

CALENDAR 2012

FACULTY OF ENGINEERING
POST-GRADUATE

Potchefstroom Campus

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PLEASE MENTION YOUR UNIVERSITY NUMBER IN ALL CORRESPONDENCE.

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

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

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Manager: Prof. E.H. Mathews, Pr.Eng., Ph.D. (PU for CHE)

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Chairperson of the Engineering Students Society

* *CRCED: Centre for Research and Continued Engineering Development*

The above is a list of current board members as at January 2012

I.1 RULES OF THE FACULTY OF ENGINEERING

I.1.1 AUTHORITY OF THE GENERAL RULES

The Faculty rules must be read in conjunction with the General Academic Rules of the University. The General **A-RULES** can be found on the university's web site at <http://www.nwu.ac.za>, or alternatively the Academic Administration department of the university can be consulted.

Further guidelines and rules regarding post-graduate study are given in the **MANUAL FOR POST-GRADUATE STUDIES**. All students are required to consult this manual in detail. A version of this Manual for Post-graduate Studies is available on the university's web site (<http://www.nwu.ac.za>).

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

I.1.2 WARNING AGAINST PLAGIARISM

Assignments are individual tasks and not group activities (unless explicitly indicated as group activities). For further details see:

http://www.puk.ac.za/beheer-bestuur/beleid-reels/index_e.html

I.1.3 SCHOOLS, CENTRES AND RESEARCH

I.1.3.1 Academic Training

Post-graduate academic programmes are presented within the Faculty of Engineering's four schools and two off-campus centres. The schools are responsible for undergraduate and post-graduate academic training of students. Different programmes and programme leaders exist in each school. The schools are:

- School of Chemical and Minerals Engineering
- School of Electrical, Electronic and Computer Engineering
- School of Mechanical and Nuclear Engineering

Two Centres for Research and Continued Engineering Development (CRCED's) exist off-campus to cater for needs of post-graduate students mainly in the Vaal Triangle and Gauteng areas.

- CRCED Vaal Triangle
- CRCED Pretoria

The Masters' course modules are presented and managed by the four schools and CRCED Vaal Triangle. CRCED Pretoria offers supervision for Masters' students in some of the disciplines offered by the Faculty. In the coordination and presentation of post-graduate training programmes, the Directors of the Schools are assisted by Post-graduate Programme Managers and by the Post-graduate Administrative Manager.

I.1.3.2**Research**

Research in the Faculty is managed in the following entities:

ENTITY	Subgroup
UNIT FOR ENERGY SYSTEMS	Nuclear Energy
	Hydrogen Energy
	Fossil Energy
	Renewable Energy
	Energy Management
GROUPS:	Materials and Manufacturing
	Engineering Management and Education
	Information and Communication
	Innovation Management

Note: Any queries regarding research opportunities within different subgroups can be directed to the Research Administrative Officer - (018) 299 4078.

I.1.4 QUALIFICATIONS AND CURRICULA

I.1.4.1 Qualifications

The following qualifications are offered by the Faculty:

Qualification	Curriculum
Diploma	Post-graduate Diploma in Nuclear Science and Technology
Master of Engineering (M.Eng.)	M.Eng. in Chemical Engineering
	M.Eng. in Computer and Electronic Engineering
	M.Eng. in Electrical and Electronic Engineering
	M.Eng. in Mechanical Engineering
	M.Eng. in Nuclear Engineering
	M.Eng. in Development and Management
Master of Science in Engineering Sciences (M.Sc.)	M.Sc. in Engineering Sciences (Chemical Engineering)
	M.Sc. in Engineering Sciences (Computer and Electronic Eng.)
	M.Sc. in Engineering Sciences (Electrical and Electronic Eng.)
	M.Sc. in Engineering Sciences (Mechanical Engineering)
	M.Sc. in Engineering Sciences (Nuclear Engineering)
Philosophiae Doctor (Ph.D.)	Ph.D. in Chemical Engineering
	Ph.D. in Computer Engineering
	Ph.D. in Computer and Electronic Engineering
	Ph.D. in Electrical Engineering
	Ph.D. in Electronic Engineering
	Ph.D. in Electrical and Electronic Engineering
	Ph.D. in Mechanical Engineering
	Ph.D. in Development and Management
	Ph.D. in Engineering Science
	Ph.D. in Nuclear Engineering

Study may be undertaken **full time** or **part time** in any of the above.

For Honours programmes, see undergraduate yearbook of the Faculty of Engineering.

I.1.4.2

Summary of qualification and curriculum codes

Diploma	QUALIFICATION CODE	CURRICULUM
Post-graduate Diploma in Nuclear Science and Technology	7051001	I501P

M.ENG.	QUALIFICATION CODE	CURRICULUM		
		Option A	Option B	Option C
Chemical Engineering	702110	I871P	I872P	
Computer & Electronic Eng.	702109	I886P	I887P	I888P
Electrical & Electronic Eng.	702108	I883P	I884P	I885P
Development & Management	702111	I891P	I892P	I893P
Mechanical Engineering	702107	I880P	I881P	I882P
Nuclear Engineering	702104		I803P	I804P

M.SC. (Engineering Sciences)	QUALIFICATION CODE	CURRICULUM		
		Option A	Option B	Option C
Chemical Engineering	203152	I890P	I891P	
Computer & Electronic Eng.	203154	I896P	I897P	I898P
Electrical & Electronic Eng.	203153	I893P	I894P	I895P
Mechanical Engineering	203151	I887P	I888P	I889P
Nuclear Engineering	203200		I803P	I804P

PH.D.	QUALIFICATION CODE	CURRICULUM
Chemical Engineering	703104	I901P
Computer Engineering	703113	I910P
Computer & Electronic Eng.	703109	I906P
Development & Management	703111	I908P
Electrical Engineering	703105	I902P
Electronic Engineering	703106	I903P
Electrical & Electronic Eng.	703108	I905P
Engineering Science	703110	I907P
Mechanical Engineering	703107	I904P
Nuclear Engineering	703112	I909P

I.1.5 MODULES AND CREDITS

I.1.5.1 Post-graduate Diploma in Nuclear Science and Technology credits

The diploma constitutes of **128** credits. Each credit represents a nominal 10 hours of study

I.1.5.2 Modules offered: Post-graduate Diploma in Nuclear Science and Technology

The diploma constitutes of 4 core modules, 3 fundamental modules and a project report. Each of these modules and report counts 16 credits.

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

Code	Course
NUCI 511	Nuclear Engineering I
NUCI 521	Thermal-Fluid Sciences
NUCI 571	Mathematics for Nuclear Engineers
NUCI 572	Nuclear Reactor Technology
NUCI 573	Nuclear Reactor Safety
NUCI 574	Nuclear Engineering Project
NUCI 575	Nuclear Physics
NUCI 576	Radiation and the Environment

I.1.5.3 Masters' degree credits

The total number of credits needed to obtain an M.Eng. or M.Sc. in Engineering Sciences degree is **180 credits**. Each credit represents a nominal 10 hours of study. Students choose one curriculum with certain course modules to be completed in order to obtain the relevant degree.

I.1.5.4 Modules offered: Masters' degrees (M.Eng. and M.Sc.)

The Masters' degree programmes allow for three options. The options are (a) a comprehensive research dissertation, (b) coursework and a research dissertation or (c) coursework and a mini research dissertation.

The three options can be summarised as follows: (see parr. 1.2.6 and 1.3.6 for a detailed description)

OPTION A		OPTION B		OPTION C	
Description	Ct	Description	Ct	Description	Ct
Dissertation	172	Mini-dissertation	92	Mini-dissertation	44
Research Meth.	8	Research Meth.	8	Research Meth.	8
	180	1 Course module	16	1 Course module	16
		2 Course module	16	2 Course module	16
		3 Course module	16	3 Course module	16
		4 Course module	16	4 Course module	16
		5 Course module	16	5 Course module	16
			180	6 Course module	16
				7 Course module	16
				8 Course module	16
					180

The course modules approved as part of the Masters' degree curricula in the Faculty of Engineering are listed below. Please consult the different curriculum descriptions for more detail. Qualification codes/degree codes for all M.Eng. programmes are also given with each curriculum description. For each curriculum, compulsory modules (where applicable) and elective modules are indicated. A list of all the modules is given below.

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

CODE	MODULE NAME
NVMI 874	Research Methodology
SCHOOL OF CHEMICAL AND MINERALS ENGINEERING	
CEMI 875	Fluid-phase Equilibrium
CEMI 876	Separation Processes
CEMI 877	Coal Technology I
CEMI 878	Coal Technology II
CEMI 879	Bioreactors and Bioprocessing
CEMI 881	Bio-ethanol Process Technology
CEMI 882	STS and Renewable Energy
CEMI 883	Introduction to Renewable and Sustainable Energy
CEMI 884	Biodiesel Process Technology
SCHOOL OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING	
EEII 881	Data Mining and Knowledge Extraction
EEII 882	Electrical Power Quality
EEII 883	Advanced Protection Systems
EEII 884	Advanced Signal Processing
EEII 885	Information Systems for e-trade and e-logistics
EEII 886	Information Security: Strategies and Techniques
EEII 887	Kalman Filters

EEL 888	Power System Dynamics
EEL 889	The Compensation of Distortion in Power Systems
EEL 891	Advanced Electronic Development and Design
EEL 892	Advanced Power Electronics
EEL 893	Advanced Electrical Machines
EER 877	Digital Control Systems
ERIE 874	Neural Networks
ERIE 875	Fuzzy Logic Systems
ERIE 876	Process Modelling and Pattern-Recognition
SCHOOL OF MECHANICAL AND NUCLEAR ENGINEERING	
MEGI 874	Computational Fluid Dynamics I
MEGI 875	Computational Fluid Dynamics II
MEGI 876	Finite Element Methods
MEGI 877	Finite Element Methods for Flow
MEGI 878	Energy Management
MEGI 879	Advanced Engineering Thermodynamics
MEGI 884	Advanced Strength of Materials
MEGI 889	Materials Selection for Design
MEGI 894	Composite Materials
MGII 885	Thermal-Fluid Systems Modelling I
MGII 886	Thermal-Fluid Systems Modelling II
MGII 887	Gas Turbine Theory and Performance
NUCI 511	Nuclear Engineering I
NUCI 621	Introduction to Thermal-fluid Sciences
NUCI 671	Mathematics for Nuclear Engineers
NUCI 874	Advanced Reactor Analysis I
NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis
NUCI 877	High Temperature Reactor Fuels and Materials
NUCI 878	High Temperature Reactor Technology
NUCI 879	Nuclear Project Management
NUCI 882	Light Water Reactor Thermal-Hydraulics
NUCI 883	Nuclear Engineering
NUCI 886	Pebble Bed Reactor Design
NUCI 887	Reactor Analysis
NUCI 888	Reactor Safety
NUCI 889	Pressurized Water Reactor Technology
CRCD VAAL	
IIOB 881	Project Management
IIOB 882	Maintenance Management
IIOB 883	Corporate Career Skills
IIOB 884	Production Optimisation Management
IIOB 885	Entrepreneurial Career Skills
IIOB 886	System Engineering

I.1.5.5 Philosophiae Doctor (Ph.D.) modules and credits

The Ph.D. degree consists of **256 credits**. Students only register for one module, depending on the field of study (see par. I. 4.10).

Students from other universities, or students who have not completed the compulsory module in Research Methodology as part of their Masters' degree study, are also required to take this 8-credit module.

I.1.6 TERMINATION OF STUDIES

I.1.6.1 By the student

According to general rule A.5.3.9 notice to cancel registration or terminate studies must be submitted in writing to the University.

