FACULTIES OF THE
UNIVERSITY OF PRETORIA

HUMANITIES
NATURAL AND AGRICULTURAL SCIENCES
LAW
THEOLOGY
ECONOMIC AND MANAGEMENT SCIENCES
VETERINARY SCIENCE
EDUCATION
HEALTH SCIENCES
ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

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FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

PART I
(this publication)

SCHOOL OF ENGINEERING
- Industrial and Systems Engineering
- Chemical Engineering
- Electrical, Electronic and Computer Engineering
- Mechanical and Aeronautical Engineering
- Materials Science and Metallurgical Engineering
- Mining Engineering
- Civil Engineering

GRADUATE SCHOOL OF TECHNOLOGY MANAGEMENT
- Engineering and Technology Management

PART II
(separate publication)

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GENERAL INFORMATION

The information regarding degree programmes here published is subject to change and may be amended prior to the commencement of the academic year in 2012.

Admission
Any person who wishes to register at the University for the first time, or after an interruption of studies, should apply or reapply for admission. Application for admission to all programmes closes on 30 September.

Selection
A selection procedure takes place prior to admission to any programme in the School of Engineering. Restrictions may be placed on the number of students admitted to the School and/or its departments. Postgraduate selection takes place as stipulated in the respective departmental rules.

Number restriction
If limited human resources and/or facilities are available, number restrictions will be applied.

Statement of symbols
When registering at this University for the first time, an undergraduate candidate must submit a statement of symbols obtained for subjects in the Grade 12 examination.

National Senior Certificate
All undergraduate candidates who enroll at the University of Pretoria for the first time, must show their original National Senior Certificate at the Student Administration of their faculty before the end of the first semester.

Language of tuition
In conducting its general business, the University uses two official languages, namely Afrikaans and English.

In formal education, the language of tuition is either Afrikaans or English or both languages, taking the demand as well as academic justification and economic viability into consideration. However, it remains the student's responsibility to determine in which language a module and any further level of that module is presented. This information is published annually in the Timetable. The University reserves the right to change the language of tuition on short notice, depending on the size of the groups and the availability of lecturers. In respect of administrative and other services, a student may choose whether the University should communicate with him or her in Afrikaans or English.

Bursaries and loans
Particulars about bursaries and loans are available on request.

Accommodation
Applications for accommodation in university residences for a particular year may be submitted as from 1 March of the preceding year. Applications will be considered while vacancies exist, and prospective students are advised to apply well in advance. Please note that admission to the University does not automatically mean that lodging will also be available.

Welcoming day, registration and start of the academic year
Details of the welcoming day to which all parents are cordially invited, and the subsequent programme for registration and start of the academic year during which all new first-year students **must** be present, are obtainable from the office of the Dean of Students.

Prescribed books
Lists of prescribed books are not available. The lecturers will supply information regarding prescribed books to students at the commencement of lectures.

Amendment of regulations and fees
The University retains the right to amend the regulations and to change tuition fees without prior notification.
NB The fees advertised and thus levied in respect of a module or study programme presentation represents a combination of the costs associated with the formal services rendered (for example lectures, practicals, access to laboratories, consumables used in laboratories, etc.) as well as associated overheads such as the provision of library and recreation facilities, security and cleaning services, electricity and water supply, etc. Therefore the fees in respect of a module or study programme presentation cannot simply be reconciled with the visible services that are rendered in respect of such module or study programme.

SYSTEM OF TUITION

In 2001, the School of Engineering commenced with phasing in a new system of tuition, which corresponds with the required guidelines of SAQA (the South African Qualifications Authority) and the NQF (National Qualifications Framework), as well as with the accreditation requirements of ECSA (Engineering Council of South Africa). In this system, programmes are offered which are outcomes-based, student-centred and market-orientated. More information on this matter is given in the Glossary of Terms below, as well as in Regulation Eng.13.

GLOSSARY OF TERMS

academic year: The duration of the academic year which is determined by the University Council.
admission regulation: A regulation compiled by the dean concerning the admission of students to a specific School, which includes a provision regarding the selection process.
credit (or **credit value**)**:** A value unit linked to learning activities, calculated in accordance with the SAQA norm of 1 **credit = 10 notional hours (learning hours)**. Credits are linked to modules and qualifications. In the School of Engineering modules normally carry credit values of 8 or 16 each, and typically a total of 640 credits is required for the Bachelor of Engineering degree.
curriculum: A series of modules which form a programme, grouped together over a specified period of time and in a certain sequence according to the regulations.
ECSA: Engineering Council of South Africa. This is a statutory council which is inter alia responsible for the registration of professional engineers and for the accreditation of the academic programmes for engineers at South African universities.
examination mark: The mark a student obtains for an examination in a module, including practical examinations where applicable.

extended programme: A programme for a degree or diploma that is completed over a longer period than the minimum duration of the particular degree or diploma.
final mark: The mark calculated on the basis of the semester/year mark and the examination mark a student obtains in a particular module according to a formula which is determined from time to time in the regulations for each module with the proviso that should no semester/year mark be required in a module, the examination mark serves as the final mark.
GS: A combined (final) mark (semester/year mark and examination mark) of 40% - 49%.
grade point average based on module credits (GPA): an average mark that is calculated by multiplying the final mark achieved in a module with the credit value of that module and then dividing the sum of these values by the total of the credit values of all the modules for which a student was enrolled. The result of these calculations is a weighted average based on module credits.
learning outcome: The end product of a specified learning process, i.e. the learning result (specific skills) that one intends to achieve at the end of the learning process.
level of a module: The academic level (year) of a module which is indicated in the module code, which gives an indication of the complexity of the module.
module: An independent, defined learning unit, designed to result in a specific set of learning outcomes, and which is a component of a programme.
module code: Consists of an equal number of letters and digits, which indicate the name of the module, the year of study, the period of study and the level of the module.
notional hours (learning hours): The estimated number of hours students should spend to master the learning content of a particular module or programme. The total number of learning hours for a module consists of the time needed for lectures, tutorials and practicals (contact hours), as well as for self-study, examination preparation and any other activity required by the study programme. (**notional hours = credits x10**)
NQF: National Qualifications Framework. This is a national framework in which all SAQA-registered qualifications are listed, arranged on eight levels in accordance with the complexity of the qualification.
programme: This is a comprehensively planned, structured and coherent set of teaching and learning units (modules), designed to satisfy a specific set of outcomes at exit-level, which culminates in a student being awarded a particular qualification (diploma, degree).
promotion: Promotion means that for certain modules a student may be exempted from the final examination, provided that a student's semester or year mark for the module exceeds a certain predetermined minimum percentage (e.g. 75%).
qualification: In outcomes-based education, a qualification is a diploma or a degree which is obtained after attaining the learning outcomes as specified in a coherent learning programme, expressed as an accumulation of credits at specific levels.
SAQA: South African Qualifications Authority. This body has been established by law and has as its purpose the registration of qualifications, programmes and unit standards, in order to ensure that specific national and international criteria are achieved.
semester/year mark: The mark a student obtains during the course of a semester or a year for tests, class-work, practical work or any other work in a particular module as approved by regulation.
student-centred learning: Teaching and learning methodology which facilitates the student's own responsibility for the learning process. A prerequisite is that lectures, tutorials and practicals be adapted so that active participation by students is always achieved.
syllabus: Summary of the contents of a module.

DEGREES CONFERRED IN THE SCHOOL OF ENGINEERING AND GRADUATE SCHOOL OF TECHNOLOGY MANAGEMENT

The following degree is awarded in the School of Engineering (minimum duration in brackets):

(a) **Bachelor's degree:**
  (i) Bachelor of Engineering – [BEng] (four years)

The following degrees are awarded in the School of Engineering and the Graduate School of Technology Management (minimum duration in brackets):

(a) **Honours degrees:** (one year)
  (i) Bachelor of Engineering Honours – [BEngHons]
  (ii) Bachelor of Science Honours – [BScHons]
(b) **Master's degrees:** (one year)
  (i) Master of Engineering – [MEng]
  (ii) Master of Science – [MSc]
(c) **Doctorates:** (one year)
  (i) Doctor of Philosophy– [PhD]
  (ii) Doctor of Philosophy in Engineering – [PhD (Engineering)]
  (iii) Doctor of Engineering – [DEng]

Regulations for the degree: Bachelor of Engineering [BEng]

Eng. 1
Admission to degree study
General Regulations G.1 to G.15 are applicable to all bachelor's degrees. Where the General Regulations have vested authority in the Faculty to determine its own provisions, these provisions appear in this publication.

General
To register for a first bachelor's degree at the University, a candidate must, in addition to the required National Senior Certificate with admission for degree purposes, comply with the specific admission requirements for particular programmes and fields of study as prescribed in the admission regulations and the regulations of the departments. Applicants are notified in writing of provisional admission. Admission to the School of Engineering is based on the final grade 12 examination results.

(a) The following persons may also be considered for admission:
  (i) A candidate who is in possession of a certificate which is deemed by the University to be equivalent to the required National Senior Certificate with admission for degree purposes.
  (ii) A candidate who is a graduate from another tertiary institution or has been granted the status of a graduate of such an institution.
  (iii) A candidate who passes an entrance examination, which is prescribed by the University from time to time.

  Abovementioned candidates are requested to contact the faculty for more information regarding admission requirements.
  Note: A conditional exemption certificate does not grant admission to bachelor's study. However, in certain circumstances some of the faculties do accept a

conditional exemption on the basis of mature age and prior knowledge. Candidates are advised to contact the specific faculty administration in this regard.

(b) The Senate may limit the number of students allowed to register for a programme, in which case the Dean concerned may, at his discretion, select from the students who qualify for admission those who may be admitted.

(c) Subject to faculty regulations and the stipulations of General Regulations G.1.3 and G.62, a candidate will only be admitted to postgraduate studies, if he or she is already in possession of a recognised bachelor's degree.

Academic literacy

It is expected of all new undergraduate students who wish to study at the University to sit for an academic literacy test. Certain modules which address shortcomings in this respect, are included in the undergraduate curriculum, as indicated in Eng. 15.1 and 15.2. In addition, modules which have the purpose of developing specific language and communication skills in the context of the requirements of the engineering profession are also included in the curriculum.

Admission requirements for candidates with a National Senior Certificate (NSC)

To be able to gain access to the faculty and specific programmes prospective students require the appropriate combinations of recognised NSC subjects as well as certain levels of achievement in the said subjects. In this regard the determination of an admission point score (APS) is explained and a summary of the faculty specific requirements, i.e. the APS per programme and the specific subjects required per programme is provided.

Determination of an Admission Point Score (APS)

The calculation is simple and based on a candidate's achievement in six 20-credit recognised subjects by using the NSC ratings, that is the "1 to 7 scale of achievement". Thus, the highest APS that can be achieved is 42.

Life Orientation is excluded from the calculation determining the APS required for admission.

Rating code	Rating	Marks %
7	Outstanding achievement	80-100%
6	Meritorious achievement	70-79%
5	Substantial achievement	60-69%
4	Adequate achievement	50-59%
3	Moderate achievement	40-49%
2	Elementary achievement	30-39%
1	Not achieved	0-29%

Preliminary admission is based on the results obtained in the final Grade 11 examination. Final admission is based on Grade 12 results. Please note: The final Grade 12 results will be the determining factor with regard to admission.

Alternative admission channels:

Candidates with an APS lower than required could be considered for admission to the faculty if they meet the additional assessment criteria specified by the faculty from time to time. Preference will, however, be given to students who comply with the regular admission requirements of the faculty.

Specific requirements for the Faculty of Engineering, Built Environment and Information Technology

1. A valid National Senior Certificate with admission for degree purposes.
2. Minimum subject and level requirements

School of Engineering – minimum requirements					
Degree	APS	Group A		Group B	
		Two Languages	Mathematics	Physical Science	Two other subjects
Engineering (4-year programme)	36	Comply with NSC minimum require-ments; ADDITIONALLY one of these languages must be Afrikaans OR English at level 5 (60-69%).	7 (80-100%) OR 6 (70-79%) provided a mark of 7 (80-100%) is obtained in Physical Science	6 (70-79%)	Any two subjects
Engineering (4-year or 5-year programme depending on results of the compulsory institutional proficiency test)	30	Comply with NSC minimum require-ments; ADDITIONALLY one of these languages must be Afrikaans OR English at level 5 (60-69%).	6 (70-79%)	5 (60-69%)	Any two subjects
Engineering (5-year programme) depending on results of the compulsory institutional proficiency test)	25	Comply with NSC minimum requirements; ADDITIONALLY one of these languages must be Afrikaans OR English at level 4 (50-59%).	5 (60-69%)	4 (50-59%)	Any two subjects

NB
Mining Engineering students are advised to also check if they are medically compliant with the government requirements to work on a mine.
Consult: http://mohealth.co.za
and
www.dme.gov.za/pdfs/mhs/occupational_health/fitness_minimum_standards.pdf

Note:

- The applications of candidates whose Grade 11 marks do not meet the admission requirements, but who comply with the above requirements in the Grade 12 examinations, will be reconsidered on request, based on their results in the institutional proficiency test and only if there are places available in the

Faculty, and on condition that the candidates applied for admission to engineering studies prior to 30 September of the previous year.

- Candidates, who are admitted provisionally on the basis of their Grade 11 results, retain their admission after sitting for the Grade 12 examinations, only if they obtain an NSC with admission for degree purposes and comply with all of the above requirements.

