Module outcomes: • *Properties of composite materials*: Polymer matrix materials; • *Elastic properties of fibre reinforced composite materials*: Micromechanical models, laminate analysis, short fibre composites; and • *Strength of composite materials*: Tensile strength, fibre orientation and tensile properties, tensile properties of multi-layered laminates, compressive strength, shear strength, toughness and fatigue life.	

MGII 885 *(phases out 2018)*	NQF level: 9
Title: Thermal-Fluid Systems Modelling I	
Module outcomes: The aim of the module is to present the underlying principles and concepts on which thermal-fluid simulation and design software, such as Flownex, is based. In the process the student should also gain enhanced understanding of the practical implications of the fundamental theoretical principles. This is not a software-user module, but rather an extension and enrichment of the knowledge required to apply modelling and simulation in the design process. In this regard the student will be guided through the development of mathematical models and integrated cycle simulations with the aid of the generic Engineering Equation Solver (EES) software package.	

Students will be required to successfully complete several thermal-fluid modelling assignments.

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

- integrate comprehensive knowledge of thermodynamics, fluid mechanics and heat transfer with specialized techniques required to simulate thermal-fluid systems for both steady state and transient conditions; and
- apply higher level engineering synthesis skills and specialized software tools to create mathematical models with the appropriate degree of complexity that can be used in the simulation and design of thermal-fluid components and systems.

MGII 886 *(phases out 2018)*	**NQF level: 9**

Title: Thermal-Fluid Systems Modelling II

Module outcomes:

This module builds on the first module (MGII 885) in the series on thermal-fluid system simulation, which addresses the underlying principles and concepts on which simulation and design software are based. Having successfully completed the first module is therefore a pre-requisite to taking part in this one. Also, having applied it extensively in the first module, the student is expected to be quite proficient in the use of the generic Engineering Equation Solver (EES) software package as a simulation tool.

The focus of this module is on advanced concepts, processes and applications. In the process the student should also gain an enhanced understanding of the practical implications of the fundamental theoretical principles. In this regard the student is expected to develop quite advanced mathematical simulation models of thermal-fluid system components and associated processes.

This is not a software-user module, but rather an extension and enrichment of the knowledge required to apply modelling and simulation in the design process.

After the completion of this module the student must be able to:

- integrate fundamental knowledge of thermodynamics, fluid mechanics and heat transfer with specialized techniques required to simulate advanced thermal-fluid systems and processes; and
- apply higher level engineering synthesis skills and specialized software tools to create mathematical models with the appropriate degree of complexity that can be used in the simulation and design of thermal-fluid components and systems.

MGII 887	**NQF level: 9**

Title: Gas Turbine Theory and Performance

Module outcomes:

- *Axial compressors*: Fundamental concepts regarding axial compressors, general axial flow compressor design, axial compressor stage design principles, velocity triangles, thermodynamic design principles, off-design performance, surge and stall, blade design, mechanical integrity;
- *Axial turbines*: Fundamental concepts of axial flow turbines, thermodynamics of gas turbine process, turbine velocity triangles and turbine blade design; and

- *Combined gas turbine cycle*: Combining of compressor and turbine into a gas turbine cycle, compressor/turbine matching, simulation of gas turbine cycle, transient gas turbine cycle simulations.

NCEP 820	**NQF level: 9**

Title: Nuclear Energy and Business

Module outcomes:

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

- Knowledge and skill to analyse the financial and environmental outlook for the Global energy market, with a specific view to understanding the opportunities and challenges for the nuclear energy industry within this framework.
- Knowledge and skill to analyse the sustainability and energy security issues for nuclear and alternative energy sources, with a specific view to optimizing the energy resource mix in their countries with respect to sustainability and energy security.
- Knowledge and skill to analyse spent fuel and radioactive waste management processes, with a specific view to optimizing the energy resource mix and waste management practices in their countries in this respect.
- Knowledge and skill to analyse the environmental issues of nuclear and other energy sources, with a specific view to optimizing the energy resource mix in their countries with respect to the protection of the environment.
- Knowledge and understanding of the fundamentals of the effect of radiation on the environment; the process of establishing a nuclear emergency plan and an environmental impact assessment in the South African environment.
- Knowledge and understanding of the fundamentals of the costs involved in the life cycle of nuclear energy.
- Knowledge and understanding of the fundamentals of the international financing concepts and models
- Knowledge and understanding of the fundamentals of the contracting concepts and models of Nuclear Power Plants
- Knowledge and understanding of the fundamentals of the localisation strategies and processes in South Africa