I.1.6.2 By the Faculty/University

A student's registration may be cancelled if he/she fails to comply with the dissertation/thesis proposal submission rules as prescribed (general rule A.7.4.8). Studies may also be terminated in terms of general rule A.5.5, i.e. if the student fails to comply with the requirements laid down by the senate and/or faculty, or exceeds the maximum duration of the study period.

A student who does not expect to complete the curriculum within the maximum study period, must, before the end of the maximum allowed period of study, apply to the school director (on the prescribed form), for an extension of the study period for one academic year (in accordance with rule A.7.6.) The supervisor makes a recommendation to the school director with regard to extension of the study period. Students should contact the Faculty post-graduate administrative manager in this regard.

I.2 RULES FOR THE POST-GRADUATE DIPLOMA IN NUCLEAR SCIENCE AND TECHNOLOGY

I.2.1 INTRODUCTION

This programme will provide 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.

Furthermore, the Post-graduate diploma in Nuclear Science and Technology pursues knowledge and innovation in the field of nuclear power generation and will develop and empower graduates to think laterally and critically and to serve the country specifically within the fields of power generation.

I.2.2 ADMISSION AND REGISTRATION

The entry requirements for the programme are a

- three year B.Sc. degree (with Maths or Physics to at least the second year)
- or B.Tech. (Engineering)

The admission and registration requirements are set out in General Rules A.7.1 and A.7.4.

Prospective students must start by applying for **admission** to the North-West University - forms and information available from the Department of Academic Administration - Post-graduate Admissions - tel. (018) 299-4049.

After a student has been admitted, **registration** forms are issued, which must be signed by the Faculty Post-graduate Administration Manager before the student will be allowed to register. Prescribed **fees** must also be paid BEFORE registration.

Students must **re-register** every year according to the prescribed procedure, on or before the date set by the University.

Note: No student will be allowed to attend lectures of a particular module unless the prescribed registration fee has been paid.

I.2.2.1 Foreign qualifications

Students holding a foreign qualification (i.e. not obtained at a South African University), are required to have the qualification evaluated by SAQA (South African Qualifications Authority) and a certificate re. the evaluation must be submitted with the application form. For more information, contact SAQA at www.saqa.org.za.

I.2.3 APPROVAL OF THE STUDY PROGRAMME

Approval of the study programme is given in terms of the provisions in General Rules A.7.2.2 and A.7.3 as well as the relevant requirements in the Manual for Post-graduate Studies. **All students must consult this Manual carefully.** This Manual for Post-graduate Studies as well as the General Rules, are available on the university's web site (www.nwu.ac.za).

I.2.4 DURATION OF THE STUDY

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

I.2.5 COMPOSITION OF THE POST-GRADUATE DIPLOMA IN NUCLEAR SCIENCE AND TECHNOLOGY PROGRAMME

The Post-graduate diploma in Nuclear Science and Technology is structured as follows:

Components	Credits	Composition
Project Report (compulsory)	16	Core
Fundamental and core modules courses (compulsory)	7 x 16	3 x Fundamental 4 x Core
TOTAL CREDITS	128	

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

I.2.6 METHOD OF PRESENTATION

The modules are presented by a distance-contact model developed by North-West University in collaboration with overseas institutions. 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. e-Fundi supports a flexible teaching environment to facilitate collaboration between geographically dispersed students, facilitators and lecturers.

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

All lectures of a specific module are given 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.

I.2.7 EXAMINATION

The examination for the Post-graduate diploma in Nuclear Science and Technology is conducted in accordance with the requirements of General Rule A.7.5 16-credit course modules should preferably be completed in the first year of study.

I.2.8**POST-GRADUATE DIPLOMA IN NUCLEAR SCIENCE AND TECHNOLOGY CURRICULA – I501P**

Qualification code: 7051001

Information regarding the course schedule, lecture venue, structure of the courses etc. can be obtained from the Post-graduate School of Nuclear Science and Engineering, at tel. (018) 299-1355

Code	Course	Credits
NUCI 511	Nuclear Engineering I	16
NUCI 521	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
Total credits to be obtained:		128

I.3 RULES FOR THE DEGREE MASTER OF ENGINEERING (M.ENG.)

The M.Eng. degree is a degree following on a four-year ECSA accredited Bachelors degree in Engineering. The study may be completed full time or part time.

I.3.1 ADMISSION AND REGISTRATION

The admission and registration requirements are set out in General Rules A.7.1 and A.7.4.

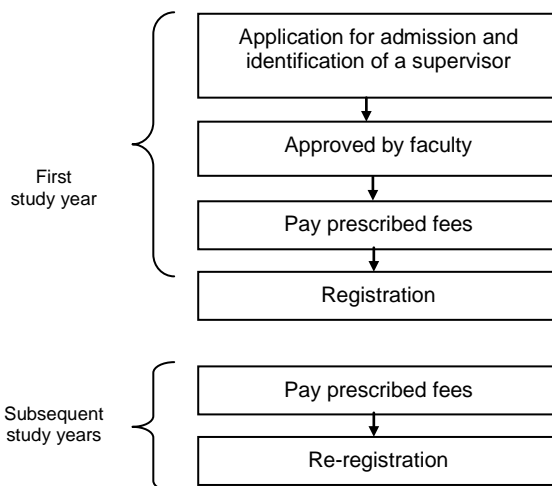
Prospective students must start by applying for **admission** to the North-West University - forms and information available from the Department of Academic Administration - Post-graduate Admissions - tel. (018) 299-4049.

Prospective students must consult the Post-graduate Prospectus to help them identify a **supervisor**. The Prospectus provides a list of research projects available for participation by students. The supervisor will then sign a supervisor acceptance form which must accompany the application form. Students will not be allowed to register unless a supervisor has been confirmed. The Prospectus is available from the Post-graduate Administrative manager - tel. (018) 299 4020 or on the web site: www.nwu.ac.za

After a student has been admitted, **registration** forms are issued, which must be signed by the Faculty Post-graduate Administration Manager before the student will be allowed to register. Prescribed **fees** must also be paid BEFORE registration.

Students must **re-register** every year according to the prescribed procedure, on or before the date set by the University.

The process can be illustrated as follows:



Note: No student will be allowed to attend lectures of a particular module unless the prescribed registration fee has been paid.

I.3.1.1 Foreign qualifications

Students holding a foreign qualification (i.e. not obtained at a South African University), are required to have the qualification evaluated by SAQA (South African Qualifications Authority) and a certificate re. the evaluation must be submitted with the application form. For more information, contact SAQA at www.saqa.org.za.

I.3.2 APPROVAL OF THE STUDY PROGRAMME

Approval of the study programme is given in terms of the provisions in General Rules A.7.2.2 and A.7.3 as well as the relevant requirements in the Manual for Post-graduate Studies. **All students must consult this Manual carefully.** This Manual for Post-graduate Studies as well as the General Rules, are available on the university's web site (www.nwu.ac.za).

I.3.3 ADDITIONAL REQUIREMENTS

The title of the dissertation, the research proposal and the appointment of external examiners must be reviewed by the Faculty Management Committee (post-graduate). Further information regarding rules and procedures are contained in the general academic rules A.7.5.7 and in the Manual for Post-graduate Study.

In addition to attaining the above-mentioned 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 peers.

Official **prescribed forms** are used in the post-graduate study process, and are available from the Faculty post-graduate admin manager - tel. (018) 299-4020 or are available on the Faculty's web site - <http://www.nwu.ac.za>.

I.3.4 ASSUMPTIONS REGARDING PRIOR LEARNING

- (a) The student holds an applicable four-year bachelors degree in engineering or has been allowed to that status.
- (b) The School Director may, with notification to the Faculty Management Committee (post-graduate), allow students who do not comply with the above-mentioned requirements to register for the M.Sc. or M.Eng. degree, on the grounds of knowledge and experience gained through prior learning. The Faculty's policy with regard to Recognition of Prior Learning applies.
- (c) Programme-specific assumptions are, where applicable, indicated at each programme description.

I.3.5 DURATION OF THE STUDY

The minimum term of study is one (1) year and the maximum term of study is two (2) years for full-time study and three (3) years for part-time study, calculated from the beginning of the first year of registration for the relevant programme.

I.3.6

COMPOSITION OF THE M.ENG. PROGRAMME

The Masters' degree programmes allow for three options. 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 three options can be summarised as follows:

OPTION A		OPTION B		OPTION C	
<u>Description</u>	<u>Ct</u>	<u>Description</u>	<u>Ct</u>	<u>Description</u>	<u>Ct</u>
Full dissertation	172	Dissertation	92	Mini-dissertation	44
Research Meth.	8	Research Meth.	8	Research Meth.	8
	<hr/>	1 Course module	16	1 Course module	16
	180	2 Course module	16	2 Course module	16
		3 Course module	16	3 Course module	16
		4 Course module	16	4 Course module	16
		5 Course module	16	5 Course module	16
			<hr/>	6 Course module	16
			180	7 Course module	16
				8 Course module	16
					<hr/>
					180

I.3.6.1

OPTION A: Comprehensive research dissertation

(a) Composition

<u>Description</u>	<u>Credits</u>
Full dissertation	172
Research Methodology	8
	<hr/>
	180

(b) Purpose of the programme

To provide thorough training in research methodology.

(c) Programme outcomes

The programme outcomes will have been achieved if it is demonstrated that the candidate is competent in applying research methodology as evidenced by a dissertation with proper structure, style and language that includes:

- Identification of the research problem and formulation of clear objectives for the study.
- A critical, relevant and comprehensive literature survey.
- Development of the necessary research procedures and experimental facilities/numerical models.
- Execution of either an empirical or numerical investigation in order to address the research problem.
- Verification and validation of the results.
- Assessment of the results.

- Conclusions, generalisations and recommendations.

I.3.6.2

OPTION B: Coursework and a research dissertation

(a) Composition

<u>Description</u>	<u>Credits</u>
Dissertation	92
Research Methodology	8
Elective course module (1)	16
Elective course module (2)	16
Elective course module (3)	16
Elective course module (4)	16
Elective course module (5)	16
Total credits:	180

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

(b) Purpose of the programme

To provide specialist knowledge in a chosen field and advanced competence in research methodology.

(c) Programme outcomes

The programme outcomes will have been achieved if it is demonstrated that:

- The candidate is competent in applying specialised knowledge in a chosen field as evidenced by coursework assessment that includes:
 - Application of specialised tools and techniques.
 - Higher level problem solving and engineering synthesis.
 - Integration of knowledge across fields.
- The candidate is competent in applying research methodology or advanced design and/or investigative skills as evidenced by a dissertation with proper structure, style and language that includes:
 - Identification of the research or engineering problem and formulation of clear objectives for the study.
 - A critical and relevant literature survey.
 - Development of the necessary research or design/ investigative procedures and experimental facilities/ numerical models.
 - Execution of a comprehensive design or investigation to address the problem.
 - Verification of the results
 - Assessment of the results
 - Conclusions

I.3.6.3

Option C: Coursework and a mini research dissertation

(a) Composition

<u>Description</u>	<u>Credits</u>
Mini-dissertation	44
Research Methodology	8
Elective course module (1)	16
Elective course module (2)	16
Elective course module (3)	16
Elective course module (4)	16
Elective course module (5)	16
Elective course module (6)	16
Elective course module (7)	16
Elective course module (8)	16
Total credits:	180

Note: At least four (4) of the eight (8) 16-credit modules must be engineering technology courses, within the chosen curriculum.

(b) Purpose of the programme

To provide specialist knowledge in a chosen field and basic competence in research methodology.

(c) Programme outcomes

The programme outcomes will have been achieved if it is demonstrated that:

- The candidate is competent in applying specialised knowledge in a chosen field as evidenced by coursework assessment that includes:
 - Application of specialised tools and techniques.
 - Higher level problem solving and engineering synthesis.
 - Integration of knowledge across fields.
- The candidate has attained advanced design or investigative skills as evidenced by a project-based mini-dissertation with proper structure, style and language that includes:
 - Identification of the engineering problem and formulation of clear objectives for the study.
 - A clear description of the background to the problem.
 - Execution of a comprehensive design or investigation to address the problem.
 - Presentation and assessment of the proposed solution.
 - Conclusions.