Eng. 2

(a) **Registration for a specific year**

A student registers for all the modules he or she intends taking in that specific year (first and second-semester modules and year modules) at the beginning of an academic year. Changes to a curriculum at the beginning of the second semester may be made only with the approval of the Dean.

(b) **Module credits for unregistered students**

There are students who attend lectures, write tests and examinations and in this manner earn "marks", but have neither registered for modules nor registered as students. These marks will not be communicated to any student before he/she has provided proof of registration. A student cannot obtain any credits in a specific academic year for a module "passed" in this manner during a previous academic year and for which he/she was not registered. This arrangement applies even where the student is prepared to pay the tuition fees.

Eng. 3

Examinations

(a) **Examinations and projects**

(i) An examination in a module may be written and/or oral. Projects are prepared and examined as stipulated in the study guide of the module, in accordance with the regulations and procedures as described in (c) below.

(ii) The examinations for modules of the first semester are held in May/June, while all other examinations (second-semester modules and year modules) are held in October/November.

(b) **Examination admission**

A student must obtain a minimum semester/year mark of at least 40% to gain examination admission to a module, with the exception of first-year modules at first-semester level where at least 30% is required. In addition, all other examination requirements as applicable to the specific module, must be satisfied.

(c) **Pass requirements**

Refer also to General Regulations G.11.1(a) and G.12.2.2

(i) In order to pass a module a student must obtain an examination mark of at least 40% and a final mark of at least 50%. A student passes a module with distinction if a final mark of at least 75% is obtained. The final mark is compiled from the semester/year mark and the examination mark. Borderline cases (e.g. a mark of 49% or 74%) must be reconsidered by both the internal and external examiners, for determination of the possible merit of an upward adjustment of the mark. Marks may not be adjusted downwards, except when obvious marking and adding errors were detected. The pass mark is a minimum final mark of 50% and a student fails the module if a lower mark (e.g. 49%) was obtained.

(ii) Calculation of the final mark: The semester/year mark must account for no less than 40% and no more than 60% of the final mark, with the exception of

modules like design and research projects and essays, as well as in modules where the development of general skills is the primary learning activity, where appropriate alternative norms are determined by individual schools or departments. The specific details and/or formula for the calculation of the final mark are given in the study guide of each module. Also, a schedule listing this information for all the modules presented in each school will be compiled, for approval by the Dean.

(iii) Calculation of the semester/year mark. The semester/year mark is com-piled from formative assessment of learning activities such as assignments, presentations, practicals and group projects, as well as from class tests and semester tests. For each module the specific formula for the calculation of the semester/year mark is determined by the lecturer(s) responsible for the presentation of the module and the details are given in the study guide of the module. Also, a schedule listing this information for all the modules presented in each school will be compiled, for approval by the Dean. Refer also to General Regulation G.11.1(b).

(iv) In some modules specific requirements in respect of certain components of the semester/year mark may be set, in order for a student to pass the module (for example that satisfactory performance in and attendance of practical classes are required). Thus, even if a pass mark is obtained in the module, a pass is not granted unless these requirements are met. For such modules these specific requirements are given in the study guide of the module. Also, a schedule listing this information for all such modules presented in each school will be compiled, for approval by the Dean.

(v) A student must comply with the subminimum requirements in subdivisions of certain modules. For such modules these specific requirements are given in the study guide of the module. Also, a schedule listing this informa-tion for all such modules presented in each school will be compiled, for approval by the Dean.

(vi) General Regulation G.10.3 is normally not applied by the School of Engineering and no promotion (exemption from the examination) is allowed in any module, except in special cases where permission of the Dean is required.

(d) **Ancillary examinations**

Refer to General Regulation G.12.3

(e) **Supplementary examinations**

Refer to General Regulation G.12.3

In the School of Engineering a supplementary examination is only granted in instances where:

(i) A final mark of between 45% and 49% was achieved;

(ii) A final mark of between 40% and 44% was achieved and where the candidate also achieved either a semester mark or an examination mark of 50% or higher;

(iii) A pass mark has been obtained, but the required subminimum in the examination section of the module or divisions thereof has not been obtained.

(iv) A final mark of between 40% and 49% has been obtained in first-year modules in the first semester.

Calculation of the final supplementary examination mark:

(1) The semester mark is retained and the final mark is calculated as the weighted average of the supplementary examination mark and the semester

mark, in accordance with the formula as published in the study manual of the specific module, with the proviso that the maximum final mark awarded may be no more than 50%. The only exception to this rule is in the case of first-year modules at first-semester level, where the semester mark is not considered, and where the supplementary examination mark is taken as the final mark, with the proviso that the maximum final mark awarded may be no more than 50%.

(2) All other pass requirements, as published in the study manual of each specific module, remain so and are applicable during the determination of the final result of a supplementary examination in the module.

Special supplementary examinations will not be arranged for students who were not able to write the supplementary examinations during scheduled times, as given in the examinations timetable.

(f) **Special examinations (including the aegrotat)**

Refer also to General Regulation G.12.5

(i) A medical certificate stating that a student appeared ill or declared him-/herself unfit to write the examination **will not be accepted**.

(ii) The doctor must be consulted **on or before the date** on which the examination was scheduled.

(g) **Other special examinations**

Refer also to General Regulation G.12.6

(i) The Dean may, at the recommendation of the head of the department concerned, grant a special examination in a module to a student who wrote the examination and failed that module in the final year of study, and consequently does not comply with degree requirements. A student may be granted at most two such special examinations. No special examinations will be allowed for modules with a project or design component in any discipline of engineering. No other special examinations are granted in the School of Engineering.

(ii) A student should apply in writing to the Dean to be considered for such special examination(s). The head of department decides when a special examination will take place and may prescribe work to be completed satisfactorily before a student may sit for such an examination.

(iii) During calculation of the final mark the semester mark is retained and the final mark is calculated as the weighted average of the special examination mark and the semester mark, in accordance with the formula as published in the study manual of the specific module, with the proviso that the maximum final mark awarded may be no more than 50%.

(h) **Re-marking of examination scripts**

Refer to General Regulation G.14

(i) **Duration of examinations in undergraduate modules**

The duration of an examination in an 8-credit module will not exceed 90 minutes and in a 16-credit module will not exceed 180 minutes, except where special approval is granted by the Dean to exceed these limits.

The duration of a supplementary examination or a special examination in all undergraduate modules will not exceed 90 minutes, except where special approval is granted by the Dean to exceed this limit. In the event of an aegrotat, the duration of the examination can be extended to a maximum period of 180 minutes, depending on an arrangement made between the lecturer and the student.

Eng. 4
Renewal of registration
Should a student who is repeating a year of study, with the exception of first-year students, fail to obtain sufficient credits to be promoted to the subsequent year of study at the end of the year of repetition, he or she will forfeit his or her right to readmission. Students who forfeit the right to readmission, may apply in writing to the Admissions Committee for readmission to the Faculty. Provisions regarding promotion, including provisions for first-year students, appear in the regulations of the relevant fields of study.

Eng. 5
Regulation no longer in use.

Eng. 6
Modules from other faculties
A student who follows a module presented by another school or faculty must familiarise himself or herself with the admission requirements of the specific module, the subminima in examination papers, time of supplementary examinations, etc.

Eng. 7
Change of field of study
Transfer from one field of study to another may only take place with the Dean's approval, after consultation with the relevant head of department.

Eng. 8
Minimum study period
The minimum period of study for the degree is four years of full-time study.

Eng. 9
First-aid certificate
As from 2004 the First-aid certificate is no longer a requirement for the BEng degree.

Eng. 10
Exposure to the practice of engineering
Engineering students are exposed in three ways to the practice of engineering during the course of their studies:
(a) Workshop practice – a module comprising a period at the end of the first year of study during which students are trained in workshop practice. Students in electrical, electronic and computer engineering attend the measurement techniques and computer modelling module.
(b) Practical training – specific periods of work at firms during which experience is gained in the practice of engineering. Students may deviate from this stipulation only with the permission of the Dean.
(c) Excursions – study excursions arranged for students to visit various engineering firms and installations in order to obtain insight into the industry. This training is compulsory. Details of the modules regarding these aspects of training are explained in the sections of this publication which deal with the curricula and syllabi of the various programmes.

Eng. 11
Registration of modules
(a) Final cut-off dates are set for the change of modules (removing or adding) for each academic year. These dates are available from the Student Administration offices.

(b) **A student may not register for a module of a subsequent year if a timetable clash occurs with a module of a previous year which has not yet been passed and which is prescribed for his or her field of study, unless exemption is obtained from class attendance in the module of the previous year.**

(c) Should a student register for modules of the second semester at the beginning of a year of study, and it becomes evident at the end of the first semester, that he or she does not comply with the prerequisites of the second-semester modules, the registration of such modules will be cancelled. It is also the student's responsibility to ensure at the beginning of the second semester that the cancellation has been brought about.

Eng. 12
12.1 Pass with distinction

(a) A student graduates with distinction if:
  (i) no module of the third or fourth year of study was repeated and a weighted average of at least 75% was obtained in one year in all the modules of the final year of study; and
  (ii) the degree programme was completed within the prescribed four years.

(b) Exceptional cases to the above will be considered by the Dean.

12.2 Dean's Merit List

The Dean's Merit List will be published annually on the website of the Faculty and will contain the names of the students whose academic performance over the year has been excellent and deserves recognition. Letters of commendation will be sent to students who qualify for inclusion on the Dean's Merit List.

To be eligible for inclusion in the Dean's Merit List, a student must pass all the modules as prescribed in the curriculum of a specific year of study as published in the Regulations, Part I, University of Pretoria, 2012. A student registered for the first, second or third year of the four-year programme must obtain a minimum weighted average of 75% and a student registered on the first, second, third or fourth year of the five year programme must obtain a minimum weighted average of 75%.

Curricula for the BEng programmes

Eng. 13
Fields of study, learning outcomes and learning contents

The Bachelor of Engineering degree may be obtained in the following fields of study:

(a) Chemical Engineering (12130021)
(b) Civil Engineering (12130081)
(c) Computer Engineering (12130101)
(d) Electrical Engineering (12130031)
(e) Electronic Engineering (12130091)
(f) Industrial Engineering (12130011)
(g) Mechanical Engineering (12130051)
(h) Metallurgical Engineering (12130061)
(i) Mining Engineering (12130071)

All aforementioned fields of study of the BEng degree have been accredited by the **Engineering Council of South Africa** (ECSA), and comply with the academic requirements for registration as a professional engineer. All the undergraduate programmes were recently restructured and the new programme for the first year of study was phased in in 2008, the second year was phased in in 2009 and the third year has been phased in since 2010. The new fourth year has been phased in from 2011. The new programmes are designed in accordance with the outcomes-based model as required by the **South African Qualifications Authority** (SAQA). The learning outcomes and contents of the programmes have been compiled in accordance with the latest accreditation standards (PE-60 and PE-61) of ECSA, which also comply with the SAQA requirements, and which are summarised as follows:
Learning outcomes of the BEng degree:
A graduate in engineering should be able to apply the following skills on an advanced level:

(a) Engineering problem solving.
(b) Application of specialist and fundamental knowledge, with specific reference to mathematics, basic sciences and engineering sciences.
(c) Engineering design and synthesis.
(d) Investigation, experimentation and data analysis.
(e) Engineering methods, skills, tools and information technology.
(f) Professional and general communication.
(g) Awareness and knowledge of the impact of engineering activity on society and the physical environment.
(h) Work in teams and in multidisciplinary environments.
(i) An awareness and ability for lifelong learning.
(j) An awareness and knowledge of principles of professional ethics and practice.

Learning contents of the BEng programmes:
Six essential knowledge areas are included in the syllabi of the programmes. The **typical** representation of each knowledge area as a percentage of the total contents of an undergraduate programme is given in brackets ( ) in the list below. This percentage varies for the different study directions, but conforms in all instances to the minimum knowledge area content as stipulated by ECSA.
Knowledge areas:

(a) Mathematics, including numerical methods and statistics (13%)
(b) Basic sciences: the natural sciences essential to the programme (15%)
(c) Engineering sciences (40%)
(d) Engineering design and synthesis (16%)
(e) Computing and information technology (5%)
(f) Complementary studies: communication, economy, management, innovation, environmental impact, ethics, engineering practice (11%).

Eng. 14
Module information
With a few exceptions, most modules offered at the School of Engineering are **semester modules** having credit values of either 8 or 16.

A student may be permitted by the Dean, on recommendation of the relevant head of the department, to register for an equivalent module in an alternate semester, although the module is normally offered to the student's group in another semester, and providing that no timetable clashes occur.

The curriculum of each programme is given in Regulations Eng. 15.1 and 15.2 in this publication, in which the information of **each module** is given, as per the following example:

Module		**Credits**	**Prerequisites**
XYZ 163	Mathematics 163	16	XYZ 151

(a) **XYZ 163:** Module code
XYZ A letter code of which the first letter identifies the department/division which offers the relevant module(s), as indicated in the table below:

Letter	**Department**
	School of Engineering:
B	Industrial and Systems Engineering
C	Chemical Engineering
E	Electrical, Electronic and Computer Engineering
M	Mechanical and Aeronautical Engineering
N	Materials Science and Metallurgical Engineering
P	Mining Engineering
S	Civil Engineering
	Graduate School of Technology Management:
I	Engineering and Technology Management

163: Numerical code of which the first digit indicates the level of the module (year of study during which the module is normally presented).

(b) **Mathematics 163:** Name of the module, as well as three digits which are similar to the numeric part of the module code.