NUCI 511	**NQF level: 8**

Title: Nuclear Engineering I

Module outcomes:

Students are provided with a broad overview of nuclear power systems to provide them with the basic knowledge they need to function in the nuclear reactor industry. The student should be able to demonstrate an understanding of and the ability to apply and evaluate key terms, concepts, facts, principles, rule and theories of the nuclear field. The student should also have detailed knowledge of the specialization area and how that knowledge relates to other fields. The student's problem solving skills should include the ability to identify, analyse, evaluate, critically reflect on and address complex problems. Therefore, the following topics in nuclear engineering are covered:

The history of nuclear engineering, basics of atomic and nuclear physics for engineers, interaction of neutrons and nuclear radiation with matter, basic types of nuclear power plants, neutron diffusion and moderation, nuclear reactor theory, time dependent behaviour and effects and heat generation in nuclear cores.

NUCI 521	NQF level: 8

Title: Introduction to Thermal-Fluid Sciences

Module outcomes:

- *Thermodynamics*: Properties of pure substances, work and heat, First Law of Thermodynamics, Second Law of Thermodynamics, power cycles;
- *Fluid mechanics*: Fluid statics, flow analysis, conservation laws for control volumes, differential forms of basic laws, dimensional analysis, incompressible viscous flow through pipes, one-dimensional compressible flow;
- *Turbo machinery*: Basic laws, compressors, turbines; and
- *Heat transfer*: Conduction, convection and radiation heat transfer, heat exchangers.

NUCI 571	NQF level: 8

Title: Mathematics for Nuclear Engineers

Module outcomes:

On the completion of this module the student should be able to solve mathematical problems related to nuclear engineering. With this knowledge he/she should be able to:

- use different methods to solve partial and differential equations analytically;
- study special functions and their application in solving differential equations;
- use this basic knowledge to solve more complex problems; and
- use the methods learnt here in other nuclear engineering modules.

NUCI 572	NQF level: 8

Title: Nuclear Reactor Technology

Module outcomes:

The purpose of this module is to introduce students from a non-engineering discipline (BSc or BTech) to nuclear power reactor technology. The module gives a broad overview of the different types of nuclear power reactors, LWR (PWR and BWR), HWR and GCR (AGR and HTR). The module also covers the main technological elements of each type of reactor (fuel elements and core, main components, etc.). Aspects of reactor operation, reactor control and stability are covered, including elementary concepts of reactor fuel and core design, core loading, spent fuel and radioactive waste management.

NUCI 573	NQF level: 8

Title: Nuclear Reactor Safety

Module outcomes:

The main purpose of this module is to impart to the student sound knowledge, training and skills in nuclear reactor safety. The main objective is to familiarize the student with the essential principles of nuclear power plant safety, reactor siting, reactor licensing and radiation doses from nuclear power plants, reactor accidents and accident risk analysis, as well as environmental radiation protection requirements. The main areas of nuclear reactor safety cover multiple reactor design to prevent the escape of radioactivity into the environment. This involves the safe design of the fuel, cladding material, the closed coolant system, the reactor vessel and the containment. Reactor control and reactor emergency shutdown systems are presented in the module. The three levels of safety, including suitable site location and essential evacuation procedures in case of an accident, are all an integral part of the module.

NUCI 574	NQF level: 8

Title: Nuclear Engineering Project

Module outcomes:
Learners are required demonstrate their ability to execute a project in the field of nuclear engineering independently by publishing a concise scientific report on it.

NUCI 575	NQF level: 8

Title: Nuclear Physics

Module outcomes:
Learners are introduced to the principles of radioactivity and the interaction of different types of radiation with matter.

The content of the module includes:

- Properties of the nucleus;
- Basic features of radioactivity and the radioactive decay process;
- The radiations emitted by radioactive substances and their interaction with matter;
- Comparison of atomic decays; and
- Nuclear reactions.

NUCI 576	NQF level: 8

Title: Radiation and the Environment

Module outcomes:
Learners should develop a sound understanding of the characteristics of ionizing radiation and radio-nuclides, interactions of radiation with matter, biological effects, protection of persons and the environments against harmful effects of radiation and detection and measurement of radiation. The module provides the student with baseline knowledge of the use of radiation and radio-nuclides in various branches of science, technology and medicine, with special emphasis on the monitoring of the environmental pollution on nuclear techniques.