I.3.6.4

Requirements for a dissertation or mini-dissertation

Regarding technical requirements, a dissertation or mini-dissertation must comply with all requirements and outcomes laid down by the Faculty. Also see the **Manual for Post-graduate Studies** and the applicable A-Rules in this regard. For presenting a dissertation or mini-dissertation in the form of a

published research article(s) or (an) unpublished manuscript(s) in article format, see general rule A.7.5.7.4.

I.3.6.5 Change of Master's study to Doctoral study

General rule A.7.5.8 stipulates that a student who is registered for a Masters' degree and who, according to the unanimous opinion of the study leader, the Research Director and the School Director concerned, has reached outcomes, of which the quality and extent which are acceptable for a doctorate, may apply to the Faculty Board to change the registration for the masters' degree to registration for the doctorate. A student for whom such concession has been granted:

- (a) must complete the examination paper portion of the master's examination (where applicable) successfully before the thesis may be submitted;
- (b) must comply with all rules and prescriptions laid down by the University in connection with a doctorate; and
- (c) may not receive the doctorate until at least the number of credits has been acquired and the period of time has elapsed since acquisition of the qualification which allowed admission to the master's degree in terms of the appropriate faculty rules prescribed for a doctorate.

I.3.7 ARTICULATION POSSIBILITIES

- (a) After the successful completion of the M.Eng. 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.
- (b) Credit will be given to modules passed at other faculties or universities, provided the outcome and total credit requirements for this qualification/programme will be fully complied with.
- (c) 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 specialised fields in a variety of institutions.

I.3.8 POST-GRADUATE COURSE MODULES

I.3.8.1 Choice of modules

Note that for **Option A** curricula, there is in each case only a compulsory module for the dissertation plus research methodology. Option A students may also register for any of the elective modules offered, for non-degree purposes.

For **Option B** and **C** curricula, there are in each case a compulsory module for the dissertation/mini-dissertation plus research methodology, plus a list of elective courses from which five (5) for option B and eight (8) for option C must be chosen. Other compulsory modules are, where applicable, indicated at each curriculum.

I.3.8.2 Course modules from other M.Eng. curricula

Any post-graduate course module in any school in the Faculty of Engineering may be chosen after consultation with the appropriate programme manager and his/her supervisor, provided that:

- (a) More than 50% of course modules are within the chosen curriculum;
- (b) the remaining course modules are chosen from the list of approved modules in the other M.Eng. curricula, or from the approved list of complementary subjects, as listed in I.3.8.3 below; and
- (c) the supervisor has given permission in writing for the choice of other course modules to be taken.

I.3.8.3 Approved list of complementary modules

Provided prior written approval is obtained from the relevant school director, the following complementary modules offered by the Potchefstroom Business School as part of their MBA course may be taken by post-graduate engineering students (subject to availability of MBA modules):

PBSA 823 Management of Information (*second semester*)

PBSB 813 Operations Management (*second semester*)

Please note that students need to attend the above lectures from the start of the course. Enquiries should be addressed to the MBA Programme Manager, at tel. (018) 299 1415.

I.3.8.4 Module exemptions

According to general rule A.5.3.4, a student who joins this University after having completed only a portion of or a full qualification at another institution of higher learning may, with a view to further study at this University, apply in writing for recognition of modules, provided that exemption shall not be granted for more than half of the number of modules required for the curriculum. The student may repeat modules from which he/she cannot be exempted.

Any registered student of this University who wishes to change a curriculum in the course of his/her study period may, with a view to further study at this University, must apply in writing to the appropriate faculty for recognition of any modules which he/she has already passed and which forms part of the curriculum to which the student wishes to change.

I.3.9 EXAMINATION

The examination for the Masters' degree is conducted in accordance with the requirements of General Rule A.7.5 16-credit course modules should preferably be completed in the first year of study.

I.3.9.1 Submission of dissertation or mini-dissertation for examination

According to general rule A.7.5.4 a dissertation or mini-dissertation must be submitted for examination before or on the date determined annually by the senate and indicated in the relevant annual timetable. Certain prescribed forms are to be completed before and at submission. Please consult with the Faculty's Post-graduate Administration Manager for the necessary procedures to be followed and forms to be completed.

I.3.10 M.ENG. CURRICULA

Although the research is managed by the Unit for Energy Systems, the 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. Please consult with the CRCED Pretoria personnel at (012) 809-1076.

I.3.11 SCHOOL OF CHEMICAL AND MINERALS ENGINEERING

Enquiries with regard to these curricula to be directed to the Director: School of Chemical and Minerals Engineering at tel. (018) 299-1998.

I.3.11.1 M.Eng. Curriculum I871P - Chemical Engineering (Option A)

Qualification code: 702110

Type	Code	Description	Credits
Compulsory Modules	CEMI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.3.11.2 M.Eng. Curriculum I872P - Chemical Engineering (Option B)

Qualification code: 702110

Type	Code	Description	Credits
Compulsory	CEMI 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	CEMI 875	Fluid-phase Equilibrium	16
	CEMI 876	Separation Processes	16
	CEMI 877	Coal Technology I	16
	CEMI 878	Coal Technology II	16
	CEMI 879	Bioreactors and Bioprocessing	16
	CEMI 881	Bio-ethanol Process Technology	16
	CEMI 882	STS and Renewable Energy	16
	CEMI 883	Introduction to Renewable and Sustainable Energy	16
	CEMI 884	Biodiesel Process Technology	16
Total credits to be obtained:			180

I.3.11.3 M.Eng. Curriculum I873P - Chemical Engineering (Option C)

This curriculum is currently being modified and will not be available for enrolment in 2012.

I.3.12 SCHOOL OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

Enquiries with regard to these curricula to be directed to the Director: School of Electrical, Electronic and Computer Engineering at tel. (018) 299-1978.

I.3.12.1 M.Eng. Curriculum I883P - Electrical & Electronic Engineering (Option A)

Qualification code: 702108

Type	Code	Description	Credits
Compulsory Modules	EERI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.3.12.2 M.Eng. Curriculum I884P - Electrical & Electronic Engineering (Option B)

Qualification code: 702108

Type	Code	Description	Credits
Compulsory	ELEI 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	EEII 882	Electrical Power Quality	16
	EEII 883	Advanced Protection Systems	16
	EEII 884	Advanced Signal Processing	16
	EEII 887	Kalman Filters	16
	EEII 888	Power System Dynamics	16
	EEII 889	Compensation of Distortion in Power Systems	16
	EEII 891	Advanced Electronic Development & Design	16
	EEII 892	Advanced Power Electronics	16
	EEII 893	Advanced Electrical Machines	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
	Total credits to be obtained:		

I.3.12.3 M.Eng. Curriculum I885P - Electrical & Electronic Engineering (Option C)

Qualification code: 702108

Type	Code	Description	Credits
Compulsory	ELEI 873	Mini-dissertation	44
	NVMI 874	Research Methodology	8
Elective modules [choose eight (8)]	EEII 882	Electrical Power Quality	16
	EEII 883	Advanced Protection Systems	16
	EEII 884	Advanced Signal Processing	16
	EEII 887	Kalman Filters	16
	EEII 888	Power System Dynamics	16
	EEII 889	Compensation of Distortion in Power Systems	16
	EEII 891	Advanced Electronic Development & Design	16
	EEII 892	Advanced Power Electronics	16
	EEII 893	Advanced Electrical Machines	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
	Total credits to be obtained:		

I.3.12.4 M.Eng. Curriculum I886P - Computer & Electronic Engineering (Option A)

Qualification code: 702109

Type	Code	Description	Credits
Compulsory Modules	EERI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.3.12.5 M.Eng. Curriculum I887P - Computer & Electronic Engineering (Option B)

Qualification code: 702109

Type	Code	Description	Credits
Compulsory	REEI 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	EEII 881	Data mining and knowledge extraction	16
	EEII 884	Advanced Signal Processing	16
	EEII 885	Information Systems for e-trade and e-logistics	16
	EEII 886	Information Security: Strategies and Techniques	16
	EEII 887	Kalman Filters	16
	EEII 891	Advanced Electronic Development & Design	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
Total credits to be obtained:			180

I.3.12.6 M.Eng. Curriculum I888P - Computer & Electronic Engineering (Option C)

Qualification code: 702109

Type	Code	Description	Credits
Compulsory	REEI 873	Mini-dissertation	44
	NVMI 874	Research Methodology	8
Elective modules [choose eight (8)]	EEII 881	Data mining and knowledge extraction	16
	EEII 884	Advanced Signal Processing	16
	EEII 885	Information Systems for e-trade and e-logistics	16
	EEII 886	Information Security: Strategies and Techniques	16
	EEII 887	Kalman Filters	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
	EEII 891	Advanced Electronic Development & Design	16
Total credits to be obtained:			180

The following curriculums in the School of Electrical, Electronic and Computer Engineering are being phased out from 2009:

I.3.12.7 M.Eng. Curriculum I874P - Electrical Engineering (Option A)

No new applications for this curriculum are accepted from 2009, since this curriculum is being phased out.

I.3.12.8 M.Eng. Curriculum I875P - Electrical Engineering (Option B)

No new applications for this curriculum are accepted from 2009, since this curriculum is being phased out.

I.3.12.9 M.Eng. Curriculum I877P - Electronic Engineering (Option A)

No new applications for this curriculum are accepted from 2009, since this curriculum is being phased out.

I.3.12.10 M.Eng. Curriculum I878P - Electronic Engineering (Option B)

No new applications for this curriculum are accepted from 2009, since this curriculum is being phased out.

I.3.12.11 M.Eng. Curriculum I871P - Computer Engineering (Option A)

No new applications for this curriculum are accepted from 2009, since this curriculum is being phased out.

I.3.13 SCHOOL OF MECHANICAL AND NUCLEAR ENGINEERING

Enquiries with regard to these curricula to be directed to the Director: School of Mechanical and Nuclear Engineering at tel. (018) 299-1355.

I.3.13.1 MECHANICAL ENGINEERING

I.3.13.1.1 M.Eng. Curriculum I880P - Mechanical Engineering (Option A)

Qualification code: 702107

Type	Code	Description	Credits
Compulsory Modules	MEGI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.3.13.1.2 M.Eng. Curriculum I881P - Mechanical Engineering (Option B)

Qualification code: 702107

Type	Code	Description	Cr	Pre-requisite
Compulsory	MEGI 872	Dissertation	92	-
	NVMI 874	Research Methodology	8	-
Elective modules [choose five (5)]	MEGI 874	Computational Fluid Dynamics I	16	-
	MEGI 875	Computational Fluid Dynamics II	16	-
	MEGI 876	Finite Element Methods	16	-
	MEGI 877	Finite Element Methods for Flow	16	-
	MEGI 878	Energy Management	16	-
	MEGI 879	Advanced Engineering Thermodynamics	16	-
	MEGI 884	Advanced Strength of Materials	16	-
	MEGI 889	Materials Selection for Design	16	-
	MEGI 894	Composite Materials	16	-
	MGII 885	Thermal-Fluid Systems Modelling I	16	-
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
	MGII 887	Gas Turbine Theory and Performance	16	
Total credits to be obtained:			180	

I.3.13.1.3 M.Eng. Curriculum I882P - Mechanical Engineering (Option C)

Qualification code: 702107

Type	Code	Description	Cr	Pre-requisite
Compulsory	MEGI 873	Mini-dissertation	44	-
	NVMI 874	Research Methodology	8	-
Elective modules [choose eight (8)]	MEGI 874	Computational Fluid Dynamics I	16	-
	MEGI 875	Computational Fluid Dynamics II	16	-
	MEGI 876	Finite Element Methods	16	-
	MEGI 877	Finite Element Methods for Flow	16	-
	MEGI 878	Energy Management	16	-
	MEGI 879	Advanced Engineering Thermodynamics	16	-
	MEGI 884	Advanced Strength of Materials	16	-
	MEGI 889	Materials Selection for Design	16	-
	MEGI 894	Composite Materials	16	-
	MGII 885	Thermal-Fluid Systems Modelling I	16	-
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
	MGII 887	Gas Turbine Theory and Performance	16	-
Total credits to be obtained:			180	

I.3.13.2 NUCLEAR ENGINEERING

Nuclear Engineering courses are presented on a focussed contact basis. 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. More information regarding the course schedule, lecture venue, structure of the courses etc. can be obtained from the School of Mechanical and Nuclear Engineering at tel. (018) 299-1355.