(c) **16:** Number of credits allocated to the module. This is the value or the "weight" of the module, as estimated in accordance with the SAQA norm of **1 credit = 10 notional hours**. For example, for a module with a credit value of 16 the average student should devote approximately 160 hours (10 hours per week) in order to be able to achieve the set learning outcomes of the module (contact time, own study time and examination preparation time are all included). Lecturers are obliged to ensure that this is a fair time estimate when setting the workload of the module.

(d) **XYZ 151:** Prerequisite. Before a student is admitted to a module (XYZ 163), he or she must pass the prerequisite module(s) (XYZ 151), unless one of the following indications is used:

		Minimum requirement
()	Code in brackets: (XYZ 151)	Examination admission
GS	Code followed by GS: XYZ 151 GS	Combined (final) mark of 40% - 49%
#	Code followed by #: XYZ 151#	Concurrent registration

Deviations from these requirements may be permitted only with the approval of the Dean, after consultation with the relevant head(s) of department(s).

Eng. 15
Curricula

Eng. 15.1 Four-year Programmes
Please note:
The requirements for promotion from the one year of study to the next are given in **Eng. 16, Eng. 17** and **Eng. 18.**

Module		Credits	Prerequisites
SWK 122	Mechanics 122	16	WTW 158

Please note
Students who did not pass SWK 122 Mechanics 122 in their first year of study can take the module in the first semester of the following year.

Faculty requirement

Module		Credits	Prerequisites
JCP 203	Community-based project 203	8	

Notes
Students who register for the first year from 2005 will be required to successfully complete the above module as part of the requirements for the BEng degree. A student may register for the module during any of the years of study of the programme, but preferably not during the first or the final year of study.

(a) Chemical Engineering

First year of study
First semester

Module		Credits	Prerequisites
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General chemistry 171	16	
CIR 113	Chemical engineering 113	8	
HAS 110	Humanities and social sciences 110	8	
	Total	80	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
EBN 122	Electricity and electronics 122	16	
SWK 122	Mechanics 122	16	WTW 158
CHM 181	General chemistry 181	16	CHM 171
CIR 123	Chemical engineering 123	8	CHM 171GS, CIR 113
HAS 120	Humanities and social sciences 120	8	
	Total	80	

Recess training

WWP 121	Workshop practice 121	6

Notes
(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study
First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
CHM 215	Chemistry 215	16	CHM 171/172, 181
SWK 210	Strength of materials 210	16	SWK122, WTW168/WTW 128
CIR 211	Chemical engineering 211	8	CIR 123
MPR 213	Programming and information technology 213	18	
CJJ 210	Professional and technical communication 210	8	CIR 123
JCP 203	Community-based project 203	8	
	Total	90	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
CHM 226	Chemistry 226	8	CHM 171/172, 181
EIR 221	Electrical engineering 221	16	EBN 111/122, WTW 161
CTD 223	Thermodynamics 223	16	CIR 211, MPR 212/213 (WTW 258)
BES 220	Engineering statistics 220	8	
	Total	72	

Third year of study
First semester

Module		Credits	Prerequisites
BSS 310	Engineering management 310	8	
COP 311	Transfer processes 311	16	WTW 238, (WTW 263)
CPA 310	Particle technology 310	16	(CIR 211), COP 311#
CMO 320	Mass transfer 320	16	(CTD 223), COP 311#
CIR 310	Chemical engineering 310	16	(CTD 223), (SWK 210), (CHM 215)
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
CPN 321	Process dynamics 321	16	CIO 310#, CKN 321#
CKN 321	Kinetics 321	16	(CTD 223)
CLB 321	Laboratory 321	16	JSQ 216, CPN 321#, CKN 321#, (CMO320), CIO 310#
CIO 310	Chemical engineering design 310	16	(CTD 223)
	Total	72	

Recess training

CPY 311	Practical training 311	16	(JSQ 216), (CIR 211)

Fourth year of study
First semester

Module		Credits	Prerequisites
CPS 410	Process synthesis 410	8	CLB 321
CBI 410	Biotechnology 410	16	(CKN 321), (CMO 320), (CPA 310)
CPB 410	Process control 410	16	(CPD 320)/(CPN 321)
CRO 410	Reactor design 410	16	(CKN 320)/(CKN 321)
CSC 411	Research project 411	16	CLB 321, CPB 410#, CRO 410#
	Total	72	

Note:
- Students who have passed CBI 311, receive credit for CBI 410.
- Students who have not passed CIR 412, have to register for CPA 310 in 2012.

Second semester

CPJ 421	Design project 421	24	(CPB 410), (CRO 410), BIE 310/BSS 310, CPS 420#, CPR 420#
CPS 420	Process analysis 420	8	CPS 410
CPR 420	Chemical engineering practice 420	8	CLB 321
CSS 420	Specialisation 420	16	CPJ 421#
CSC 421	Research project 421	16	(CSC 411)
	Total	72	

Recess training

CPY 411	Practical training 411	16	(CMO 320), CPY 311

(b) Civil Engineering

First year of study
First semester

Module		Credits	Prerequisites
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
NMC 113	Materials science 113	16	
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
FSK 176	Physics 176	16	
EBN 122	Electricity and electronics 122	16	
SWK 122	Mechanics 122	16	WTW 158
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

SWP 121	Workshop practice 121	6

Notes

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study

First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
SWK 210	Strength of materials 210	16	SWK 122, WTW 168/128
SGM 210	Geomaterials and processes 210	16	
SUR 210	Surveying 210	16	
SJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	80	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
SIN 223	Structural analysis 223	16	WTW 161,168, SWK 210
SGM 221	Pavement materials and design 221	16	SGM 210 GS
SBZ 221	Civil engineering measurement techniques 221	8	
	Total	72	

Third year of study

First semester

Module		Credits	Prerequisites
SIE 310	Civil engineering economics 310	8	
SHC 310	Hydraulics 310	16	(SWK 210)
SIB 310	Timber design 310	8	SIN 223 GS
SIN 311	Structural analysis 311	8	SIN 223
SGM 311	Soil mechanics 311	16	(SWK 210)
MPR 213	Programming and information technology 213	18	
	Total	74	

Second semester

SHC 321	Hydraulics 321	16	(SHC 310)
SGM 323	Geotechnical engineering 323	16	(SGM 311)
SIN 323	Steel design 323	8	SIN 311 GS
SIN 324	Reinforced concrete design 324	8	SIN 311 GS
SVC 323	Transportation engineering 323	16	BES 220
SBM 321	Civil building materials 321	16	
	Total	80	

Fourth year of study
First semester

Module		Credits	Prerequisites
SHC 410	Hydraulics 410	16	(SHC 310) SHC 321GS
SSC 412	Research project 412	24	(SHC 321), (SIN 323), (SIN 324), (SGM 323), (SVC 323), (SBM 321)
SIN 411	Steel design 411	8	(SIN 323)
SIN 413	Reinforced concrete design 413	8	(SIN 324)
SVC 412	Infrastructure planning 412	16	(SVC 323) (BIE 310/ SIE 310)
IPI 410	Engineering professionalism 410	8	
	Total	80	

Second semester

SEV 421	Environmental geotechnology 421	16	
SBZ 420	Civil engineering construction management 420	16	(SVC 412)
SDC 420	Design concept 420	8	(SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
SDO 420	Detailed design 420	24	(SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
SPV 420	Public presentation 420	8	(SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
	Total	72	

Recess training

SPY 410	Practical training 410	16	

(c) Computer Engineering

First year of study
First semester

Module		Credits	Prerequisites
WST 111	Mathematical statistics 111	16	
WTW 158	Calculus 158	16	
EBN 111	Electricity and electronics 111	16	
COS 131	Introduction to programming 131	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
FSK 176	Physics 176	16	
ERA 284	Computer architecture 284	16	COS 130GS/COS 131GS/COS 132GS
COS 110	Program design: Introduction 110	16	COS 130GS/COS 131GS/COS 132GS

HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

EMR 100	Measurement technique and computer modelling 100	4	
EIW 121	Information technology practice 121	8	

Second year of study

First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
COS 212	Data structures and algorithms 212	16	COS 110
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
COS 216	Netcentric computer systems 216	16	COS 110
EJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	80	

Second semester

WTW 238	Mathematics 238	16	WTW 258GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
ELI 220	Linear systems 220	16	EIR 211
ERS 220	Digital systems 220	16	
COS 222	Operating systems 222	16	COS 130/COS 131/COS 132
	Total	72	

Recess training

EIW 221	Information technology practice 221	8	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
BSS 310	Engineering management 310	8	
EME 310	Electromagnetic compatibility 310	16	
EMK 310	Microprocessors 310	16	ERS 220GS
ENE 310	Analogue electronics 310	16	EIR 211/221 GS
EAI 320	Intelligent systems 320	16	WTW 258
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
ERD 320	Computer engineering design 320	16	EMK 310GS
EBB 320	Control systems 320	16	ELI 220GS
EDC 310	Digital communication 310	16	ELI 220GS
EPE 321	Software engineering 321	16	COS 212
	Total	72	

Recess training

EIW 320	Information technology practice 320	8	EIW 221

Fourth year of study
First semester

Module		Credits	Prerequisites
EPR 402	Project 402	16	All prescribed 3rd-year modules passed Finalists only
IPI 410	Engineering professionalism 410	8	
ESP 411	DSP: programming and application 411	16	ESC 320 GS or EDC 310 GS
EAS 410	Computer engineering: architecture and systems 410	16	EMK 310 GS
EHN 410	E-business and network security 410	16	
	Total	72	

Second semester

EPR 402	Project 402	48	All prescribed 3rd-year modules passed Finalists only
ERP 420	Specialisation 420	16	
	Total	64	

Recess training

EPY 423	Practical training and report 423	12	

(d) Electrical Engineering

First year of study
First semester

Module		Credits	Prerequisites
NMC 113	Materials science 113	16	
CHM 171	General chemistry 171	16	
WTW 158	Calculus 158	16	
MGC 110	Graphical communication 110	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
FSK 176	Physics 176	16	
SWK 122	Mechanics 122	16	WTW 158
EBN 122	Electricity and electronics 122	16	
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

EMR 100	Measurement technique and computer modelling 100	4

Notes

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study

First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
COS 131	Introduction to programming 131	16	
EJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	80	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211
ERS 220	Digital systems 220	16	
	Total	64	

Recess training

EPW 200	Practical wiring 200	4

Third year of study

First semester

Module		Credits	Prerequisites
BSS 310	Engineering management 310	8	
EMK 310	Microprocessors 310	16	ERS 220GS
ENE 310	Analogue electronics 310	16	EIR 211/221 GS
ELX 311	Electrical machines 311	16	EIR 211
EMZ 310	Electromagnetism 310	16	WTW 256, 258
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
ENR 320	Energy 320	16	
EBB 320	Control systems 320	16	ELI 220GS
EDF 320	Power electronics 320	16	ELX 311, ELI 220 GS

EKK 320	Power system components 320	16	EIR 211
	Total	72	

Recess training

ESP 300	DSP programming 300	4	EPW 200

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
EPR 400	Project 400	16	All prescribed 3rd-year modules passed Finalists only
IPI 410	Engineering professionalism 410	8	
EKK 410	Power system analysis 410	16	EKK 320
EAD 410	Electrical drives 410	16	ELX 311 GS, EDF 320 GS
EBT 410	Automation 410	16	EBB 320 GS
	Total	72	

Second semester

EPR 400	Project 400	48	All prescribed 3rd-year modules passed Finalists only
EEO 420	Electrical engineering design 420	16	EKK 320, EKK 410 GS
	Total	64	

Recess training

EPY 423	Practical training and report 423	12	

(e) Electronic Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
NMC 113	Materials science 113	16	
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
EBN 122	Electricity and electronics 122	16	
FSK 176	Physics 176	16	
SWK 122	Mechanics 122	16	WTW 158
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

EMR 100	Measurement technique and computer modelling 100	4

Note

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study

First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
COS 131	Introduction to programming 131	16	
EJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	80	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211
ERS 220	Digital systems 220	16	
	Total	64	

Third year of study

First semester

Module		Credits	Prerequisites
BSS 310	Engineering management 310	8	
EMK 310	Microprocessors 310	16	ERS 220 GS
EMZ 310	Electromagnetism 310	16	WTW 256, 258
ENE 310	Analogue electronics 310	16	EIR 211/221 GS
EMS 310	Modulation systems 310	16	ELI 220
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
ELO 320	Electronic engineering design 320	16	EMK 310GS
EMZ 320	Microwaves and antennas 320	16	EMZ 310
EBB 320	Control systems 320	16	ELI 220GS
ESC 320	Stochastic communication systems 320	16	EMS 310, WTW 258, 256, 238
	Total	72	

Fourth year of study
First semester

Module		Credits	Prerequisites
EPR 400	Project 400	16	All prescribed 3rd-year modules passed Finalists only
IPI 410	Engineering professionalism 410	8	
ESP 411	DSP: programming and application 411	16	ESC 320 GS or EDC 310 GS
ENE 410	Advanced electronics 410	16	ENE 310 GS
EBT 410	Automation 410	16	EBB 320 GS
	Total	72	

Second semester

EPR 400	Project 400	48	All prescribed 3rd-year modules passed Finalists only
EES 424	Specialisation 424	16	
	Total	64	

Recess training

EPY 423	Practical training and report 423	12

(f) Industrial Engineering

First year of study
First semester

Module		Credits	Prerequisites
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
EBN 111	Electricity and electronics 111	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
SWK 122	Mechanics 122	16	WTW 158
CHM 172	General chemistry 172	16	
NMC 123	Materials science 123	16	
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