The content includes:

- Characteristics of ionizing radiation;
- Properties of radio-nuclides and other sources of radiation;
- Basic processes involved in interactions of radiation with matter;
- Main radiation quantities and units;
- Physical, chemical and biological effects of radiation;
- Protection of people and the environment against harmful effects of radiation;
- Radiation detection; measurement and spectrometry;
- Monitoring of environmental radioactivity;
- Applications of radiation and radio-nuclides in science, industry and medicine; and
- The use of nuclear techniques in assessing various pollutants in the environment.

NUCI 621	NQF level: 8

Title: Introduction to Thermal-Fluid Sciences

Module outcomes:

On the completion of this module the student should be able to:

- demonstrate a thorough understanding of thermodynamics, fluid mechanics, heat transfer and turbo machines by analysing and solving simple and complex industry related problems;
- demonstrate an understanding of how the different constituent parts of an integrated system interact and influence each other by describing the interaction and calculating the effect of changing certain variables; and
- evaluate the performance of simple and complex systems and propose actions to improve their performance.

NUCI 671	NQF level: 8

Title: Mathematics for Nuclear Engineers

Module outcomes:

On completion of this module the student should be able to solve mathematical problems related to nuclear engineering. With this knowledge they should be able to:

- use different methods to solve partial and differential equations analytically;
- solve partial and differential equations numerically;
- study special functions and their application in solving differential equations;
- use this basic knowledge to solve more complex problems;
- use the methods learnt here in other nuclear engineering modules.

NUCI 811	NQF level: 9

Title: Nuclear Engineering I

Module outcomes:

The module provides students with a broad overview of nuclear engineering to provide them with the basic knowledge they need to function in the nuclear reactor industry. The student should be able to demonstrate specialist knowledge to enable engagement with criticism of current nuclear research and nuclear practices. The student's problem solving skill should be developed to demonstrate the ability to use a wide range of specialist skills in identifying, conceptualizing, designing and implementing methods to address complex practical and theoretical nuclear problems. The student should also demonstrate an understanding of the consequences of any nuclear solution.

Therefore, the following topics in nuclear engineering are covered:

- The history of nuclear engineering;
- Basics of anatomic and nuclear physics for engineers;
- Interaction of neutrons and nuclear radiation with matter;
- Basic types of nuclear power plants, neutron diffusion and moderation;
- Nuclear reactor theory;
- Time dependent behaviour and effects;
- Heat generation in nuclear cores;
- Radiation protection;
- Radiation shielding; and
- Reactor safety and licencing.

NUCI 874	NQF level: 9
Title: Advanced Reactor Analysis I	
Module outcomes: The following topics in nuclear engineering are covered: • Neutron transport theory (Sn, Pn derivation); • Neutron diffusion theory (FD, codes); • Neutron energy distribution; • Neutron thermalization; • Reactivity changes (bum up, point kinetics); and • Introduction to Monte Carlo methods (basic equations, approaches, cross-sections, statistics).	

NUCI 876 *(phases out 2018)*	NQF level: 9
Title: High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	
Module outcomes: Upon completion of this module, students should possess a comprehensive and systematic knowledge base and skills in the following: • Physical properties of fluids and solid materials used in HTR's; • Pressure drop relationships for flow through a pebble bed reactor; • Heat generation in HTR's; • Heat transfer mechanisms in pebble be HTR's; • Conservation equations governing heat transfer and fluid flow in HTR's; • Numerical solution techniques of the governing equations; and • HTR design bases.	

NUCI 877 *(phases out 2018)*	NQF level: 9
Title: High Temperature Reactor Fuels and Materials	
Module outcomes: On completion of this module, the students are expected to: • Understand the reasoning for selecting proper materials for HTR's; • Demonstrate knowledge of basic steps of design and fabrication of high temperature reactor fuel; • Calculate main operational parameters such as fuel temperature, burn-up, CO production, etc.; • Discuss main problems and ways of improvements for HTR fuel and structural materials; and • Relate reactor physics, thermal hydraulics and reactor design aspects with reactor fuel and materials.	