The option A (full dissertation) curriculum is not offered for Nuclear Engineering.

Full-time students will register for Option B and part-time will register for Option C.

Component	Option B		Option C	
	Credits	Composition	Credits	Composition
Dissertation (compulsory)	92	Dissertation	44	Mini-dissertation
Fundamental and core modules (compulsory)	56	1x8 credit module + 3x16 credit modules	72	1x8 credit module + 4x16 credit modules
Elective modules	32	2x16 credit modules	64	4x16 credit modules
TOTAL CREDITS	180		180	

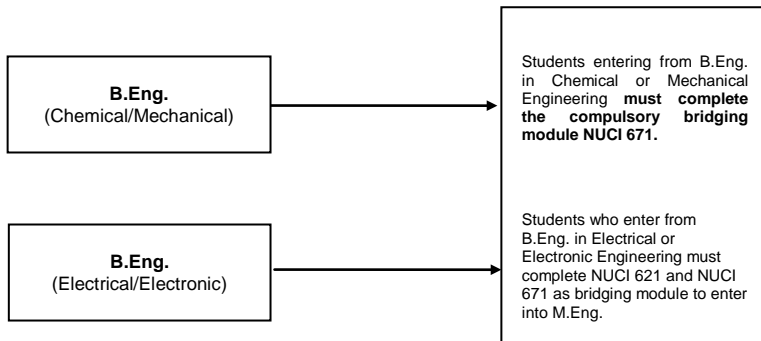
I.3.13.2.1 Pre-requisites for entering the M.Eng. in Nuclear Engineering

The route to entering the Masters' programme can be described as follows:

Students in possession of either a B.Eng. (Mechanical) or a B.Eng. (Chemical) degree must register for Mathematics for Nuclear Engineers (NUCI 671) which will be a bridging module.

Students coming through the B.Eng. (Electrical/Electronic) must register for Mathematics for Nuclear Engineers (NUCI 671) and Introduction to Thermal-Fluid Sciences (NUCI 621) which will be bridging modules.

The credits for the two bridging modules do not count towards the 180 credits for the Masters' degree.



I.3.13.2.2 Programme Structure

For **option B** curricula, a student must complete the compulsory modules plus two (2) of the modules in the list of elective modules.

Full-time students will register for Option B and part-time students will register for Option C.

I.3.13.2.3 M.Eng. Curriculum I803P - Nuclear Engineering (Option B)

Qualification code: 702104

Type	Code	Module	Cr	Pre-requisite
Compulsory	NUCI 872	Dissertation	92	-
	NVMI 874	Research Methodology	8	-
	NUCI 511	Nuclear Engineering I	16	-
	NUCI 883	Nuclear Engineering	16	NUCI 511 NUCI 621 NUCI 671
	NUCI 887	Reactor Analysis	16	NUCI 883
Elective modules [choose two (2)]	NUCI 888	Reactor Safety	16	NUCI 883, NUCI 887
	NUCI 874	Advanced Reactor Analysis I	16	NUCI 887
	NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	16	NUCI 883, MEGI 874*
	NUCI 877	High Temperature Reactor Fuels and Materials	16	NUCI 883, NUCI 887
	NUCI 878	High Temperature Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 886	Pebble Bed Reactor Design	16	NUCI 883, NUCI 874
	NUCI 879	Nuclear Project Management	16	-
	NUCI 889	Pressurized Water Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 882	Light Water Reactor Thermal-Hydraulics	16	NUCI 883, MGII 885
	MEGI 874	Computational Fluid Dynamics I	16	MGII 885
	MGII 885	Thermal-Fluid Systems Modelling I	16	NUCI 621
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
IIOB 886	System Engineering	16	-	
Total credits to be obtained:			180	

I.3.13.2.4 M.Eng. Curriculum I804P - Nuclear Engineering (Option C)

Qualification code: 702104

Type	Code	Module	Cr	Pre-requisite
Compulsory	NUCI 873	Dissertation	44	-
	NVMI 874	Research Methodology	8	-
	NUCI 511	Nuclear Engineering I	16	-
	NUCI 883	Nuclear Engineering	16	NUCI 511 NUCI 621 NUCI 671
	NUCI 887	Reactor Analysis	16	NUCI 883
	NUCI 888	Reactor Safety	16	NUCI 883, NUCI 887
Elective [choose four (4)]	NUCI 874	Advanced Reactor Analysis I	16	NUCI 887
	NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	16	NUCI 883, MEGI 874*
	NUCI 877	High Temperature Reactor Fuels and Materials	16	NUCI 883, NUCI 887
	NUCI 878	High Temperature Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 886	Pebble Bed Reactor Design	16	NUCI 883, NUCI 874
	NUCI 879	Nuclear Project Management	16	-
	NUCI 889	Pressurized Water Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 882	Light Water Reactor Thermal- Hydraulics	16	NUCI 883, MGII 885
	MEGI 874	Computational Fluid Dynamics I	16	MGII 885
	MGII 885	Thermal-Fluid Systems Modelling I	16	NUCI 621
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
	IIOB 886	System Engineering	16	-
Total credits to be obtained:			180	

I.3.13.2.5 Short courses offered

All of the Masters' modules are available for enrolment as short courses. Apart from these Masters' modules, the following modules may also be enrolled for as short courses (enquiries: School of Mechanical and Nuclear Engineering at tel. (018) 299-1355).

Code	Module/Short Course name	Credits
NUCI 511	Nuclear Engineering I (<i>also part of M-programme</i>)	16
NUCI 521	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
PRA	The Fundamentals of Probabilistic Risk Assessment	
	Lateral Thinking and Problem Solving	

Students enrolling for the diploma may be granted exemption for a maximum of four modules completed as short courses, on condition that

an examination has been written and a mark obtained. The administration re. these short courses is taken care of by the School of Mechanical and Nuclear Engineering and does not form part of the formal University Academic Administration system (i.e. marks are not displayed on an Academic Record until exemption is granted).

I.3.14 CRCED (VAAL) - DEVELOPMENT AND MANAGEMENT

The following curricula in Development and Management are offered by the Centre for Research and Continued Engineering Development - CRCED (Vaal) and lectures are presented on a part-time basis, on the Vaal Triangle Campus. Enquiries to be directed to the programme leader, prof. PW Stoker, at tel. (016) 981-3951.

I.3.14.1 M.Eng. Curriculum I891P - Development and Management (Option A)

Qualification code: 702111

Type	Code	Description	Credits
Compulsory Modules	IIOB 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.3.14.2 M.Eng. Curriculum I892P - Development and Management (Option B)

Qualification code: 702111

Type	Code	Description	Credits
Compulsory	IIOB 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	IIOB 881	Project Management	16
	IIOB 882	Maintenance Management	16
	IIOB 883	Corporate Career Skills	16
	IIOB 884	Production Optimisation Management	16
	IIOB 885	Entrepreneurial Career Skills	16
	IIOB 886	System Engineering	16
	IIOB 887	Quality Management in Engineering Projects	16
	PBSB 813	Operations Management	16
Total credits to be obtained:			180

I.3.14.3 M.Eng. Curriculum I893P - Development and Management (Option C)

Qualification code: 702111

Type	Code	Description	Credits
Compulsory	IIOB 873	Mini-dissertation	44
	NVMI 874	Research Methodology	8
Elective modules [choose eight (8)]	IIOB 881	Project Management	16
	IIOB 882	Maintenance Management	16
	IIOB 883	Corporate Career Skills	16
	IIOB 884	Production Optimisation Management	16
	IIOB 885	Entrepreneurial Career Skills	16
	IIOB 886	System Engineering	16
	IIOB 887	Quality Management in Engineering Projects	16
	PBSB 813	Operations Management	16
Total credits to be obtained:			180

I.4 RULES FOR THE DEGREE OF MASTER OF SCIENCE (M.SC.) IN ENGINEERING SCIENCES

The M.Sc.-degree in Engineering Science may follow on a B.Sc. (Hons.) degree or a four-year degree of Bachelor in Engineering or another recognized qualification that will allow the student to attain equivalent status and which is approved by the Post-graduate Research Quality Assurance Committee. The study may be completed full time or part time.

I.4.1 ADMISSION AND REGISTRATION

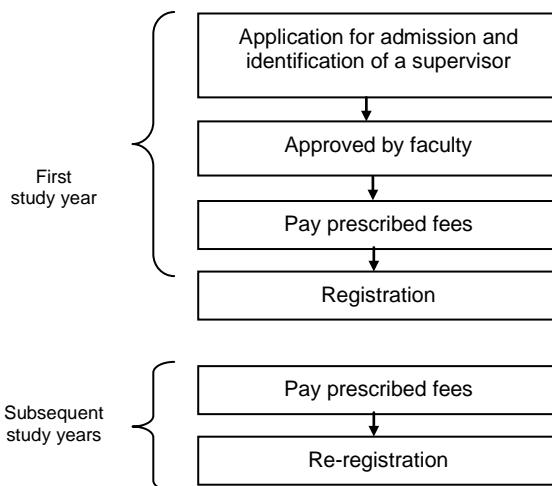
The admission and registration requirements are set out in General Rules A.7.1 and A.7.4.

Prospective students must start by applying for **admission** to the North-West University - forms and information available from the Department of Academic Administration - Post-graduate Admissions - tel. (018) 299-4049.

Prospective students must consult the Post-graduate Prospectus to help them identify a **supervisor**. The Prospectus provides a list of research projects available for participation by students. The supervisor will then sign a supervisor acceptance form which must accompany the application form. Students will not be allowed to register unless a supervisor has been confirmed. The Prospectus is available from the Post-graduate Administrative manager - tel. (018) 299 4020 or on the web site: www.nwu.ac.za

After a student has been admitted, **registration** forms are issued, which must be signed by the Faculty Post-graduate Administration Manager before the student will be allowed to register. Prescribed **fees** must also be paid BEFORE registration.

Students must **re-register** every year according to the prescribed procedure, on or before the date set by the University. The process can be illustrated as follows:



Note: No student will be allowed to attend lectures of a particular module unless the prescribed registration fee has been paid.

I.4.1.1 Foreign qualifications

Students holding a foreign qualification (i.e. not obtained at a South African University), are required to have the qualification evaluated by SAQA (South African Qualifications Authority) and a certificate re. the evaluation must be submitted with the application form. Visit the website at www.saqqa.org.za.

I.4.2 APPROVAL OF THE STUDY PROGRAMME

Approval of the study programme is given in terms of the provisions in General Rules A.7.2.2 and A.7.3. as well as the relevant requirements in the Manual for Post-graduate Studies. **All students must consult this Manual carefully.** This Manual for Post-graduate Studies as well as the General Rules, are available on the university's web site (www.nwu.ac.za).

I.4.3 ADDITIONAL REQUIREMENTS

The title of the dissertation, the research proposal and the appointment of external examiners must be reviewed by the Faculty Management Committee (post-graduate). Further information regarding rules and procedures are contained in the general academic rules A.7.5.7 and in the Manual for Post-graduate Study.