WWP 121	Workshop practice 121	6

Notes

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study
First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
MOW 217	Manufacturing and design 217	16	MGC 110, SWK 122
MPR 213	Programming and information technology 213	18	
BJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	82	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
MTX 221	Thermodynamics 221	16	FSK 116/176
BPZ 220	Productivity 220	16	
	Total	64	

Third year of study
First semester

Module		Credits	Prerequisites
BAN 313	Industrial analysis 313	8	
BSS 310	Engineering management 310	8	
MVS 311	Manufacturing systems 311	16	
BOB 310	Operational management 310	16	
BOZ 312	Operations research 312	16	
FBS 110	Financial management 110	10	
BER 310	Business law 310	8	
	Total	82	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
BLK 320	Industrial logistics 320	16	(BOB 310)
BID 320	Information systems design 320	16	
BUY 321	Simulation modelling 321	16	(BAN 313)
BFB 320	Facilities planning 320	8	
	Total	64	

Recess training

BPY 310	Practical training 310	16

Fourth year of study
First semester

Module		Credits	Prerequisites
BPJ 410	Project 410	16	Finalists only

BON 410	Operations research 410	16	(BES 220), (BOZ 312)
BGC 410	Quality assurance 410	16	
BSR 410	Management accounting 410	16	(FBS 110)
IPI 410	Engineering professionalism 410	8	
	Total	72	

Second semester

BSS 410	Systems engineering 410	16	
BPJ 420	Project 420	24	BPJ 410
BPZ 421	Business engineering 421	16	Finalists only
ABV 320	Labour relations 320	8	BER 310
	Total	64	

Recess training

BPY 410	Practical training 410	16	

(g) Mechanical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
EBN 111	Electricity and electronics 111	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
CHM 172	General chemistry 172	16	
SWK 122	Mechanics 122	16	WTW 158
NMC 123	Materials science 123	16	
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

WWP 121	Workshop practice 121	6	

Notes

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	FSK 116/176, SWK 122, WTW 256#

MPR 213	Programming and information technology 213	18	
MOW 217	Manufacturing and design 217	16	MGC 110, SWK 122
MJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	82	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
MOW 227	Machine design 227	16	MOW 217
MTX 221	Thermodynamics 221	16	FSK 116/176
	Total	64	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
BSS 310	Engineering management 310	8	
MOW 312	Machine design 312	16	MOW 227
MTX 311	Thermodynamics 311	16	MTX 221
MSY 310	Structural mechanics 310	16	MOW 217, WTW 256
MTV 310	Thermoflow 310	16	
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
MOW 323	Machine design 323	16	(MOW 312)
EIR 221	Electrical engineering 221	16	EBN 111/122, WTW 161
MVR 320	Vibrations and noise 320	16	(MSD 210)
MKM 320	Continuum mechanics 320	16	(MSY 310), (MTV 310)
	Total	72	

Recess training

MPY 315	Practical training 315	16

Fourth year of study
First semester

Option – Mechanical and Aeronautical

Module		**Credits**	**Prerequisites**
MKM 410	Computational mechanics 410	16	MKM 320 GS
MTV 410	Thermoflow 410	16	MTV 310
MOX 410	Design 410	16	MOW 312GS, MOW 323GS
MSC 412	Project 412	16	Finalists only
IPI 410	Engineering professionalism 410	8	
	Total	72	

Note: For the Aeronautical Option, the themes of both the Design and the Project must be aeronautical-related.

Second semester
Option – Mechanical

MSC 422	Project 422	16	Finalists only, MSC 412
MBB 410	Control systems 410	16	MVR 320 GS
MTV 420	Thermal and fluid machines 420	16	MTV 310, (MTX 311)
	One elective from the following:		
MVE 420	Vehicle engineering 420	16	
MLV 420	Aeronautics 420	16	MTV 310
MII 420	Maintenance engineering 420	16	
MKI 420	Nuclear engineering 420	16	
MEG 421	Mechatronics 421	16	
MHM 420	Heat and mass transfer 420	16	
MUU 420	Fossil fuel power stations 420	16	
MWN 420	Numerical methods 420	16	
MOO 420	Optimum design 420	16	
MAN 420	Porous flow 420	16	

Offering of electives depends on the availability of resources and industry support.

	Total	64	

or

Option – Aeronautical

MSC 422	Project 422	16	Finalists only, MSC 412
MBB 410	Control systems 410	16	MVR 320 GS
MTV 420	Thermal and fluid machines 420	16	MTV 310, (MTX 311)
	Elective module:		
MLV 420	Aeronautics 420	16	MTV 310

Offering of electives depends on the availability of resources and industry support.

	Total	64	

Recess Training

MPY 415	Practical training 415	16	

(h) Metallurgical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
CHM 171	General chemistry 171	16	
NMC 113	Materials science 113	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
FSK 176	Physics 176	16	

SWK 122	Mechanics 122	16	WTW 158
EBN 122	Electricity and electronics 122	16	
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

WWP 121	Workshop practice 121	6

Notes

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study

First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	FSK 116/176, SWK 122, WTW 256#
MPR 213	Programming and information technology 213	18	
GMI 210	Mineralogy 210	16	
NJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	82	

Second semester

WTW 238	Mathematics 238	16	WTW 258GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
NMC 223	Materials science 223	16	NMC 113/123
NPT 220	Process thermodynamics 220	16	(CHM 171/172)
EIR 221	Electrical engineering 221	16	EBN 111/122, WTW 161
	Total	80	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
BSS 310	Engineering management 310	8	
MTV 310	Thermoflow 310	16	
NMC 313	Materials science 313	16	(NMC 223)
NMP 310	Minerals processing 310	16	
NEC 310	Electrochemistry 310	16	
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
NMM 320	Mechanical metallurgy 320	16	(NMC 223)
NPM 321	Pyrometallurgy 321	16	(NPT 220)

NHM 322	Hydrometallurgy 322	16	(NPT 220), (NEC 310)
NVM 321	Refractory materials 321	8	(NPT 220), NPM 321#
NEX 320	Excursions 320	8	(NMP 310)
	Total	72	

Recess training

NPY 316	Practical training 316	16

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
NPB 412	Process metallurgy and control 412	8	(NPM 321)
NSC 412	Literature survey 412	8	NEX 320
IPI 410	Engineering professionalism 410	8	
NHM 412	Hydrometallurgy 412	16	(NHM 322)
NPW 411	Metals processing 411	16	(NMC 313), (NMM 320)
NMP 411	Minerals processing 411	16	(NMP 310)
	Total	72	

Second semester

NSC 422	Project 422	32	NSC 412/411
NOP 421	Process design 421	32	(NMP 411)
	Total	64	

Recess training

NPY 416	Practical training 416	16

(i) Mining Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MGC 110	Graphical communication 110	16	
WTW 158	Calculus 158	16	
CHM 171	General chemistry 171	16	
NMC 113	Materials science 113	16	
HAS 110	Humanities and social sciences 110	8	
	Total	72	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear algebra 161	8	
FSK 176	Physics 176	16	
EBN 122	Electricity and electronics 122	16	
SWK 122	Mechanics 122	16	WTW 158
HAS 120	Humanities and social sciences 120	8	
	Total	72	

Recess training

PWP 121	Workshop practice 121	8

Notes

(i) Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Second year of study

First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	FSK 116/176, SWK 122, WTW 256#
MPR 213	Programming and information technology 213	18	
SWK 210	Strength of materials 210	16	SWK122, WTW168/WTW 128
PJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
	Total	82	

Second semester

WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
BES 220	Engineering statistics 220	8	
MTX 221	Thermodynamics 221	16	FSK 116/176
SUR 220	Surveying 220	16	
	Total	64	

Recess training

PPY 220	Experiential training 220	16	

Third year of study

First semester

Module		Credits	Prerequisites
BSS 310	Engineering management 310	8	
MTV 310	Thermoflow 310	16	
GLY 155	Introduction to geology 155	16	
NMP 310	Minerals processing 310	16	
PMY 311	Surface mining and geotechnics 311	16	
	Total	72	

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
PMY 320	Mining 320	16	PMY 311
PME 320	Mineral economics 320	16	
PSC 321	Introduction to project 321	8	
PNB 300	Industrial excursions 300	8	
PRX 321	Explosives engineering 321	8	MTX 221
GLY 161	Historical geology 161	8	GLY 151 GS, 152 GS or GLY 155GS
	Total	72	

Recess training

PPY 320	Experiential training 320	16	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
PEE 410	Mine environmental control engineering 410	16	MTV 310
PSZ 410	Strata control 410	16	PMY 320
PSC 411	Project 411	10	PSC 321
IPI 410	Engineering professionalism 410	8	
GLY 254	Structural geology 254	12	GLY 151, GLY 152 or GLY 155
PNB 400	Industrial excursions 400	8	PNB 300
PMY 410	Mining 410	16	PMY 311
	Total	76	

Second semester

PMZ 422	Mine design 422	42	PMY 410, PMY 320, PSZ 410, PEE 410
GLY 361	Ore deposits 361	18	GLY 254
PMY 423	Mine risk management – Health and safety 423	8	Finalists only
PNB 400	Industrial excursions 400	8	PNB 300
	Total	68	

Recess training

PPY 418	Practical training 418	16

Eng. 15.2 Engineering Augmented Degree Programme (ENGAGE)
Please note:
The Engineering Augmented Degree Programme (ENGAGE) is an extended degree programme with a five-year curriculum. It is designed to enable students who show academic potential but who do not meet the normal entry requirements for the four-year degree programme, to obtain an Engineering degree. ENGAGE students spend the first three years of the programme covering the content of the first two years of the four-year degree programme. They also take compulsory augmented modules in each of the Level 1 subjects. These augmented modules provide students with background knowledge and skills needed to succeed in an engineering degree. The curriculum for years four and five of the ENGAGE programme are identical to the curriculum for years 3 and 4 of the 4-year programme, respectively. Students may apply directly for admission to the programme.

- Students must register for the entire programme, not components of it. The curriculum is fixed; there are no electives.
- Attendance at all components of years 1 to 3 of the programme is compulsory. Non-attendance will only be condoned in the case of illness (sick note required) or family crisis (e.g. a death in the family), in which case students must inform the programme administration immediately.
- Students who fail to meet the attendance requirement for any module in any semester of years 1 to 3 of the programme will be excluded from the programme.

- No augmented module may be repeated more than once.
- Selection into the programme will be based on a combination of performance in the National Senior Certificate examinations or equivalent and other selection tests approved by the faculty.
- A student who fails a mainstream module (e.g. Chemistry) but passes the associated augmented module (e.g. Additional chemistry) does not need to repeat the augmented module.
- A student who fails an augmented module (e.g. Additional chemistry) but passes the associated mainstream module (e.g. Chemistry) does not need to repeat the mainstream module.
- A student must meet the attendance requirement and obtain at least 40% for both the continuous assessment and test components as well as a final mark of 50% in order to pass an augmented module.

i) The requirements for promotion from the one year of study to the next are given in **Eng. 16, Eng. 17** and **Eng. 18**.

(ii) Only the curricula of the first, second and third years of study are given here. The curricula of the fourth and the fifth years of study are identical to those of the third and the fourth years of the four-year programmes and are given in **Eng. 15.1.**

(iii) JPO 110 is a prerequisite for JPO 120. Credit for JPO is obtained with a final mark ≥50%. Conditional admission to JPO 120: If the final mark for JPO 110 is between 45% and 49%, a student can register for JPO 120 but credit for JPO 110 and JPO 120 will only be obtained if the final combined mark for JPO 110 and JPO 120 is ≥50%.

Faculty requirement

Module		**Credits**	**Prerequisites**
JCP 203	Community-based project 203	8	

Notes

Students who register for the first year from 2005 will be required to successfully complete the above module as part of the requirements for the BEng degree. A student may register for the module during any of the years of study of the programme, but preferably not during the first or the final year of study.

(a) Chemical Engineering

First year of study

First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 111	Additional chemistry 1 111	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
FSK 176	Physics 176	16	

HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 122	Additional physics 122	8	
	Total	**64**	

Recess training

WWP 121	Workshop practice 121	6

Second year of study
First semester

Module		**Credits**	**Prerequisites**
CIR 113	Chemical engineering 113	8	
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**72**	

Second semester

CHM 181	General chemistry 181	16	CHM 171
CIR 123	Chemical engineering 123	8	CHM 171 GS, CIR 113
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW 161, 168
JPO 121	Additional chemistry 2 121	8	
JPO 125	Additional mechanics 125	8	
	Total	**64**	

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
CIR 211	Chemical engineering 211	8	CIR 123
CHM 215	Chemistry 215	16	CHM 171/172, 181
CJJ 210	Professional and technical communication 210	8	CIR 123
MPR 213	Programming and information technology 213	18	
SWK 210	Strength of materials 210	16	SWK 122, WTW 168/128
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**74**	

Second semester

BES 220	Engineering statistics 220	8	
CHM 226	Chemistry 226	8	CHM 171/172, 181
CTD 223	Thermodynamics 223	16	CIR 211, MPR 212/213, (WTW 258)
EIR 221	Electrical engineering 221	16	EBN 111/122, WTW 161
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**64**	

(b) Civil Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 111	Additional chemistry 1 111	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
FSK 176	Physics 176	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 122	Additional physics 122	8	
	Total	**64**	

Recess training

SWP 121	Workshop practice 121	6

Second year of study
First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW 161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
SJJ 210	Professional and technical communication 210	8	
SGM 210	Geomaterials and processes 210	16	
SUR 210	Surveying 210	16	
SWK 210	Strength of materials 210	16	SWK122, WTW168128
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**64**	

Second semester

BES 220	Engineering statistics 220	8	
SBZ 221	Civil engineering measurement techniques 221	8	
SGM 221	Pavement materials and design 221	16	SGM 210 GS
SIN 223	Structural analysis 223	16	WTW 161, 168, SWK 210
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**64**	

(c) Computer Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
WST 111	Mathematical statistics 111	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 115	Additional statistics 115	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8

WTW 168	Calculus 168	8	WTW 158 GS
FSK 176	Physics 176	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 122	Additional physics 122	8	
	Total	**64**	

Recess training

EIW 121	Information technology practice 121	8

Second year of study
First semester

Module		**Credits**	**Prerequisites**
COS 131	Introduction to programming 131	16	
EBN 111	Electricity and electronics 111	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW 158, 168
COS 153	Introduction to programming (continued) 153	8	
JPO 114	Additional programming 1 114	8	
JPO 112	Additional electricity and electronics 112	8	
	Total	**64**	

Note: Students who were registered as first-year students in 2011 still need to register for WST 111 and JPO 115 as part of the second year of study.