NUCI 878	NQF level: 9
Title: High Temperature Reactor Technology	
Module outcomes: On completion of this module, the student will have obtained a basic knowledge in the field of HTR technology, safety aspects and applications of HTR. The students receive additional information on different processes of electricity production and several of the future important processes of nuclear heat application and on estimation of production costs. The student should be able to analyse physical, technical and safety relevant questions, not only valid for HTR-plants, but for other concepts too.	

NUCI 879	NQF level: 9
Title: Nuclear Project Management	
Module outcomes: After successful completion of the Nuclear Project Management (NPM) module the student should demonstrate mastery of basic knowledge and skills pertaining to the theory, concepts, processes, tools and techniques of project management. He/she will have applied it to a typical nuclear industry project.	

NUCI 882 *(phases out 2018)*	NQF level: 9
Title: Light Water Reactor Thermal-Hydraulics	
Module outcomes: LWR Thermal-Hydraulics examines detailed thermal hydraulic analysis with an emphasis on those TH phenomena important to Light Water Reactor (LWR) design and operation. Specifically, analysis of the transport equations for single and two-phase flow is presented with an added emphasis on two-phase flow dynamics and heat transfer. Analysis methods for LWR power stations are introduced via the formulation of reactor thermal hydraulic design problems. Particularly, steady state and transient analysis of single, heated channels are covered.	

NUCI 883	NQF level: 9
Title: Nuclear Engineering II	
Module outcomes: On completion of this module, the student will have obtained the basic knowledge in understanding how nuclear power plants are designed and operated. With the knowledge the student have obtained from the module, he/she should be able to solve basic thermal-hydraulic problems related to nuclear reactor engineering and communicate with the engineering community about these problems. The student's knowledge in the thermal-hydraulic analysis of nuclear reactors, as well as knowledge of nuclear fuel and reactor operations, will enable him/her to work in the nuclear industry.	

NUCI 886 *(phases out 2018)*	NQF level: 9
Title: Pebble Bed Reactor Design	
Module outcomes: Upon completion of this module, learners should possess a comprehensive and systematic knowledge base and skills in the following: • Understanding the difference between typical reactors and pebble bed reactors. Special attention shall be given to: • The fuel design; • Reactor design; and • The reactor operation. The various physical characteristics encountered inside the reactor and how it is simulated by calculation are explained. These properties include aspects of: • Neutron moderation; • Double heterogeneity; • Spectrum calculations; • Flux distribution;	

- Power generation;
- Bum-up characteristics;
- Pebble movement in the reactor under gravity;
- Temperature feedback;
- Decay heat production; and
- How the characteristics mentioned above and combinations thereof are simulated by the VSOP-A suite of codes.

Learners should also be able to independently perform simulations of the design baselines for HTR's using existing codes and interpret the results.

NUCI 887	**NQF level: 9**

Title: Reactor Analysis

Module outcomes:

Upon successful completion of the module, the student should have acquired basic knowledge of nuclear reactor analysis, which includes the following topics:

- Physics of neutron-nuclear interactions and fission chain reaction;
- Neutron transport model and diffusion theory;
- Neutron energy distribution, including slowing down, resonance absorption and group energy method;
- Nuclear reactor dynamics; and
- Fuel burn-up.

This level of knowledge would enable the student to understand physical principles and apply computational methods for reactor design and analysis such as the calculation of neutron flux distribution in space and energy for simple homogenous geometrics and heterogeneous lattices.

NUCI 888	**NQF level: 9**

Title: Reactor Safety

Module outcomes:

On completion of this module the student should have developed a basic knowledge in the field of reactor safety. With this knowledge he/she should be able to:

- understand accidental situations and the student should have learned the necessary methods to evaluate them;
- the student should be able to communicate with the engineering community about these problems;
- the student should furthermore be able to carry out estimations for important accidents in nuclear plants;
- use the basic knowledge to go deeper and to use complex programmes for safety analysis; and
- use the knowledge to work in the nuclear industry or in safety organizations for supervision of nuclear power plants.

The methods used in nuclear safety analysis are helpful in other fields of technology.

NUCI 889	NQF level: 9
Title: Pressurized Water Reactor Technology	
Module outcomes: On completion of this module the student should: • have basic knowledge to understand how Pressurized Water Reactors (PWR's) are designed and operated; • understand the functions of various PWR systems; • understand how improvements have made this form of power plant the choice for the advanced PWR's now being ordered; • have knowledge of the PWR systems that will help foster an understanding of the various design requirements; and • understand how the various systems interact to provide a reliable and safe source of electricity.	