In addition to attaining the above-mentioned 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 peers.

Official **prescribed forms** are used in the post-graduate study process, and are available from the Faculty post-graduate admin manager - tel. (018) 299-4020 or are available on the Faculty's web site - <http://www.nwu.ac.za>.

I.4.4 ASSUMPTIONS REGARDING PRIOR LEARNING

- (a) The student holds an applicable Honours B.Sc. degree and/or an applicable four-year Bachelors degree, or has been allowed to that status.
- (b) The School Director may, with notification to the Faculty Management Committee (post-graduate), allow students who do not comply with the above-mentioned requirements to register for the M.Sc. degree, on the grounds of knowledge and experience gained through prior learning. The Faculty's policy with regard to Recognition of Prior Learning applies.
- (c) Programme-specific assumptions are, where applicable, indicated at each programme description.

I.4.5 DURATION OF THE STUDY

The minimum term of study is one (1) year and the maximum term of study is two (2) years full-time and three (3) years part-time calculated from the first year of registration for the relevant programme.

I.4.6

COMPOSITION OF THE M.SC. IN ENGINEERING SCIENCES PROGRAMME

The Masters' degree programmes allow for three options. These options allow different combinations of coursework and/or research dissertations that are fundamental in nature and are based on analysis of a problem leading to scientific knowledge.

The three options can be summarised as follows:

OPTION A		OPTION B		OPTION C	
<u>Description</u>	<u>Ct</u>	<u>Description</u>	<u>Ct</u>	<u>Description</u>	<u>Ct</u>
Dissertation	172	Mini-dissertation	92	Mini-dissertation	44
Research Meth.	8	Research Meth.	8	Research Meth.	8
	180	1 Course module	16	1 Course module	16
		2 Course module	16	2 Course module	16
		3 Course module	16	3 Course module	16
		4 Course module	16	4 Course module	16
		5 Course module	16	5 Course module	16
			180	6 Course module	16
				7 Course module	16
				8 Course module	16
					180

I.4.6.1

OPTION A: Comprehensive research dissertation

(a) Composition

<u>Description</u>	<u>Credits</u>
Full dissertation	172
Research Methodology	8
	180

(b) Purpose of the programme

To provide thorough training in research methodology.

(c) Programme outcomes

The programme outcomes will have been achieved if it is demonstrated that the candidate is competent in applying research methodology as evidenced by a dissertation with proper structure, style and language that includes:

- Identification of the research problem and formulation of clear objectives for the study.
- A critical, relevant and comprehensive literature survey.
- Development of the necessary research procedures and experimental facilities/numerical models.
- Execution of either an empirical or numerical investigation in order to address the research problem.
- Verification and validation of the results.
- Assessment of the results.

- Conclusions, generalisations and recommendations.

I.4.6.2

OPTION B: Coursework and a research dissertation

(a) Composition

<u>Description</u>	<u>Credits</u>
Dissertation	92
Research Methodology	8
Elective course module (1)	16
Elective course module (2)	16
Elective course module (3)	16
Elective course module (4)	16
Elective course module (5)	16
Total credits:	180

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

(b) Purpose of the programme

To provide specialist knowledge in a chosen field and advanced competence in research methodology.

(c) Programme outcomes

The programme outcomes will have been achieved if it is demonstrated that:

- The candidate is competent in applying specialised knowledge in a chosen field as evidenced by coursework assessment that includes:
 - Application of specialised tools and techniques.
 - Higher level analysis.
 - Integration of knowledge across fields.
- The candidate is competent in applying research methodology or advanced design and/or investigative skills as evidenced by a dissertation with proper structure, style and language that includes:
 - Identification of the research or engineering problem and formulation of clear objectives for the study.
 - A critical and relevant literature survey.
 - Development of the necessary research or design/ investigative procedures and experimental facilities/ numerical models.
 - Execution of a comprehensive design or investigation to address the problem.
 - Verification of the results
 - Assessment of the results
 - Conclusions

I.4.6.3

Option C: Coursework and a mini research dissertation

(a) Composition

<u>Description</u>	<u>Credits</u>
Project-based mini-dissertation	44
Research Methodology	8
Elective course module (1)	16
Elective course module (2)	16
Elective course module (3)	16
Elective course module (4)	16
Elective course module (5)	16
Elective course module (6)	16
Elective course module (7)	16
Elective course module (8)	16
Total credits:	180

Note: At least four (4) of the eight (8) 16-credit modules must be engineering technology courses, within the chosen curriculum.

(b) Purpose of the programme

To provide specialist knowledge in a chosen field and basic competence in research methodology.

(c) Programme outcomes

The programme outcomes will have been achieved if it is demonstrated that:

- The candidate is competent in applying specialised knowledge in a chosen field as evidenced by coursework assessment that includes:
 - Application of specialised tools and techniques.
 - Higher level problem solving and engineering synthesis.
 - Integration of knowledge across fields.
- The candidate has attained advanced design or investigative skills as evidenced by a project-based mini-dissertation with proper structure, style and language that includes:
 - Identification of the analytical problem and formulation of clear objectives for the study.
 - A clear description of the background to the problem.
 - Execution of a comprehensive analysis or investigation to address the problem.
 - Presentation and assessment of the proposed solution.
 - Conclusions.

I.4.6.4

Requirements for a dissertation or mini-dissertation

Regarding technical requirements, a dissertation or mini-dissertation must comply with all requirements and outcomes laid down by the Faculty. Also see the **Manual for Post-graduate Studies** and the applicable A-Rules in this

regard. For presenting a dissertation or mini-dissertation in the form of a published research article(s) or (an) unpublished manuscript(s) in article format, see general rule A.7.5.7.4.

I.4.6.5 Change of Master's study to Doctoral study

General Rule A.7.5.8 stipulates that a student who is registered for a masters' degree and who, according to the unanimous opinion of the study leader, the Research Director and the School Director concerned, has reached outcomes, of which the quality and extent which are acceptable for a doctorate, may apply to the Faculty Board to change the registration for the masters' degree to registration for the doctorate. A student for whom such concession has been granted:

- (a) must complete the examination paper portion of the master's examination (where applicable) successfully before the thesis may be submitted;
- (b) must comply with all rules and prescriptions laid down by the University in connection with a doctorate; and
- (c) may not receive the doctorate until at least the number of credits has been acquired and the period of time has elapsed since acquisition of the qualification which allowed admission to the master's degree in terms of the appropriate faculty rules prescribed for a doctorate.

I.4.7 ARTICULATION POSSIBILITIES

- (a) After the successful completion of the M.Sc. 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.
- (b) Credit will be given to modules passed at other faculties or universities, provided the outcome and total credit requirements for this qualification/programme will be fully complied with.
- (c) 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 specialised fields in a variety of institutions.

I.4.8 POST-GRADUATE COURSE MODULES

I.4.8.1 Choice of modules

Note that for **Option A** curricula, there is in each case only a compulsory module for the dissertation plus research methodology. Option A students may also register for any of the elective modules offered, for non-degree purposes.

For **Option B** and **C** curricula, there are in each case a compulsory module for the dissertation/mini-dissertation plus research methodology, plus a list of elective courses from which five (5) for option B and eight (8) for option C must be chosen. Other compulsory modules are, where applicable, indicated at each curriculum.

I.4.8.2 Course modules from other M.Sc. in Engineering Sciences curricula

Any post-graduate course module in any school in the Faculty of Engineering may be chosen after consultation with the appropriate programme manager and his/her supervisor, provided that:

- (a) More than 50% of course modules are within the chosen curriculum;
- (b) the remaining course modules are chosen from the list of approved modules in the other M.Eng. curricula, or from the approved list of complementary subjects, as listed below; and
- (c) the supervisor has given permission in writing for the choice of other course modules to be taken.

I.4.8.3 Approved list of complementary modules

Provided prior written approval is obtained from the relevant school director, the following complementary modules offered by the Potchefstroom Business School as part of their MBA course may be taken by post-graduate engineering students (subject to availability of MBA modules):

PBSA 823 Management of Information (*second semester*)

PBSB 813 Operations Management (*second semester*)

Please note that students need to attend the above lectures from the start of the course. Enquiries should be addressed to the MBA Programme Manager, at tel. (018) 299 1415.

I.4.8.4 Module exemptions

According to general rule A.5.3.4, a student who joins this University after having completed only a portion of or a full qualification at another institution of higher learning may, with a view to further study at this University, apply in writing for recognition of modules, provided that exemption shall not be granted for more than half of the number of modules required for the curriculum. The student may repeat modules from which he/she cannot be exempted.

Any registered student of this University who wishes to change a curriculum in the course of his/her study period may, with a view to further study at this University, must apply in writing to the appropriate faculty for recognition of any modules which he/she has already passed and which forms part of the curriculum to which the student wishes to change.

I.4.9 EXAMINATION

The examination for the Masters' degree is conducted in accordance with the requirements of General Rule A.7.5. 16-credit course modules should preferably be completed in the first year of study.

I.4.9.1 Submission of dissertation or mini-dissertation for examination

According to general rule A.7.5.4, a dissertation or mini-dissertation must be submitted for examination before or on the date determined annually by the senate and indicated in the relevant annual timetable. Certain prescribed forms are to be completed before and at submission. Please consult the Faculty's Post-graduate Administration Manager for the necessary procedures to be followed and forms to be completed.

I.4.10 M.SC. IN ENGINEERING SCIENCES CURRICULA

Although the research is managed by the Unit for Energy Systems, the course modules are managed by the respective schools. Curricula are listed under the schools or units in which they are presented, for easy reference.

I.4.11 SCHOOL OF CHEMICAL AND MINERALS ENGINEERING

Enquiries with regard to these curricula to be directed to the Director: School of Chemical and Minerals Engineering at tel. (018) 299-1998.

I.4.11.1 M.Sc. Curriculum I890P - Chemical Engineering (Option A)

Qualification code: 203152

Type	Code	Description	Credits
Compulsory Modules	CEMI 871	Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.4.11.2 M.Sc. Curriculum I891P - Chemical Engineering (Option B)

Qualification code: 203152

Type	Code	Description	Credits
Compulsory	CEMI 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	CEMI 875	Fluid-phase Equilibrium	16
	CEMI 876	Separation Processes	16
	CEMI 877	Coal Technology I	16
	CEMI 878	Coal Technology II	16
	CEMI 879	Bioreactors and Bioprocessing	16
	CEMI 881	Bio-ethanol Process Technology	16
	CEMI 882	STS and Renewable Energy	16
	CEMI 883	Introduction to Renewable and Sustainable Energy	16
	CEMI 884	Biodiesel Process Technology	16
Total credits to be obtained:			180

I.4.11.3 M.Sc. Curriculum I892P - Chemical Engineering (Option C)

This curriculum is currently being modified and will not be available for enrolment in 2012.

I.4.12 SCHOOL OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

Enquiries with regard to these curricula to be directed to the Director: School of Electrical, Electronic and Computer Engineering at tel. (018) 299-1978.