Second semester

COS 110	Programme design: Introduction 110	16	COS 130GS/COS 131GS/COS 132GS
ERA 284	Computer architecture 284	16	COS 130GS/ COS 131 GS/ COS 132GS
WTW 263	Numerical methods 263	8	WTW161, 168
JPO 124	Additional computing 2 124	8	
JPO 127	Additional computers 127	8	
	Total	**56**	

Recess training

EMR 100	Measurement technique and computer modelling 100	4
EIW 221	Information technology practice 221	8

Third year of study
First semester

Module		**Credits**	**Prerequisites**
EJJ 210	Professional and technical communication 210	8	
COS 216	Netcentric computer systems 216	16	COS 110
COS 212	Data structures and algorithms 212	16	COS 110

EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**64**	

Second semester

COS 222	Operating systems 222	16	COS 130/ COS 131/ COS 132
ELI 220	Linear systems 220	16	EIR 211
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**64**	

(d) Electrical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 152	Additional physics 152	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
CHM 172	General chemistry 172	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 161	Additional chemistry 1 161	8	
	Total	**64**	

Second year of study
First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW 158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW 161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Recess training

EMR 100	Measurement technique and computer modelling 100	4
EPW 200	Practical wiring 200	4

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
EJJ 210	Professional and technical communication 210	8	
COS 131	Introduction to programming 131	16	
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**64**	

Second semester

BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**56**	

(e) Electronic Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 152	Additional physics 152	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
CHM 172	General chemistry 172	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 161	Additional chemistry 1 161	8	
	Total	**64**	

Second year of study
First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW 158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW 161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Recess training

EMR 100	Measurement technique and computer modelling 100	4

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
EJJ 210	Professional and technical communication 210	8	
COS 131	Introduction to programming 131	16	
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
MSD 210	Dynamics 210	16	SWK 122, FSK116/176, WTW 256#
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**64**	

Second semester

BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**56**	

(f) Industrial Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 111	Additional chemistry 1 111	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
FSK 176	Physics 176	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 122	Additional physics 122	8	
	Total	**64**	

Recess training

WWP 121	Workshop practice 121	6

Second year of study
First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW 158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158

WTW 263	Numerical methods 263	8	WTW 161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
BJJ 210	Professional and technical communication 210	8	
MOW 217	Manufacturing and design 217	16	MGC 110, SWK 122
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
MPR 213	Programming and information technology 213	18	
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**66**	

Second semester

BES 220	Engineering statistics 220	8	
BPZ 220	Productivity 220	16	
MTX 221	Thermodynamics 221	16	FSK 116/176
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**56**	

(g) Mechanical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 152	Additional physics 152	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
CHM 172	General chemistry 172	16	
HAS 120	Humanities and social sciences 120	8	

JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 161	Additional chemistry 1 161	8	
	Total	**64**	

Recess training

WWP 121	Workshop practice 121	6

Second year of study

First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW 158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW 161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Note

Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study

First semester

Module		**Credits**	**Prerequisites**
MJJ 210	Professional and technical communication 210	8	
MOW 217	Manufacturing and design 217	16	MGC 110, SWK 122
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
MPR 213	Programming and information technology 213	18	
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**66**	

Second semester

BES 220	Engineering statistics 220	8	
MOW 227	Machine design 227	16	MOW 217
MTX 221	Thermodynamics 221	16	FSK 116/176
WTW 238	Mathematics 238	16	WTW 258GS, 256
	Total	**56**	

(h) Metallurgical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 152	Additional physics 152	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
CHM 172	General chemistry 172	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 161	Additional chemistry 1 161	8	
	Total	**64**	

Recess training

WWP 121	Workshop practice 121	6

Second year of study
First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW 158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158

WTW 263	Numerical methods 263	8	WTW161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
NJJ 210	Professional and technical communication 210	8	
GMI 210	Mineralogy 210	16	
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
MPR 213	Programming and information technology 213	18	
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**66**	

Second semester

BES 220	Engineering statistics 220	8	
EIR 221	Electrical engineering 221	16	EBN 111/122, WTW 161
NMC 223	Materials science 223	16	NMC 113/123
NPT 220	Process thermodynamics 220	16	(CHM 171/172)
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**72**	

(i) Mining Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 116	Additional mathematics 1 116	8	
JPO 152	Additional physics 152	8	
	Total	**64**	

Second semester

WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
CHM 172	General chemistry 172	16	

HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 126	Additional mathematics 2 126	8	
JPO 161	Additional chemistry 1 161	8	
	Total	**64**	

Recess training

PWP 121	Workshop practice 121	8

Second year of study
First semester

Module		**Credits**	**Prerequisites**
EBN 111	Electricity and electronics 111	16	
MGC 110	Graphical communication 110	16	
JCP 203	Community-based project 203	8	
WTW 258	Calculus 258	8	WTW158, 168
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
	Total	**64**	

Second semester

NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW158
WTW 263	Numerical methods 263	8	WTW161, 168
JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
	Total	**56**	

Note
Students may be promoted in Graphical communication 110, if a semester test mark and a practicum mark of at least 65% each is obtained.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
PJJ 210	Professional and technical communication 210	8	
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
MPR 213	Programming and information technology 213	18	
SWK 210	Strength of materials 210	16	SWK 122, WTW168/128
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**66**	

Second semester

BES 220	Engineering statistics 220	8	
MTX 221	Thermodynamics 221	16	FSK 116/176
SUR 220	Surveying 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**56**	

REQUIREMENTS FOR PROMOTION TO THE FOLLOWING YEAR OF STUDY

Eng. 16
Promotion to the second semester of the first year and to the second year of study

(a) A new first-year student who has failed in all the prescribed modules of the programme at the end of the first semester, is excluded from studies in the School of Engineering. A student who is registered for the Engineering Augmented Degree Programme and has passed fewer than 8 credits will also be excluded.

(b) A student who complies with all the requirements of the first year of study, is promoted to the second year of study.

(c) A student who has not passed at least 70% of the credits of the first year of study after the November examinations, must reapply for admission should he/she intend to proceed with his/her studies. Application on the prescribed form must be submitted to the Student Administration of the School of Engineering not later than 11 January. Late applications will be accepted only in exceptional circumstances after approval by the Dean. Should first-year students be readmitted, conditions of readmission will be determined by the Admissions Committee.

(d) Students who have not passed all the prescribed modules at first year level (level 100), as well as students who are readmitted in terms of Regulation Eng. 16.(c) must register for the outstanding first-year level (level-100) modules.

(e) A student who is repeating his or her first year, may, on recommendation of the relevant heads of department and with the approval of the Dean, be permitted to enrol for modules of the second-year of study in addition to the first-year modules which he or she failed, providing that he or she complies with the prerequisites for the second-year modules and no timetable clashes occur. Students on the ENGAGE programme may, following the same procedure, be permitted to enrol for level-200 modules in addition to the level-100 modules which he/she failed providing that he/she complies with the prerequisites for the modules at 200-level and no timetable clashes occur. On recommendation of the relevant head of department and with special permission from the Dean, permission may be granted to exceed the prescribed number of credits. The total number of credits which may be approved may not exceed the normal number of credits per semester by more than 16 credits.

(f) Students in Computer, Electrical and Electronic Engineering, who fail a first-year module for the second time, forfeit the privilege of registering for any modules of an advanced year of study.

Please note:

(i) From the second year of study each student should be in possession of an approved calculator. It is assumed that each student will have easy access to a personal computer.

(ii) Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out in the syllabi of PWP 121 Workshop practice 121.

Eng. 17
Promotion to the third year of study of the Four-year Programme, as well as to the third and the fourth years of study of the ENGAGE Programme. In case of the fourth year of study of the ENGAGE Programme, the words "first", "second" and "third" must be substituted with the words "second", "third" and "fourth" respectively.

(a) A student who complies with all the requirements of the second year of study, is promoted to the third year of study.
(b) A student must pass all the prescribed modules at first year level (level 100) before he or she is admitted to any module at third year level (level 300).
(c) A student who is repeating his or her second year must register for all the second-year modules still outstanding. Such a student may, on recommendation of the relevant head of department and with the approval of the Dean, be permitted to enrol for modules of the third year of study in addition to the second-year modules which he or she failed, providing that he or she complies with the prerequisites for the third-year modules and no timetable clashes occur. On recommendation of the relevant head of department, and with special permission from the Dean, permission may be granted to exceed the prescribed number of credits. The total number of credits which may be approved, may not exceed the normal number of credits per semester by more than 16 credits.
(d) Students in Computer, Electrical and Electronic Engineering who fail a second-year module for the second time, forfeit the privilege of registering for any modules of the third year of study.
(e) Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out in the syllabi of PWP 120 Workshop practice 120, as well as PPY 317 Practical training 317.

Eng. 18
Promotion to the fourth year of study of the Four-year Programme, as well as to the fifth year of study of the ENGAGE Programme. In case of the fifth year of study of the ENGAGE Programme, the words "second", "third" and "fourth" must be substituted with the words "third", "fourth" and "fifth" respectively.

(a) A student who complies with all the requirements of the third year of study is promoted to the fourth year of study. A student who does not comply with all the requirements but who is able to register for all outstanding modules in order to complete the degree programme, may at registration be promoted to the fourth year of study.
(b) A student must pass all the prescribed modules of the second year of study, before he or she is admitted to any module of the fourth year of study.
(c) A student who has not passed all the prescribed modules of the third year of study, must register for the outstanding modules. A student may be admitted by the Dean, on the recommendation of the head of department concerned, to modules of the fourth year of study, in addition to the outstanding third-year modules, provided that he or she complies with the prerequisites of the fourth-year modules and no timetable clashes occur. The total number of credits per semester for which a student registers may not exceed the normal number of credits per semester by more than 16 credits. In exceptional cases, the Dean may, on recommendation of the relevant head of department, permit a student to exceed the above limit.
(d) Students in Computer, Electrical and Electronic Engineering who fail a third-year module for the second time, forfeit the privilege of registering for any modules of the fourth year of study.

REGULATIONS FOR POSTGRADUATE PROGRAMMES IN THE SCHOOL OF ENGINEERING AND THE GRADUATE SCHOOL OF TECHNOLOGY MANAGEMENT

Bachelor of Engineering Honours [BEngHons]

Eng. 19

Also consult the General Regulations G.16 to G.29.

(a) Subject to the stipulations of Reg. G.1.3 and G.62, a BEng degree or equivalent qualification is required for admission.

(b) The minimum duration of the programme is one year of full-time study.

(c) The curriculum is determined in consultation with the relevant heads of departments. A student is required to pass modules to the value of at least 128 credits.

(d) The degree is awarded in the following fields of engineering:

(i)	Bioengineering	(Code 12240201)
(ii)	Chemical Engineering	(Code 12240021)
(iii)	Computer Engineering	(Code 12240211)
(iv)	Control Engineering	(Code 12240231)
(v)	Electrical Engineering	(Code 12240031)
(vi)	Electronic Engineering	(Code 12240091)
(vii)	Environmental Engineering	(Code 12240221)
(viii)	Geotechnical Engineering	(Code 12240212)
(ix)	Industrial Engineering	(Code 12240011)
(x)	Mechanical Engineering	(Code 12240051)
(xi)	Metallurgical Engineering	(Code 12240061)
(xii)	Microelectronic Engineering	(Code 12240191)
(xiii)	Mining Engineering	(Code 12240071)
(xiv)	Structural Engineering	(Code 12240121)
(xv)	Technology Management	(Code 12240251)
(xvi)	Transportation Engineering	(Code 12240111)
(xvii)	Water Resources Engineering	(Code 12240161)
(xviii)	Water Utilisation Engineering	(Code 12240101)

(e) The degree is awarded on the basis of examinations only.

(f) **Examinations**

(i) The examination in each module for which a student is registered, takes place during the normal examination period after the conclusion of lectures (i.e. November/January or June/July).

(ii) A student registered for the honours degree must complete his or her studies within two years (full-time), or within three years (part-time) after first registration for the degree: Provided that the Dean, on recommendation of the relevant head of department, may approve a stipulated limited extension of this period.

(iii) A student must obtain at least 50% in an examination for each module where no semester or year mark is required. A module may only be repeated once.

(iv) In modules where semester or year marks are awarded, a minimum examination mark of 40% and a final mark of 50% is required.

(v) No supplementary or special examinations are granted at postgraduate level.

(g) A student passes with distinction if he or she obtains a weighted average of at least 75% in the first 128 credits for which he or she has registered (excluding modules which were discontinued timeously). The degree is not awarded with distinction if a student fails any one module (excluding modules which were discontinued timeously).

(h) **Credit for modules**
Consult General Regulation G.23

Master of Engineering [MEng]
Master of Science (Engineering Management) [MSc (Engineering Management)]
Master of Science (Project Management) [MSc (Project Management)]

Eng. 20
Also consult the General Regulations G.30 to G.44. and G.57 to G.62

(a) Subject to the stipulations of Reg. G.1.3 and G.62, a BEngHons degree or equivalent qualification is required for admission to the MEng programmes [excluding the MEng (Engineering Management) and the MEng (Project Management)]. The admission requirement for the MEng (Engineering Management) and the MEng (Project Management) is a BEng or equivalent qualification. The admission requirement for the MSc (Engineering Management) and the MSc (Project Management) is a BScHons or equivalent qualification.

(b) The minimum duration of the MEng programmes [excluding the MEng (Engineering Management) and the MEng (Project Management)] is one year of full-time study. The programmes MEng (Engineering Management), MEng (Project Management), MSc (Engineering Management) and the MSc (Project Management) can be completed in a minimum period of two years.

(c) A minimum of 128 credits is required to obtain the MEng degree [excluding the MEng (Engineering Management) and the MEng (Project Management)]. Either a mini-dissertation (64 credits) and coursework (64 credits) **or** a dissertation (128 credits) is included in the programme. A minimum of 256 credits is required for the MEng (Engineering Management), MEng (Project Management), MSc (Engineering Management) and the MSc (Project Management), including a mini-dissertation (64 credits) and coursework(192 credits).

(d) Recognition is not granted for credits acquired during studying for the BEngHons or the BScHons.

(e) The degree Master of Engineering is awarded in the following fields of engineering:

		Degree code	Dissertation	Degree code	Mini-dissertation
(i)	Bioengineering	12250201	EIB 890		
(ii)	Chemical Engineering	12250021	CVD 800	12256021	CSC 800
(iii)	Computer Engineering	12250211	ERI 890		
(iv)	Control Engineering	12250231	CVD 800	12256231	CSC 800
(v)	Electrical Engineering	12250031	EIR 890		
(vi)	Electronic Engineering	12250091	EIN 890		
(vii)	Engineering Management	12250171	IGB 895	12250172	IGB 898
(viii)	Environmental Engineering	12250221	CVD 800	12256221	CSC 800
(ix)	Geotechnical Engineering	12250212	SGI 890	12256212	SGT 896
(x)	Industrial Engineering	12250011	BIR 890		
(xi)	Mechanical Engineering	12250051	MIR 890		
(xii)	Metallurgical Engineering	12250061	NIN 890		
(xiii)	Microelectronic Engineering	12250191	EEY 890		

(xiv)	Mining Engineering	12250071	PYI 890		
(xv)	Software Engineering	12250202	EPR 890		
(xvi)	Project Management	12250261	ISC 895	12250262	IGB 898
(xvii)	Structural Engineering	12250121	SIN 890	12256121	SIN 896
(xviii)	Technology Management	12250251	ITB 890	12250252	IGB 898
(xix)	Transportation Engineering	12250111	SVI 890	12256111	SVI 896
(xx)	Water Utilisation Engineering	12250101	CVD 800	12256101	CSC 800
(xxi)	Water Resources Engineering	12250161	WBK 890	12256161	SSC 890

(f) Unless the Dean, on recommendation of the relevant head of department, decides otherwise, the master's degree is conferred on the basis of examinations of coursework and a mini-dissertation **or** a dissertation (including an examination on the dissertation).

(g) The curriculum is determined in consultation with the relevant head of department.

(h) **Examinations**

(i) The stipulations of Eng. 19 (f)(i), (iii), (iv) and (v) are applicable.

(ii) An MEng student [excluding the MEng (Engineering Management) and the MEng (Project Management)] is required to complete his or her degree studies within three years after the first registration: Provided that the Dean, in consultation with the relevant head of department, may, in exceptional circumstances, approve a stipulated limited extension of this period.

(iii) A student for an MEng (Engineering Management), MEng (Project Management), MSc (Engineering Management) or an MSc (Project Management) is required to complete his or her degree studies within four years after the first registration: Provided that the Dean, in consultation with the relevant head of department, may, in exceptional circumstances, approve a stipulated limited extension of this period.

(iv) The Dean may, on recommendation of the relevant head of department, exempt a student from the examination on the dissertation.

(i) Guidelines for the preparation and examination of mini-dissertations are available from all departments. The average mark awarded by all the examiners is the final mark, with the pass mark being at least 50%.

(j) **Pass with distinction**

(i) A student who submits a dissertation passes with distinction if an average mark of at least 75% is obtained for the dissertation (and the examination on the dissertation).

(ii) A student who completes the master's degree on grounds of coursework and a mini-dissertation, passes with distinction if a weighted average mark of at least 75% is obtained in the first 128 credits obtained for the degree [first 256 credits in the case of the MEng (Engineering Management), MEng (Project Management), MSc (Engineering Management) or the MSc (Project Management)], provided that 64 of these credits are allocated to the mini-dissertation. However, the degree is not awarded with distinction should a student fail any of these modules (excluding modules which have been timeously discontinued). The degree is also not awarded with distinction if a student obtains less than 70% for the mini-dissertation.

(k) **General master's degree requirements and draft article**

A student must by means of a dissertation or mini-dissertation prove that he or she is capable of planning, instituting and executing a scientific investigation. Unless the

Senate, on the recommendation of the supervisor, decides otherwise, a student, before or on submission of a dissertation, must submit proof issued by a recognised academic journal that an article was submitted, to the Head: Student Administration. The draft article should be based on the research that the student has conducted for the dissertation and be approved by the supervisor if the supervisor is not a co-author. The supervisor shall be responsible for ensuring that the paper is taken through all the processes of revision and resubmission, as may be necessary. Conferment of the degree may be made subject to compliance with the stipulations of this regulation.

Curricula for the following programmes:
BEngHons
MEng
MSc (Engineering Management)
MSc (Project Management)

Eng. 21
Any specific module is offered on condition that a minimum number of students are registered for the module, as determined by the head of department and the Dean. Students must consult the relevant head of department in order to compile a meaningful programme, as well as for information on the syllabi of the modules. The various departmental postgraduate brochures should also be consulted.
Note: The programmes are arranged in alphabetical order according to the names of the academic departments.

(a) CHEMICAL ENGINEERING

A limited number of appropriate modules from other departments and from other divisions of Chemical Engineering are allowed.
Not all modules listed are presented each year. Please consult the departmental postgraduate brochure.

BEngHons (Chemical Engineering)(12240021)

	Code	**Credits**
Bioprocessing 732	CBP 732	32
Carbon materials science and technology 732	CMS 732	32
Chemical engineering 702	CIR 702	32
Fluoro-materials science and technology 732	CFT 732	32
Polymer materials science 732	CPW 732	32
Polymer processing 732	CPP 732	32
Process integration 732	CIP 732	32
Product design 732	CPO 732	32
Reactor design 700	CRO 700	32
Reactor hydrodynamics 732	CRH 732	32
Separation technology 732	CSK 732	32
Surfactant technology 732	CYM 732	32

BEngHons (Control Engineering)(12240231)

	Code	**Credits**
Model-based control laboratory 732	CML 732	32
Multivariable control system design 700	CBO 700	32

Multivariable control system theory 700	CBT 700	32
Process control system development 732	CSP 732	32

BEngHons (Environmental Engineering)(12240221)

	Code	**Credits**
Air quality control 780	CAM 780	32
Principles of environmental engineering 780	CEM 780	32
Industrial waste engineering 780	WAI 780	32
Water quality management 780	WQB 780	32

BEngHons (Water Utilisation Engineering)(12240101)

	Code	**Credits**
Biological water treatment 780	WBW 780	32
Chemical water treatment 780	WCW 780	32
Water quality management 780	WQB 780	32
The remaining 32 credits may be taken by selecting one of the following relevant modules:		
Industrial waste engineering 780	WAI 780	32
Process integration 732	CIP 732	32
Separation technology 732	CSK 732	32

MEng (Chemical Engineering)(12250021)
MEng (Control Engineering)(12250231)
MEng (Environmental Engineering)(12250221)
MEng (Water Utilisation Engineering)(12250101)

	Code	**Credits**
Dissertation 800	CVD 800	128

(b) CIVIL ENGINEERING

A limited number of appropriate modules from other departments or from other divisions of Civil Engineering are allowed.

BEngHons (Water Resources Engineering)(12240161)
At least 128 credits from the following:

	Code	**Credits**
At least 96 credits from the following:		
Statistical methods 791	SHC 791	24
Flood hydrology 792	SHC 792	24
Hydraulic design 793	SHC 793	24
Free surface flow 794	SHC 794	24
Pipe flow 795	SHC 795	24
Pump systems 785	SHW 785	24
Water resource analysis and management 796	SHC 796	24
and		
the remainder of the credits from the following:		
Pavement design 793	SGC 793	24
Concrete technology 794	SGC 794	24
Reinforced concrete design 778	SIN 778	24
Geotechnical design special 795	SGC 795	24
Civil engineering special 792	SGC 792	24
Maintenance special 780	SVC 780	24

or

the balance of the credits may also elected from the following electives presented by the Department of Chemical Engineering:

Principles of environmental engineering 780	CEM 780	32
Air quality control 780	CAM 780	32
Water quality management 780	WQB 780	32
Chemical water treatment 780	WCW 780	32
Biological water treatment 780	WBW 780	32
Industrial waste engineering 780	WAI 780	32

BEngHons (Geotechnical Engineering)(12240212)

At least 128 credits from the following:

	Code	**Credits**
Core modules:		
Geotechnical design special 795	SGC 795	24
Soil mechanics special 784	SGM 784	24
Geotechnical laboratory testing 785	SGS 785	24
In-situ soil testing and monitoring 786	SGS 786	24
Statistical methods 791	SHC 791	24
Electives:		
Engineering geology 703	IGL 703	16
Engineering geology 704	IGL 704	16
Civil engineering special 792	SGC 792	24
Pavement design 793	SGC 793	24
Concrete technology 794	SGC 794	24

BEngHons (Urban Engineering)(12240213)

This degree programme has not been offered since 2009.

At least 128 credits in consultation with the head of department to enable students currently registered to complete the degree.

BEngHons (Structural Engineering)(12240121)

At least 128 credits from the following:

	Code	**Credits**
At least 96 credits from the following:		
Steel design 776	SIN 776	24
Structural mechanics 777	SIN 777	24
Reinforced concrete design 778	SIN 778	24
Timber design 779	SIN 779	24
Structural analysis 790	SIN 790	24
Prestressed concrete design 791	SIN 791	24
and		
the remainder of the credits from the following:		
Hydraulic design 793	SHC 793	24
Concrete technology 794	SGC 794	24
Geotechnical design special 795	SGC 795	24
Statistical methods 791	SHC 791	24
Civil engineering special 792	SGC 792	24

An approved module from the Department of Mathematics and Applied Mathematics.

An approved module from the Department of Mechanical and Aeronautical Engineering.

BEngHons (Transportation Engineering)(12240111)
At least 128 credits from the following:

	Code	Credits
Core modules:		
Transportation planning 789	SVC 789	24
Statistical methods 791	SHC 791	24
Electives:		
Asphalt technology 798	SGC 798	24
Pavement design 793	SGC 793	24
Stabilised materials and compaction 796	SGC 796	24
Road rehabilitation technology 797	SGC 797	24
Traffic engineering 792	SVC 792	24
Multimodal transport 788	SVV 788	24
Geometric design and safety 791	SVV 791	24
Concrete technology 794	SGC 794	24
Transportation studies 790	SVC 790	24
Transportation special 791	SVC 791	24
Maintenance special 780	SVC 780	24
Civil engineering special 792	SGC 792	24

MEng (Water Resources Engineering)(12250161)

	Code	Credits
Dissertation 890	WBK 890	128

or

MEng (Water Resources Engineering)(12256161)

Mini-dissertation 890	SSC 890	64
and *64 credits from the following:*		
Computer applications for civil engineers 880	SHC 880	32
Advanced hydraulics 885	SHC 885	32

MEng (Geotechnical Engineering)(12250212)

	Code	Credits
Dissertation 890	SGI 890	128

MEng (Structural Engineering)(12250121)

	Code	Credits
Dissertation 890	SIN 890	128

or

MEng (Structural Engineering)(12256121)

Mini-dissertation 896	SIN 896	64
and *64 credits from the following:*		
Computer applications for civil engineers 880	SHC 880	32
Advanced structural design 886	SIN 886	32
Advanced structural analysis 887	SIN 887	32

An approved module from the Department of Mechanical and Aeronautical Engineering.

MEng (Transportation Engineering)(12250111)

	Code	Credits
Dissertation 890	SVI 890	128

or

MEng (Transportation Engineering)(12256111)

Mini-dissertation 896	SVI 896	64
and *64 credits from the following:*		
Advanced transportation I 882	SVV 882	32
Advanced transportation II 883	SVV 883	32
Computer applications for civil engineers 880	SHC 880	32

(c) ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

BEngHons (Electrical Engineering)(12240031)

Students may take modules to the value of 32 credits from other fields of specialisation or from other departments, with approval of the Coordinator: Postgraduate Studies.