I.4.12.1 M.Sc. Curriculum I893P - Electrical & Electronic Engineering (Option A)

Qualification code: 203153

Type	Code	Description	Credits
Compulsory Modules	EERI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.4.12.2 M.Sc. Curriculum I894P - Electrical & Electronic Engineering (Option B)

Qualification code: 203153

Type	Code	Description	Credits
Compulsory	ELEI 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	EEII 882	Electrical Power Quality	16
	EEII 883	Advanced Protection Systems	16
	EEII 884	Advanced Signal Processing	16
	EEII 887	Kalman Filters	16
	EEII 888	Power System Dynamics	16
	EEII 889	The Compensation of Distortion in Power Systems	16
	EEII 891	Advanced Electronic Development & Design	16
	EEII 892	Advanced Power Electronics	16
	EEII 893	Advanced Electrical Machines	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
Total credits to be obtained:			180

I.4.12.3 M.Sc. Curriculum I895P - Electrical & Electronic Engineering (Option C)

Qualification code: 203153

Type	Code	Description	Credits
Compulsory	ELEI 873	Mini-dissertation	44
	NVMI 874	Research Methodology	8
Elective modules [choose eight (8)]	EEII 882	Electrical Power Quality	16
	EEII 883	Advanced Protection Systems	16
	EEII 884	Advanced Signal Processing	16
	EEII 887	Kalman Filters	16
	EEII 888	Power System Dynamics	16
	EEII 889	The Compensation of Distortion in Power Systems	16
	EEII 891	Advanced Electronic Development & Design	16
	EEII 892	Advanced Power Electronics	16
	EEII 893	Advanced Electrical Machines	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
Total credits to be obtained:			180

I.4.12.4 M.Sc. Curriculum I896P - Computer & Electronic Engineering (Option A)

Qualification code: 203154

Type	Code	Description	Credits
Compulsory Modules	EERI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.4.12.5 M.Sc. Curriculum I897P - Computer & Electronic Engineering (Option B)

Qualification code: 203154

Type	Code	Description	Credits
Compulsory	REEI 872	Dissertation	92
	NVMI 874	Research Methodology	8
Elective modules [choose five (5)]	EElI 881	Data Mining and Knowledge Extraction	16
	EElI 884	Advanced Signal Processing	16
	EElI 885	Information Systems for e-trade and e-logistics	16
	EElI 886	Information Security: Strategies and Techniques	16
	EElI 887	Kalman Filters	16
	EElI 891	Advanced Electronic Development & Design	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
Total credits to be obtained:			180

I.4.12.6 M.Sc. Curriculum I898P - Computer & Electronic Engineering (Option C)

Qualification code: 203154

Type	Code	Description	Credits
Compulsory	REEI 873	Mini-dissertation	44
	NVMI 874	Research Methodology	8
Elective modules [choose eight (8)]	EElI 881	Data Mining and Knowledge Extraction	16
	EElI 884	Advanced Signal Processing	16
	EElI 885	Information Systems for e-trade and e-logistics	16
	EElI 886	Information Security: Strategies and Techniques	16
	EElI 887	Kalman Filters	16
	EElI 891	Advanced Electronic Development & Design	16
	EERI 877	Digital Control Systems	16
	ERIE 874	Neural Networks	16
	ERIE 875	Fuzzy Logic Systems	16
	ERIE 876	Process Modelling and Pattern-Recognition	16
Total credits to be obtained:			180

I.4.13 SCHOOL OF MECHANICAL AND NUCLEAR ENGINEERING

Enquiries with regard to these curricula to be directed to the Director: School of Mechanical and Nuclear Engineering at tel. (018) 299-1355.

I.4.13.1 MECHANICAL ENGINEERING

I.4.13.1.1 M.Sc. Curriculum I887P - Mechanical Engineering (Option A)

Qualification code: 203151

Type	Code	Description	Credits
Compulsory Modules	MEGI 871	Full Dissertation	172
	NVMI 874	Research Methodology	8
Total credits to be obtained:			180

I.4.13.1.2 M.Sc. Curriculum I888P - Mechanical Engineering (Option B)

Qualification code: 203151

Type	Code	Description	Cr	Pre-requisite
Compulsory	MEGI 872	Dissertation	92	-
	NVMI 874	Research Methodology	8	-
Elective modules [choose five (5)]	MEGI 874	Computational Fluid Dynamics I	16	-
	MEGI 875	Computational Fluid Dynamics II	16	-
	MEGI 876	Finite Element Methods	16	-
	MEGI 877	Finite Element Methods for Flow	16	-
	MEGI 878	Energy Management	16	-
	MEGI 879	Advanced Engineering Thermodynamics	16	-
	MEGI 884	Advanced Strength of Materials	16	-
	MEGI 889	Materials Selection for Design	16	-
	MEGI 894	Composite Materials	16	-
	MGII 885	Thermal-Fluid Systems Modelling I	16	-
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
MGII 887	Gas Turbine Theory and Performance	16	-	
Total credits to be obtained:			180	

I.4.13.1.3 M.Sc. Curriculum I889P - Mechanical Engineering (Option C)

Qualification code: 203151

Type	Code	Description	Cr	Pre-requisite
Compulsory	MEGI 873	Mini-dissertation	44	-
	NVMI 874	Research Methodology	8	-
Elective modules [choose eight (8)]	MEGI 874	Computational Fluid Dynamics I	16	-
	MEGI 875	Computational Fluid Dynamics II	16	-
	MEGI 876	Finite Element Methods	16	-
	MEGI 877	Finite Element Methods for Flow	16	-
	MEGI 878	Energy Management	16	-
	MEGI 879	Advanced Engineering Thermodynamics	16	-
	MEGI 884	Advanced Strength of Materials	16	-
	MEGI 889	Materials Selection for Design	16	-
	MEGI 894	Composite Materials	16	-
	MGII 885	Thermal-Fluid Systems Modelling I	16	-
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
	MGII 887	Gas Turbine Theory and Performance	16	-
Total credits to be obtained:			180	

I.4.13.2 NUCLEAR ENGINEERING

Nuclear Engineering courses are presented on focussed contact basis. 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. More information regarding the course schedule, lecture venue, structure of the courses etc. can be obtained from the School of Mechanical and Nuclear Engineering, at tel. (018) 299-1355.

The option A (full dissertation) curriculum is not offered for Nuclear Engineering.

Full-time students will register for Option B and part-time will register for Option C.

Component	Option B		Option C	
	Credits	Composition	Credits	Composition
Dissertation (compulsory)	92	Dissertation	44	Mini-dissertation
Fundamental and core modules (compulsory)	56	1x8 credit module + 3x16 credit modules	72	1x8 credit module + 4x16 credit modules
Elective modules	32	2x16 credit modules	64	4x16 credit modules
TOTAL CREDITS	180		180	

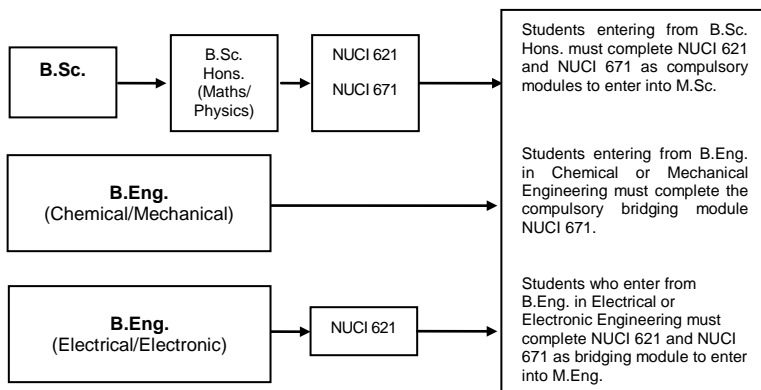
I.4.13.2.1 Pre-requisites for entering the M.Sc. in Nuclear Engineering

- a B.Sc. degree with Mathematics, Applied Mathematics or Physics at least to the third year level or a B.Tech. degree in Engineering (Mechanical, Electrical or Chemical) plus a B.Sc. Honours degree in Physics or Mathematics.
- Post-Graduate diploma in Nuclear Engineering **with pass average of 65%**.

Students coming through the **B.Sc. degree** or B.Sc. Honours route must also register for Mathematics for Nuclear Engineers (NUCI 671) and **Thermal-Fluid Sciences (NUCI 671)** which will be bridging modules

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

The route to entering the Masters' programme can be described as follows:



I.4.13.2.2 Programme Structure

For **option B** curricula, a student must complete the compulsory modules plus two (2) of the modules in the list of elective modules.

Full-time students will register for Option B and part-time students will register for Option C.

I.4.13.2.3 M.Sc. Curriculum I803P - Nuclear Engineering (Option B)

Qualification code: 203200

Type	Code	Module	Cr	Pre-requisite
Compulsory	NUCI 872	Dissertation	92	-
	NVMI 874	Research Methodology	8	-
	NUCI 511	Nuclear Engineering I	16	-
	NUCI 883	Nuclear Engineering	16	NUCI 511 NUCI 621 NUCI 671
	NUCI 887	Reactor Analysis	16	NUCI 883
Elective modules two (2)]	NUCI 874	Advanced Reactor Analysis I	16	NUCI 887
	NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	16	NUCI 883, MEGI 874*
	NUCI 877	High Temperature Reactor Fuels and Materials	16	NUCI 883, NUCI 887
	NUCI 878	High Temperature Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 886	Pebble Bed Reactor Design	16	NUCI 883, NUCI 874
	NUCI 888	Reactor Safety	16	NUCI 883, NUCI 887
	NUCI 879	Nuclear Project Management	16	-
	NUCI 889	Pressurized Water Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 882	Light Water Reactor Thermal-Hydraulics	16	NUCI 883, MGII 885
	MEGI 874	Computational Fluid Dynamics I	16	MGII 885
	MGII 885	Thermal-Fluid Systems Modelling I	16	NUCI 621
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
	IIOB 886	System Engineering	16	-
Total credits to be obtained:			180	

I.4.13.2.4 M.Sc. Curriculum I804P - Nuclear Engineering (Option C)

Qualification code: 203200

Type	Code	Module	Cr	Pre-requisite
Compulsory	NUCI 873	Dissertation	44	-
	NVMI 874	Research Methodology	8	-
	NUCI 511	Nuclear Engineering I	16	-
	NUCI 883	Nuclear Engineering	16	NUCI 511, NUCI 621, NUCI 671
	NUCI 887	Reactor Analysis	16	NUCI 883
	NUCI 888	Reactor Safety	16	NUCI 883, NUCI 887
Elective [choose four (4)]	NUCI 874	Advanced Reactor Analysis I	16	NUCI 887
	NUCI 876	High Temperature Gas-Cooled Reactor Thermal-Fluid Analysis	16	NUCI 883, MEGI 874*
	NUCI 877	High Temperature Reactor Fuels and Materials	16	NUCI 883, NUCI 887
	NUCI 878	High Temperature Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 886	Pebble Bed Reactor Design	16	NUCI 883, NUCI 874
	NUCI 879	Nuclear Project Management	16	-
	NUCI 889	Pressurized Water Reactor Technology	16	NUCI 883, NUCI 887
	NUCI 882	Light Water Reactor Thermal- Hydraulics	16	NUCI 883, MGII 885
	MEGI 874	Computational Fluid Dynamics I	16	MGII 885
	MGII 885	Thermal-Fluid Systems Modelling I	16	NUCI 621
	MGII 886	Thermal-Fluid Systems Modelling II	16	MGII 885
	IIOB 886	System Engineering	16	-
Total credits to be obtained:			180	

I.4.13.2.5 Short courses offered

All of the Masters' modules are available for enrolment as short courses. Apart from these Masters' modules, the following modules may also be enrolled for as short courses (enquiries: Post-Graduate School of Nuclear Science and - Engineering):

Code	Module/Short Course name	Credits
NUCI 511	Nuclear Engineering I <i>(also part of M-programme)</i>	16
NUCI 521	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
PRA	The Fundamentals of Probabilistic Risk Assessment	
	Lateral Thinking and Problem Solving	

Students enrolling for the diploma may be granted exemption for a maximum of four modules completed as short courses, on condition that

an examination has been written and a mark obtained. The administration re. these short courses is taken care of by the School of Mechanical and Nuclear Engineering and does not form part of the formal University Academic Administration system (i.e. marks are not displayed on an Academic Record until exemption is granted).

I.5 RULES FOR THE DEGREE OF PHILOSOPHIAE DOCTOR

The Ph.D. in Engineering may follow on a Masters' in Engineering or another recognized qualification that will allow the student to attain equivalent status and which is approved by the Faculty Management Committee (post-graduate). The study may be undertaken full time or part time.

I.5.1 INTRODUCTION

Research in the Engineering Faculty is managed by the Unit for Energy Systems. The research required for a Ph.D. thesis must be conducted in the sub-programmes of the Unit for Energy Systems.

Promoters take full responsibility for the training of doctoral students who are expected to work independently on a thesis.

I.5.2 ADMISSION AND REGISTRATION

The admission and registration requirements are set out in General Rules A.8.1 and A.8.4.

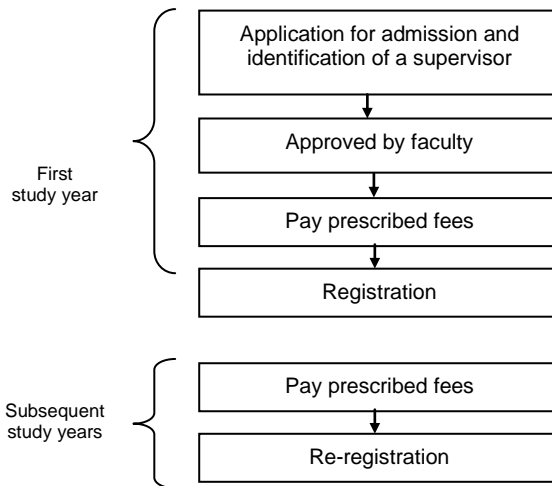
Prospective students must start by applying for **admission** to the North-West University - forms and information available from the Department of Academic Administration - Post-graduate Admissions - tel. (018) 299-4049.

Prospective students must consult the Post-graduate Prospectus to help them identify a **supervisor**. The Prospectus provides a list of research projects available for participation by students. The supervisor will then sign a supervisor acceptance form which must accompany the application form. Students will not be allowed to register unless a supervisor has been confirmed. The Prospectus is available from the Post-graduate Administrative manager - tel. (018) 299 4020 or on the web site: www.nwu.ac.za

After a student has been admitted, **registration** forms are issued, which must be signed by the Faculty Post-graduate Administration Manager before the student will be allowed to register. Prescribed **fees** must also be paid BEFORE registration.

Students must **re-register** every year according to the prescribed procedure, on or before the date set by the University.

The process can be illustrated as follows:



I.5.2.1 Foreign qualifications

Students holding a foreign qualification (i.e. not obtained at a South African University), are required to have the qualification evaluated by SAQA (South African Qualifications Authority) and a certificate re. the evaluation must be submitted with the application form. Visit their website at www.saqa.org.za.

I.5.3 APPROVAL OF THE STUDY PROGRAMME

Approval of the study programme is given in terms of the provisions in General Rule A.8.2 as well as the relevant requirements in the Manual for Post-graduate Studies. **All students must consult this Manual carefully.** A version of this Manual for Post Graduate Studies is available on the university's web site (www.nwu.ac.za).

I.5.4 ADDITIONAL REQUIREMENTS

The title of the thesis, the research proposal and appointment of external examiners must be reviewed by the Faculty Management Committee (post-graduate). Further information regarding rules and procedures are contained in the general academic rules A.8.5.7 and in the Manual for Post-graduate Study.

In addition to attaining the above-mentioned outcomes, students are also required to:

- (a) Take part in at least two formal colloquiums and/or technical conferences where aspects of their work are presented to an audience of established researchers and peers.

- (b) Have at least one full-length research paper on aspects of the dissertation submitted for publication in an accredited scientific journal before being allowed to submit the dissertation for examination.

Official **prescribed forms** are used in the post-graduate study process, and are available from the Faculty post-graduate admin manager - tel. (018) 299-4020 or are available on the Faculty's web site - www.nwu.ac.za.

I.5.5 ASSUMPTIONS REGARDING PRIOR LEARNING

- (a) The student holds a Masters' degree in Engineering, or a M.Sc. in Engineering Sciences, or has been allowed to that status.
- (b) The School Director may, with notification to the Faculty Management Committee (post-graduate), allow students who do not comply with the above-mentioned requirements to register for the M.Sc. or M.Eng. degree, on the grounds of knowledge and experience gained through prior learning. The Faculty's policy with regard to Recognition of Prior Learning applies.
- (c) Programme specific assumptions are, where applicable, indicated at each programme description.

I.5.6 ARTICULATION POSSIBILITIES

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

I.5.7 OUTCOMES

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.

The programme outcomes will have been achieved if it is demonstrated that the candidate has made an original contribution to knowledge in a chosen field as evidenced by a thesis with proper structure, style and language that includes:

- Identification and formulation of an original research problem.
- A critical, relevant and comprehensive literature survey indicating the originality of the envisaged contribution.
- Development of the necessary research procedures and experimental facilities/numerical models.
- Execution of either an empirical or numerical investigation in order to address the research problem.
- Verification and validation of the results.
- Assessment of the results and conclusions making the case for the original contribution.

I.5.8 DURATION OF THE STUDY

The minimum term of study is two (2) years and the maximum term of study is four (4) years full-time and six years part-time calculated from the beginning of the first year of registration.

General Rule A.7.5.8 is applicable to students whose Masters' registration has been converted to Ph.D. registration.

I.5.9 EXAMINATION

The examination for the Ph.D. degree is conducted in accordance with the requirements of General Rule A.8.5.

I.5.9.1 Submission of thesis for examination

According to general rule A.8.5.4, a thesis must be submitted for examination before or on the date determined annually by the senate and indicated in the relevant annual timetable. Certain prescribed forms are to be completed before and at submission.

Please consult the Faculty's Post-graduate Administration Manager for the necessary procedures to be followed and forms to be completed.

I.5.10**PROGRAMMES: PH.D. IN THE FACULTY OF ENGINEERING**

Please note that all students who have not yet completed the compulsory 8-credit module Research Methodology as part of their Masters' studies, have to complete this module as well before Ph.D. studies are commenced.

Programme qualification codes, curriculum codes and modules follow below. All modules are 256 credit-modules.

Branch	Programme qual. code	Curriculum code	Module code
School of Chemical & Minerals Engineering			
Chemical Engineering	703104	I901P	CEMI 971
School of Electrical, Electronic and Computer Engineering			
Computer Engineering	703113	I910P	EREI 971
Computer and Electronic Eng.	703109	I906P	REEI 971
Electrical Engineering	703105	I902P	EERI 971
Electronic Engineering	703106	I903P	EEEI 971
Electrical and Electronic Eng.	703108	I905P	ELEI 971
School of Mechanical and Nuclear Engineering			
Mechanical Engineering	703107	I904P	MEGI 971
Nuclear Engineering	703112	I909P	NUCI 971
CRCED Vaal			
Development and Management	703111	I908P	IIOB 971
All			
Engineering Science	703110	I907P	IWTS 971

Note: CRCED Pretoria offers supervision in a variety of the above study areas. Please consult the CRCED personnel at (012) 809-1076.

I.5.11

MODULE DESCRIPTIONS AND/OR OUTCOMES (ALPHABETICAL ORDER)

CEMI 875 FLUID-PHASE EQUILIBRIUM

After completion of this course, the student will 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; Use advanced thermodynamic theory for the development of separation processes such as membrane separation, supercritical extraction and relative distillation.

The module is presented as follows: About 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes. About 120 hours of self study and preparation of assignments

CEMI 876 SEPARATION PROCESSES

After completion of this course, the student will be able to:

Select membrane processes for the separation of fluids as well as 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; Develop and model reactive distillation systems for low temperature reactions with homogenous and heterogeneous catalysts.

The module is presented as follows: About 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes. About 120 hours of self study and preparation of assignments

CEMI 877 COAL TECHNOLOGY I

After completion of this course, the student will 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; Model fluidised bed combustion and gasification for design purposes.

The module is presented as follows: About 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes. About 120 hours of self study and preparation of assignments

CEMI 878 COAL TECHNOLOGY II

After completion of this course, the student will be able to:

Apply coal properties for beneficiation on coal samples from various mines; Evaluate economic aspects of coal beneficiation; 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; Undertake research on the relevant problems of coal mining, beneficiation and stockpiling.

The module is presented as follows: About 40 hours contact time with the lecturer in the form of formal lectures, tutorials and discussion classes. About 120 hours of self study and preparation of assignments

CEMI 879 BIOREACTORS AND BIOPROCESS TECHNOLOGY

After successful completion of this module the student will 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 of 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.

This module is presented as follows: Approximately 50 hours contact time with the lecturer in the form of formal lectures, approximately 70 hours of contact time with the lecturer in the form of assignments and formal workshops, approximately 40 hours in the form practical laboratory sessions.

CEMI 881 BIO-ETHANOL PROCESS TECHNOLOGY

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

- 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;
- 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;
- Identify and appreciate barriers of market penetration of bio-ethanol in some developing countries.

This module is presented as follows: Approximately 30 hours contact time with the lecturer in the form of interactive lectures and discussion groups and 130 hours of self-study and preparation of assignments.

CEMI 882 STS AND RENEWABLE ENERGY

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

- Understand and know the concepts pertaining to science, technology and society (STS) in context of renewable energy;
- 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.

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. Approximately 50 hours for a community project and meetings.

CEMI 883 INTRODUCTION TO RENEWABLE & SUSTAINABLE ENERGY

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

- 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.

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 contacts time with the lectures in the form of form of a formal practical demonstration and approximately 117 hours of self-study and preparation of workshops and practical demonstration models.

CEMI 884 BIODIESEL PROCESS TECHNOLOGY

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

- Have a working knowledge of the cultivation of crops for biodiesel production;
- 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;
- Have a working knowledge of the technologies available for the recovery and purification of glycerol from the biodiesel production process;
- Devise a production route for the production of biodiesel from various feedstocks;
- 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 properties of biodiesel;
- Identify and appreciate barriers of market penetration of biodiesel fuels in some developing countries.

This module is presented as follows: Approximately 30 hours contact time with the lecturer in the form of interactive lectures and discussion groups and 130 hours of self-study and preparation of assignments.

EEII 881**DATA MINING AND KNOWLEDGE EXTRACTION**

Motivation for the application of data mining and knowledge extraction, discussion of the typical application and purpose of the 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 analyses, prediction of future behaviour. *Practical examples:* complex industrial processes, financial markets, logistic processes, communication networks, client behaviour as part of CRM, detection of fraud.

EEII 882**ELECTRICAL POWER QUALITY**

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**ADVANCED PROTECTION SYSTEMS**

The course 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 practicals to test their designs and setpoint values on real machines with a variety of relays.

EEII 884**ADVANCED SIGNAL PROCESSING**

This course concentrates on digital signal processing methods. Signal processing methods can be classified into two groups namely transform orientated and other (e.g. heuristically orientated). 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 (Fourrier) 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**INFORMATION SYSTEMS FOR E-TRADE AND E-LOGISTICS**

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

stability, design of controller applications in multi-changing systems, condition changing formulations, minimising of cost functions, optimal controllers, realising of digital control systems, system simulation. Modern control software.

ERIE 874 NEURAL NETWORKS

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 course 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 visualisation, generalisation capacity, optimising, algorithms, error functions.

Topologies: memory, grouping algorithms and networks, linear networks, multi-layer perceptron networks, radial base function networks, neural networks with feedback, multi-network systems, fuzzy logic and neural networks.

Application: pattern recognising, neural networks in control systems, neural networks and regression.

ERIE 875 FUZZY LOGIC SYSTEMS

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 PROCESS MODELLING AND IDENTIFICATION

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 using neural networks. The successful student will be able to write computer code to do modelling from a menu with components.