	Code	**Credits**
Electrical drives 780	ETE 780	32
Energy management 732	EES 732	32
Power distribution engineering 732	EEV 732	32
Power electronics 780	EED 780	32
Introduction to research 732	EIN 732	32
Advanced topics in energy research 732	ERT 732	32
Energy optimisation 732	ENO 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32

BEngHons (Electronic Engineering)(12240091)

Students may take modules to the value of 32 credits from other fields of specialisation or from other departments, with approval of the Coordinator: Postgraduate Studies.

	Code	**Credits**
Adaptive systems 732	ETA 732	32
Advanced microprocessor system design 780	ERV 780	32
Antenna theory 780	EMA 780	32
Coding theory 732	ETK 732	32
Computational robotics 732	ECR 732	32
Computer vision 732	ECV 732	32
Detection and estimation 732	EOP 732	32
Digital image processing 732	EAA 732	32
Digital communications 732	ETD 732	32
Digital radio techniques 732	ESR 732	32
Electro optics 732	EEO 732	32
Electronic warfare 780	ELB 780	32
Hardware and software parallel processing 732	EHS 732	32
Information fusion 732	EIT 732	32
Introduction to research 732	EIN 732	32
Microwave theory 780	EMM 780	32
Mobile communications 732	ETR 732	32
Multivariable control systems 732	EMB 732	32
Numerical Bayesian methods 732	ENB 732	32
Optimal control 780	EBO 780	32
Pattern recognition and neural networks 732	ERP 732	32
Real-time and reactive systems 732	ERR 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32

Telecommunication systems engineering 732	ETT 732	32
Theory of Bayesian inference 732	ETB 732	32
Cellular wireless telephony 710	ECW 710	32
Introductory radiometry and photometry 716	ERD 716	16
Interferometry 716	EFR 716	16
Advanced classical optics 732	EAD 732	32
Electro-optical systems design 732	ESD 732	32
Optical design 732	EOD 732	32
Topics in photonics 732	ETP 732	32

BEngHons (Computer Engineering)(12240211)
Students may take modules to the value of 32 credits from other fields of specialisation or from other departments, with approval of the Coordinator: Postgraduate studies.

	Code	**Credits**
Advanced microprocessor system design 780	ERV 780	32
Computational robotics 732	ECR 732	32
Computer networks 780	ERN 780	32
Computer vision 732	ECV 732	32
Detection and estimation 732	EOP 732	32
Digital image processing 732	EAA 732	32
Electronic warfare 780	ELB 780	32
Hardware and software parallel processing 732	EHS 732	32
Information fusion 732	EIT 732	32
Information security 780	ETH 780	32
Introduction to research 732	EIN 732	32
New generation networks 732	ERC 732	32
Numerical Bayesian methods 732	ENB 732	32
Pattern recognition and neural networks 732	ERP 732	32
Real-time and reactive systems 732	ERR 732	32
Theory of Bayesian inference 732	ETB 732	32
Wireless sensor networks 732	EKS 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32

BEngHons (Bioengineering)(12240201)
Students may take modules to the value of 32 credits from other fields of specialisation or from other departments, with approval of the Coordinator: Postgraduate studies.

It is a requirement that a student must complete all three the bioengineering honours modules, as well as Introduction to research 732 (EIN 732), to enrol for a master's or a PhD in Bioengineering.

	Code	**Credits**
Bioelectricity and electronics 732	EBE 732	32
Bioelectromagnetism and modelling 732	EBI 732	32
Biosignals and systems 732	EBB 732	32
Introduction to research 732	EIN 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32

BEngHons (Microelectronic Engineering)(12240191)
Students may take modules to the value of 32 credits from other fields of specialisation or from other departments, with approval of the Coordinator: Postgraduate studies.

	Code	Credits
Analogue electronic design 732	EME 732	32
Communication electronics 732	EMK 732	32
Introduction to research 732	EIN 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32

MEng (Electrical Engineering)(12250031)

	Code	Credits
Dissertation 890	EIR 890	128

MEng (Electronic Engineering)(12250091)

	Code	Credits
Dissertation 890	EIN 890	128

MEng (Computer Engineering)(12250211)

	Code	Credits
Dissertation 890	ERI 890	128

MEng (Bioengineering)(12250201)

	Code	Credits
Dissertation 890	EIB 890	128

MEng (Microelectronic Engineering)(12250191)

	Code	Credits
Dissertation 890	EEY 890	128

MEng (Software Engineering)(12250202)

	Code	Credits
Dissertation 890	EPR 890	128

(d) ENGINEERING AND TECHNOLOGY MANAGEMENT

BEngHons (Technology Management)(12240251)
At least 128 credits from the following:

	Code	Credits
Core modules:		
Decision analysis 780	IBD 780	16
Innovation strategy 780	INV 780	16
Project management 780	IPK 780	16
Systems engineering 780	ISE 780	16
Operations management 781	IVV 781	16
Technological entrepreneurship 780	IEE 780	16
Quality management 780	IKK 780	16
and		
Electives /Ad hoc modules		
Maintenance management 780	IMC 780	16
Engineering logistics 780	IIX 780	16
Research methodology 781	INI 781	16
(Contact department for more information)		

* Students who wish to continue with the Master's in Technology Management need to take Research Methodology as elective module.

MEng (Technology Management)(12250251)
This qualification follows upon the BEngHons (Technology Management).

	Code	Credits
Dissertation 890	ITB 890	128

or

MEng (Technology Management)(12250252)

Mini-dissertation 898	IGB 898	64
People management 884	PEM 884	16
Financial management 831	FBS 831	16
Strategic management 802	ISM 802	16
and		
Elective module		
Technology commercialisation 881	IKG 881	16

or
Module from the MEM/MPM programme (subject to the approval of the head of department)

MEng (Engineering Management)(12250171)

	Code	Credits
Dissertation 895	IGB 895	128

or

MEng (Engineering Management)(12250172)
MSc (Engineering Management)(12251074)
Minimum requirements: 192 credits of coursework modules and a mini-dissertation (64 credits).
Total: 256 credits.

	Code	Credits
Mini-dissertation 898 (MEng)	IGB 898	64
Mini-dissertation 898 (MSc)	ISC 898	64
and		
Core modules		
Systems engineering and management 801	ISE 801	16
Production and operations management 801	IPP 801	16
People management 883	PEM 883	16
Financial management 830	FBS 830	16
Technology management 801	ITB 801	16
Maintenance management 801	IIB 801	16
Project management 803	IPK 803	16
Research methodology 800	INI 800	16
and		
Select two modules from the domain of specialisation in consultation with the Department of Engineering and Technology Management.		
Details regarding the curricula as well as syllabi of the respective domains are available from the Department.		
Domain: General		
Risk management 801	IRI 801	16
Strategic management 801	ISM 801	16

Electives		
Quality management 801	IKK 801	16
Marketing management 884	BEM 884	16
Engineering service management 801	IGB 801	16
New ventures and entrepreneurship 801	IOE 801	16
Engineering logistics 801	IIX 801	16
Life cycle management of SHE 802	ILE 802	16
Information management 884	ILB 884	16
Legal aspects of project management 803	ILC 803	16
or		
Domain: Asset and Maintenance Management		
Life cycle management of SHE 802	ILE 802	16
Asset management 801	IAM 801	16
Risk management 801	IRI 801	16
Electives		
Reliability engineering 801	IBI 801	16
Engineering logistics 801	IIX 801	16
Legal aspects of project management 803	ILC 803	16
Strategic management 801	ISM 801	16
or		
Domain: Sustainable development		
Life cycle management of SHE 802	ILE 802	16
Strategic management 801	ISM 801	16
Electives		
Asset management 801	IAM 801	16
Risk management 801	IRI 801	16
New ventures and entrepreneurship 801	IOE 801	16
Engineering logistics 801	IIX 801	16
Engineering service management 801	IGB 801	16
Marketing management 884	BEM 884	16
Legal aspects of project management 803	ILC 803	16
or		
Domain: Engineering Service Management		
Engineering service management 801	IGB 801	16
Advanced engineering service management 802	IGB 802	16
Strategic management 801	ISM 801	16
Electives		
Information management 884	ILB 884	16
Risk management 801	IRI 801	16
Legal aspects of project management 803	ILC 803	16
Engineering logistics 801	IIX 801	16

MEng (Project Management)(12250261)

	Code	**Credits**
Dissertation 895	ISC 895	128

or

MEng (Project Management)(12250262)
MSc (Project Management)(12251075)
Minimum requirements: 192 credits of coursework modules and a mini-dissertation (64 credits).
Total: 256 credits

	Code	Credits
Mini-dissertation 898 (MEng)	IGB 898	64
Mini-dissertation 898 (MSc)	ISC 898	64
and		
Core modules		
Project system engineering 802	ISE 802	16
Introduction to project management 801	IPM 801	16
Project human resource management 801	IHR 801	16
Project finance and cost management 802	IPF 802	16
Project procurement management 801	IPJ 801	16
Project quality management 801	IQM 801	16
Project risk management 801	IRM 801	16
Research methodology 800	INI 800	16
and		
Select two modules from the domain of specialisation in consultation with the Department of Engineering and Technology Management.		
Details regarding the curricula as well as syllabi of the respective domains are available from the Department.		
Domain: General		
Project management practice 801	IMP 801	16
Strategic project management 804	ISM 804	16
Electives		
Engineering service management 801	IGB 801	16
New ventures and entrepreneurship 801	IOE 801	16
Legal aspects of project management 803	ILC 803	16
Engineering logistics 801	IIX 801	16
Marketing management 884	BEM 884	16
Life cycle management of SHE 802	ILE 802	16
Information management 884	ILB 884	16
or		
Domain: Engineering Service Management		
Engineering service management 801	IGB 801	16
Advanced engineering service management 802	IGB 802	16
Strategic project management 804	ISM 804	16
Electives		
Legal aspects of project management 803	ILC 803	16
Project management practice 801	IMP 801	16
Engineering logistics 801	IIX 801	16
Information management 884	ILB 884	16
Domain: Construction Management		
Construction management I 803	KBS 803	16
Construction management II 804	KBS 804	16
Construction management III 805	KBS 805	16
Strategic project management 804	ISM 804	16
Electives		
Project management practice 801	IMP 801	16
Legal aspects of project management 803	ILC 803	16
New ventures and entrepreneurship 801	IOE 801	16
Engineering logistics 801	IIX 801	16

(e) INDUSTRIAL AND SYSTEMS ENGINEERING

A limited number of appropriate modules from other departments are allowed.

BEngHons (Industrial Engineering)(12240011)

	Code	Credits
Business architecture 780	BBA 780	16
Business engineering 780	BSI 780	16
Business logistics 780	BLK 780	16
Ergonomics 780	BEE 780	16
Health and safety in the workplace 780	BGW 780	16
Industrial analysis 780	BAN 780	16
Information systems 780	BIS 780	16
Megatronics 780	BMK 780	16
Operations research 780	BOZ 780	16
Probability models 780	BHM 780	16
Production management 781	BPZ 781	16
Quality management 780	BGH 780	16
Reliability engineering 780	BTH 780	16
Research methodology 781	INI 781	16
Simulation modelling 780	BUY 780	16
Supply chain design 780	BVK 780	16
Design and analysis of experiments 780	BDE 780	16

MEng(Industrial Engineering)(12250011)

	Code	Credits
Dissertation 890	BIR 890	128

(f) MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

A limited number of appropriate modules from other departments are allowed.

BEngHons (Metallurgical Engineering)(12240061)

	Code	Credits
Corrosion 700	NKR 700	32
Electrometallurgy 700	NEL 700	32
Froth flotation 700	NSF 700	32
Heat treatment 700	NHB 700	32
Hydrometallurgy 700	NHM 700	32
Literature survey 700	NLO 700	32
Mechanical metallurgy 700	NMM 700	32
Metallurgical analysis 700	NPA 700	32
Minerals processing 700	NMP 700	32
Physical metallurgy 700	NFM 700	32
Pyrometallurgy 700	NPM 700	32
Refractory materials 700	NVM 700	32
Welding metallurgy 700	NSW 700	32
Welding processes 700	NWP 700	32
Design of welded structures 700	NWP 701	32
Fabrication engineering 700	NFE 700	32
Applied theory of sampling for minerals processing 700	NMP 701	32

Nuclear reactor materials 700	NNR 700	32
Option: Welding Engineering		
The following 128 credits are prescribed:		
Welding metallurgy 700	NSW 700	32
Welding processes 700	NWP 700	32
Design of welded structures 700	NWP 701	32
Fabrication engineering 700	NFE 700	32

MEng (Metallurgical Engineering)(12250061)

	Code	**Credits**
Dissertation 890	NIN 890	128

(g) MECHANICAL AND AERONAUTICAL ENGINEERING

A limited number of appropriate modules from other departments are allowed.
Not all modules listed are presented each year. Please consult the departmental post-graduate brochure.