IIOB 881 PROJECT MANAGEMENT

After successful completion of the module the student will have **knowledge** and **skills** pertaining to the theory, concepts, processes, tools and techniques of project management. He/she will have applied the same to a real life study project. The student will further have the capability and confidence to professionally manage projects in the work environment, and he/she will 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;
- Risk management factors in project management.

IIOB 882 MAINTENANCE MANAGEMENT

The objective of the module is to teach students the underlying theoretical knowledge and principles of maintenance management in its broadest sense, and 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 will have **knowledge** of the following:

- Systems Engineering (SE) Principles with emphasis on Maintainability and Reliability
- The roll 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
- Computerised Maintenance Management Systems (CMMS) and its application
- Maintenance Information and how to maximise its use.
- Maintenance Life Cycle Costing and the cost of maintenance
- Maintenance Management Theory at top academic level and knowledge of its application and management on plant and equipment level.

IIOB 883 CORPORATE CAREER SKILLS

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 will have **knowledge** of the following:

- 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 & sales, the supply chain, product development, human resources, environmental & social responsibilities, financial accounting & reporting)
- The legal environment within which the corporate operates (the tax system, HR development legislation, environmental & safety legislation, etc.)
- The physical and psychological impact that the work environment places on staff. How these should be managed in order to cope effectively as an individual and employee.
- Self insight in how the student fits into all of the above - how to optimise your contribution to your employer, while at the same time develop your career and personal well-being.

IIOB 885 ENTREPRENEURIAL CAREER SKILLS

After successful completion of the module the student will 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 minimise 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.
- The business power that cyberspace offers.

After successful completion of the module the student will be able (have the skills) to do the following:

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

After the successful completion of the module the student will understand and appreciate the following values:

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

IIOB 886 SYSTEM ENGINEERING

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

IIOB 887 PROJECT QUALITY MANAGEMENT

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 multi disciplinary project team.

After completion of the module in Project Quality Management the engineer will 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.

These will include to:

- Demonstrate an understanding of quality as it applies to project management in the context of the quality cycle
- Explain project quality management in the context of a safety critical project.
- Identify the applicable requirements of quality management for a specific safety critical project.
- Develop a quality management plan applicable to a safety critical project, and
- Identify the required components of quality planning, quality assurance and quality control.
- Demonstrate interpersonal skills as appropriate to project quality management.
- Implement an appreciation of human factors of quality management in a safety critical project.

More specifically as a summative assessment of learning achieved, the learner will demonstrate skill in the application of the above aspects of project quality management by application to a relevant study project and the presentation and defence of such to a panel of professional peers.

MEGI 874 COMPUTATIONAL FLUID DYNAMICS

This course 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 course the student will be able to:

- Understand the capabilities and the limitations of CFD;
- Generate various types of computational grids;
- Derive the conservation equations for flow problems and recognise the various formulations for the conservation equations, and understand turbulence and the mechanisms which form the basis of various turbulence models;
- Understand the various discretisation techniques, formulate the finite difference discretisation of the Poisson heat equation for various boundary conditions and obtain the numerical solution;
- Perform the finite volume discretisation 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.
- Generate the computational grid, set up a problem and compute the solution using a commercial code.

MEGI 875 COMPUTATIONAL FLUID DYNAMICS II

This course 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 course the student will be able to:

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

MEGI 876 FINITE ELEMENT METHODS

This course 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 course the student will be able to:

- Derive the weak formulation and obtain the Galerkin finite element formulation for one- and two-dimensional problems;
- Discretise 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;
- Extend the method to solve systems of differential equations, non-linear problems and problems with various constraints.

MEGI 877 FINITE ELEMENT METHODS FOR FLOW

This course presents the theoretical and practical aspects of the solution of the Navier-Stokes equations using the finite element method. On successful completion of the course the student will 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;
- Extend the method to include non-isothermal flow problems.

MEGI 878 ENERGY MANAGEMENT

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 ADVANCED ENGINEERING THERMODYNAMICS

Exergy and its use in open and closed systems. Exergy analysis of simple and complex systems. The time value of money. Use of exergy in Thermo-Economic analysis.

MEGI 884 ADVANCED STRENGTH OF MATERIALS

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 neutral 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.

Contact Tensions: Analysis of point and line contact tensions.

MGII 885 THERMAL-FLUID SYSTEMS MODELLING

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

- Integrate comprehensive knowledge of thermodynamics, fluid mechanics and heat transfer with specialised techniques required to simulate thermal-fluid systems for both steady state and transient conditions.
- Apply higher level engineering synthesis skills and specialised 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 THERMAL-FLUID SYSTEMS MODELLING II

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

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

MGII 887 GAS TURBINE THEORY AND PERFORMANCE

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, turbine blade design.

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.

MEGI 889 MATERIALS SELECTION FOR DESIGN

The design process, engineering and their 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, ceramics composites, materials, aesthetics and industrial design.

MEGI 894 COMPOSITE MATERIALS

Properties of composite materials: polymer matrix materials

Elastic properties of fibre reinforced composite materials: micromechanical models, laminate analysis, short fibre composites.

Strength of composite materials: Tensile strength, fibre orientation and tensile properties, tensile properties of multilayered laminates, compressive strength, shear strength, toughness and fatigue life.

NUCI 511 NUCLEAR ENGINEERING I

On the completion of this module the student should have reached the partial level required to continue with the post graduate diploma programme in nuclear engineering:

- The student should be able to reveal, apply and expand basic knowledge in atomic and nuclear physics and in nuclear engineering fields, about the interaction of radiation with matter, various nuclear power reactors and their fuel cycles, neutron moderation (slowing down) and diffusion in nuclear reactors.
- The student should also possess introductory knowledge of reactor analysis and time dependent behaviour of nuclear reactors, thermal hydraulics of nuclear reactors, radiation protection, radiation shielding, licensing, safety and environmental aspects of nuclear power.
- With the knowledge the student have obtained from this model he/she should be able to solve some basic problems related to nuclear energy and communicate with the public about the benefits and problems of nuclear power.

NUCI 521 THERMAL-FLUID SCIENCES

Thermodynamics: properties of pure substances, work and heat, First Law of Thermodynamics, Second Law of Thermodynamics, power cycles; Fluid mechanics: fluid static's, 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; Heat transfer: conduction, convection and radiation heat transfer, heat exchangers.

NUCI 572 NUCLEAR REACTOR TECHNOLOGY

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

NUCI 573 NUCLEAR REACTOR SAFETY

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 familiarise 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 barrier 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 course. 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 course.

NUCI 574 NUCLEAR ENGINEERING PROJECT

Learners will demonstrate their ability to execute a project in the field of nuclear engineering independently by publishing a concise scientific report on it.

NUCI 575 NUCLEAR PHYSICS

Learners will be introduced to the principles of radioactivity and the interaction of different types of radiation with matter. The content of the module will include; 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 RADIATIONS AND THE ENVIRONMENT

Learners will get 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. To provide the students 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 based on nuclear techniques. The content will include: 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 THERMAL-FLUID SCIENCES

On the completion of this module you 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
- Evaluate the performance of simple and complex systems and propose actions to improve their performance.

NUCI 671 MATHEMATICS FOR NUCLEAR ENGINEERS

On the completion of this module you should be able to solve mathematical problems related to Nuclear Engineering. With this knowledge you should be able to:

- Use different methods to solve partial and differential equations analytically.
- Solve partial and differential equations numerically.
- Use this basic knowledge to solve more complex problems.
- Use the methods learnt here in other nuclear engineering courses.

NUCI 874 ADVANCED REACTOR ANALYSIS I

On the completion of this module the student will have obtained a basic knowledge in neutron transport theory, neutron slowing down, resonance

absorption and neutron thermalization. With this knowledge the student should be able to:

- Understand the state-of-the-art calculational methods of deterministic transport theory and their implementation in transport theory computer codes.
- Understand the methods used for the determination of neutron energy spectrum in fast and thermal spectrum codes.
- Also understand the terminology and methods of resonance absorption calculations as part of the fast spectrum codes.
- You should be able to run and interpret the results of such computer codes as a member of a nuclear design team.
- You should furthermore be able to take part in research for development of new calculational methods in these fields.
- You should assume the role of a neutronics specialist and take part in joint projects with thermal-hydraulics specialists.
- Use the knowledge you've obtained as a base for pursuing doctoral level research in neutronics.

NUCI 876 HIGH TEMPERATURE GAS-COOLED REACTOR THERMAL-FLUID ANALYSIS

Upon completion of this module, students will possess a comprehensive and systematic knowledge base and skills in the following:

- Physical properties of fluids and solid materials used in HTRs;
- Pressure drop relationships for flow through a pebble bed reactor;
- Heat generation in HTRs;
- Heat transfer mechanisms in pebble bed HTRs;
- Conservation equations governing heat transfer and fluid flow in HTRs;
- Numerical solution techniques of the governing equations; and
- HTR design bases.

Students will also be able to independently perform simulations of all the design baselines for HTRs using existing codes and interpret the results.

NUCI 877 HIGH TEMPERATURE REACTOR FUELS AND MATERIALS

The students are expected to have the following qualifications upon the completion of this course;

- 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, burnup, CO production etc.
- Discuss main problems and ways of improvements for HTR fuel and structural materials.

- Relate reactor physics, thermal hydraulics, and reactor design aspects with reactor fuel and materials

NUCI 878 HIGH TEMPERATURE REACTOR TECHNOLOGY

- On the 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 student will get some more information on different processes of electricity production, on several in 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 NUCLEAR PROJECT MANAGEMENT

After successful completion of the Nuclear Project Management (NPM) module the student will have demonstrated mastery of basic knowledge and skills pertaining to the theory, concepts, processes, tools and techniques of project management.

He/she will have further applied the same to a typical nuclear industry project.

NUCI 882 LIGHT WATER REACTOR THERMAL-HYDRAULICS

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 will then be introduced via the formulation of reactor thermal hydraulic design problems. Particularly, steady state and transient analysis of single, heated channels will be covered.

NUCI 883 NUCLEAR ENGINEERING

- On the 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 will 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 PEBBLE BED REACTOR DESIGN

Upon completion of this module, learners will 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 will be explained. These properties include aspects of:
 - Neutron moderation;
 - Double heterogeneity;
 - Spectrum calculations;
 - Flux distribution;
 - Power generation;
 - Burn-up characteristics;
 - Pebble movement in the reactor under gravity;
 - Temperature feedback, and
 - Decay heat production.
- 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 HTRs using existing codes and interpret the results.

NUCI 887 REACTOR ANALYSIS

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;
- fuel burnup.

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 geometries and heterogenous lattices.

NUCI 888 REACTOR SAFETY

On the completion of this module the student will have obtained 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.
- Use the knowledge to work in the nuclear industry or in safety organisations for supervision of nuclear power plants.

Because the methods used in nuclear safety analysis are helpful in other fields of technology the student could get profit from the knowledge in future there, too.

NUCI 889 PRESSURIZED WATER REACTOR TECHNOLOGY

On the completion of the module the student should:

- have obtained the basic knowledge in understanding how Pressurized Water Reactors (PWRs) 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 PWRs now being ordered.
- have knowledge of the PWR systems that will help foster an understanding of the various design requirements.
- understand how the various systems interact to provide a reliable and safe source of electricity.

NVMI 874 RESEARCH METHODOLOGY

The main outcomes are the following:

1. Understanding the basic research process; and
2. Being able to implement the process.

Other detail outcomes include the following:

- Knowing how to adopt a structured approach towards research
- Knowing how to perform an effective literature study
- Performing a literature survey, for your proposal, and for the literature survey deliverable
- Being able to write your own research proposal
- Writing a research proposal as deliverable

- Learning proper writing skills and the different elements of a dissertation or thesis
- Learning the principals of plagiarism
- Applying these principals in the plagiarism work
- Learning from the mistakes that have been made by other researchers
- Giving you a head start to completing your Masters' or PhD