BEngHons (Mechanical Engineering)(12240051)

	Code	**Credits**
Advanced thermodynamics and energy systems 781	MTX 781	16
Advanced heat and mass transfer 780	MHM 780	16
Advanced finite element methods 781	MEE 781	16
Advanced fluid mechanics 781	MSX 781	16
Aerodynamics 780	MLD 780	16
Aeronautical structures 780	MLT 780	16
Air-conditioning and refrigeration 780	MLR 780	16
Aircraft design	MLW 780	16
Aircraft propulsion systems 780	MAY 780	16
Composite materials 780	MCM 780	16
Condition-based maintenance 780	MIC 780	16
Control systems 780	MBB 780	16
Design 780	MOX 780	16
Experimental structural dynamics 783	MSY 783	16
Fatigue 780	MSV 780	16
Finite element methods 780	MEE 780	16
Flight mechanics 780	MLV 780	16
Fluid mechanics 780	MSX 780	16
Fluid-structure interaction 780	MAH 780	16
Fossil fuel power stations 781	MUU 781	16
Fracture mechanics 780	MSF 780	16
Gas dynamics 780	MLG 780	16
Independent study 781	MSS 781	16
Independent study 782	MSS 782	16
Maintenance practice 780	MIP 780	16
Maintenance practice 781	MIP 781	16
Mechatronics 780	MEG 780	16
Nano and micro heat transfer 781	MWX 781	16
Numerical methods 780	MWN 780	16
Numerical thermoflow 780	MSM 780	16
Numerical thermoflow 781	MSM 781	16

Optimum design 780	MOO 780	16
Porous flow 780	MAN 780	16
Reactor coolant flow and heat transfer 782	MUA 782	16
Reactor engineering science 783	MUA 783	16
Reactor physics 784	MUA 784	16
Reactor materials engineering 785	MUA 785	16
Reactor materials engineering 786	MUA 786	16
Reactor stress analysis 787	MUA 787	16
Reliability-based maintenance 781	MII 781	16
Reliability engineering 781	MIR 781	16
Solar energy 780	MBA 780	16
Specialised design 781	MOX 781	16
Specialised design 782	MOX 782	16
Specialised structural mechanics 781	MSY 781	16
Specialised structural mechanics 782	MSY 782	16
Specialised thermoflow 780	MTV 780	16
Specialised thermoflow 781	MTV 781	16
Structural control 781	MOI 781	16
Theory of elasticity 780	MSE 780	16
Topology and shape optimisation 780	MBT 780	16
Tribology 780	MIT 780	16
Vehicle dynamics 780	MVI 780	16
Vibration-based condition monitoring 781	MEV 781	16

MEng (Mechanical Engineering)(12250051)

	Code	**Credits**
Dissertation 890	MIR 890	128

(h) MINING ENGINEERING

A limited number of appropriate modules from other departments are allowed.

BEngHons (Mining Engineering)(12240071)

	Code	**Credits**
Advanced mine design 780	PMZ 780	16
Airflow and fans 711	PKB 711	16
Financial mine evaluation 780	PFZ 780	16
Guided special studies 700	PSS 700	32
Heat and refrigeration 712	PKB 712	16
Slope stability 781	PHS 781	16
Strata control – Collieries 788	PSZ 788	16
Strata control – Hard rock mining 786	PSZ 786	16
Surface mining 783	POY 783	16
Advanced explosives engineering 785	PRX 785	16

MEng (Mining Engineering)(12250071)

	Code	**Credits**
Dissertation 890	PYI 890	128

(i) MODULES FROM OTHER DEPARTMENTS

Postgraduate modules offered by the **Department of Geology:**

Engineering geology 703	IGL 703
Engineering geology 704	IGL 704

Postgraduate modules offered by the **Department of Mathematics and Applied Mathematics:**

First semester

Mathematical models of financial engineering 732	WTW 732

Second semester

Mathematical models of financial engineering 762 (Prerequisite: WTW 732)	WTW 762

Postgraduate modules offered by the **Department of Computer Science:**

Computer networks 780	RNW 780
Graphics 780	GRF 780
Programming languages 780	PGT 780
Software engineering 780	PIN 780

Bachelor of Science Honours in Applied Science
[BScHons (Applied Science)]
Bachelor of Science Honours in Technology Management
[BScHons (Technology Management)]

Eng. 22

Also consult the General Regulations G.16 to G.29.

(a) Admission requirements: An appropriate bachelor's degree, a BTech degree or equivalent qualification.
(b) The minimum duration of the programme is one year of full-time study.
(c) A minimum of 128 credits is required to obtain the BScHons degree.
(d) The BScHons (Applied Science) degree is conferred by the following academic departments:
Chemical Engineering
Civil Engineering
Industrial and Systems Engineering
Materials Science and Metallurgical Engineering
Mechanical and Aeronautical Engineering
Mining Engineering
(e) The BScHons (Technology Management) degree is conferred by the following academic department:
Engineering and Technology Management
(f) The stipulations of Reg. Eng. 19 (e) to (g) apply *mutatis mutandis*.

Master of Science in Applied Science
[MSc (Applied Science)]
Master of Science in Technology Management
[MSc (Technology Management)]

Eng. 23
Also consult the General Regulations G.30 to G.44. and G.57 to G.62

(a) Subject to the stipulations of Regulation G.62, an appropriate BScHons or equivalent degree is required for admission.
(b) The minimum duration of the programme is one year of full-time study.
(c) The MSc (Applied Science) degree is conferred by the same departments as the BScHons (Applied Science) degree. The MSc (Technology Management) degree is conferred by the Department of Engineering and Technology Management.
(d) A minimum of 128 credits is required to obtain the MSc degree. Either a mini-dissertation (64 credits) and coursework (64 credits) **or** a dissertation (128 credits) is included in the programme.
(e) The stipulations of Regulation Eng. 20 (f) to (k) apply *mutatis mutandis*, excluding the stipulations applicable to the MEng (Engineering Management), MEng (Project Management), MSc (Engineering Management) and the MSc (Project Management).

Curricula for the following programmes:
BScHons (Applied Science)
BScHons (Technology Management)
MSc (Applied Science)
MSc (Technology Management)

Eng. 24
Any specific module is offered on the condition that a minimum number of students are registered for the module, as determined by the head of department and the Dean. Students must consult the relevant head of department in order to compile a meaningful programme, as well as on the syllabi of the modules. The relevant departmental postgraduate brochures must also be consulted.

Note: The programmes are arranged in alphabetical order according to the names of the academic departments.

(a) CHEMICAL ENGINEERING

A limited number of appropriate postgraduate modules from other departments are allowed.
Not all modules listed are presented each year. Please consult the departmental postgraduate brochure.

BScHons (Applied Science) (Control)(12243012)

	Code	**Credits**
First year first semester		
Process control 410	CPB 410	16
as well as **one** of the following modules:		
Biotechnology 410	CBI 410	16
Reactor design 410	CRO 410	16
Second semester		
** Specialisation 420	CSS 420	16
Chemical engineering 787	CIR 787	16

*** Note: Only the Advanced Control Applications option may be taken.*

Second year

Process control system development 732	CSP 732	32
and **one** of the following modules:		
Separation technology 732	CSK 732	32
Process integration 732	CIP 732	32

The modules CPB 410, CBI 410, CRO 410 and CSS 420 do not form part of the postgraduate block presentations. Individual arrangements have to be made with the relevant lecturer regarding attendance of lectures, study material, tests and assignments.

BScHons (Applied Science) (Chemical Technology)(12243015)

	Code	**Credits**
Specialisation in Carbon, Fluoro-materials and Polymer Materials Science - 128 credits from the following:		
Polymer materials science 732	CPW 732	32
Bioprocessing 732	CBP 732	32
Polymer processing 732	CPP 732	32
Fluoro-materials science and technology 732	CFT 732	32
Separation technology 732	CSK 732	32
Chemical engineering 707	CIR 707	32
Additive technology 732	CYM 732	32
Carbon materials sience and technology 732	CMS 732	32
Product design 732	CPO 732	32

Specialisation in Process Design – 128 credits

Specialisation in Process Design is possible by registering for the following modules: (Please note that a candidate selecting this option will not be allowed to register for any modules at 700-level before the modules of the first semester at 400-level had been completed successfully.)

First year first semester

Two of the following modules:

Reactor design 410	CRO 410	16
Process control 410	CPB 410	16
Biotechnology 410	CBI 410	16

Second semester

** Specialisation 420	CSS 420	16
Chemical engineering 787	CIR 787	16

*** Note: Any of the options may be taken excluding the Product Design option*

Second year

Product design 732	CPO 732	32
and **one** of the following modules:		
Separation technology 732	CSK 732	32
Process integration 732	CIP 732	32

The modules CPB 410, CBI 410, CRO 410 and CSS 420 do not form part of the post-graduate block presentations. Individual arrangements have to be made with the relevant lecturer regarding attendance of lectures, study material, tests and assignments.

BScHons (Applied Science) (Environmental Technology)(12243025)

	Code	**Credits**
The following 128 credits are prescribed:		
Principles of environmental engineering 787	CEM 787	32

Air quality control 787	CAM 787	32
Water quality management 780	WQB 780	32
Waste management engineering 787	WAI 787	32

BScHons (Applied Science) (Water Utilisation)(12243029)

	Code	**Credits**
The following 128 credits are prescribed:		
Chemical water treatment 787	WCW 787	32
Biological water treatment 787	WBW 787	32
Water quality management 780	WQB 780	32
Industrial waste engineering 787	WAI 787	32

MSc (Applied Science) (Control)(12253012)
MSc (Applied Science) (Chemical Technology)(12253015)
MSc (Applied Science) (Environmental Technology)(12253025)
MSc (Applied Science) (Water Utilisation)(12253029)

	Code	**Credits**
Dissertation 807	CVD 807	128

(b) CIVIL ENGINEERING

A limited number of appropriate modules from other departments and from other divisions of Civil Engineering are allowed.

BScHons (Applied Science)
At least 128 credits from the following:

	Code	**Credits**
Specialisation in **Water Resources (12243030)**		
Basic applied hydraulics 786	SHW 786	24
Basic fundamental hydraulics 787	SHW 787	24
and *24 credits from the following:*		
Basic soil mechanics 785	SGM 785	24
Basic concrete structures 792	SIC 792	24
Basic structural analysis 790	SIC 790	24
Basic steel structures 791	SIC 791	24
Basic transportation and traffic engineering 789	SVV 789	24
Basic pavements 786	SGM 786	24
Basic statistical methods 797	SHC 797	24

and *the remainder of the modules chosen from the modules prescribed for the BEngHons (Water Resource Engineering) programme, as approved by the head of department, and after completion of the appropriate modules from the list above.*

Specialisation in **Geotechnics (12243019)**		
Statistical methods 791	SHC 791	24
Basic soil mechanics 785	SGM 785	24
Geotechnical design special 795	SGC 795	24
Soil mechanics special 784	SGM 784	24
Geotechnical laboratory testing 785	SGS 785	24
In-situ soil testing and monitoring 786	SGS 786	24

Specialisation in **Structures (12243031)**

Basic concrete structures 792	SIC 792	24
Basic structural analysis 790	SIC 790	24
Basic steel structures 791	SIC 791	24

and *the remainder of the credits chosen from the modules prescribed for the BEngHons (Structural Engineering) programme, as approved by the head of department, and after completion of the appropriate modules from the list above.*

Specialisation in **Transportation Planning (12243028)**

Basic transportation and traffic engineering 789	SVV 789	24
Basic pavement materials and design 786	SGM 786	24
Basic statistical methods 797	SHC 797	24
Transportation planning 789	SVC 789	24

and *the remainder of the credits chosen from the modules for the BEngHons (Transportation Engineering) programme, as approved by the head of department, and after completion of the appropriate modules from the list above.*

MSc (Applied Science) (Geotechnics)(12253019)
MSc (Applied Science) (Structures)(12253036)
MSc (Applied Science) (Transportation Planning)(12253028)
MSc (Applied Science) (Water Resources)(12253031)

	Code	**Credits**
Dissertation 890	SST 890	128

or

MSc (Applied Science)(Coursework)
Specialisation in **Water Resources (12253053)**

Mini-dissertation 896	SST 896	64

and

Computer applications for civil engineers 880	SHC 880	32
Advanced hydraulics 885	SHC 885	32

or
Specialisation in **Structures (12253054)**

Mini-dissertation 896	SST 896	64

and
64 credits from the following:

Computer applications for civil engineers 880	SHC 880	32
Advanced structural analysis 887	SIN 887	32
Advanced structural design 886	SIN 886	32

An approved module from the Department of Mechanical and Aeronautical Engineering.

or
Specialisation in **Transportation Planning (12253052)**

Mini-dissertation 896	SST 896	64

and

Advanced transportation I 882	SVV 882	32
Computer applications for civil engineers 880	SHC 880	32

(c) ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

MSc (Applied Science)(12253046)

	Code	Credits
Dissertation 891	EER 891	128

(d) ENGINEERING AND TECHNOLOGY MANAGEMENT

BScHons (Technology Management)(12241072)
128 credits from the following:

	Code	Credits
Core modules		
Engineering economics 780	IKN 780	16
Innovation strategy 780	INV 780	16
Project management 780	IPK 780	16
Systems engineering 780	ISE 780	16
Operations management 781	IVV 781	16
Technological entrepreneurship 780	IEE 780	16
Quality management 780	IKK 780	16
and		
Electives		
(Ad hoc module for students from other departments)		
Maintenance management 780	IMC 780	16
Engineering logistics 780	IIX 780	16
Research methodology 781	INI 781	16

* Students who wish to continue with the Master's in Technology Management need to take Research Methodology as elective module.

MSc (Technology Management)(12251072)
This qualification follows upon the BScHons (Technology Management)

	Code	Credits
Dissertation 895	ITB 895	128
or		

MSc (Technology Management)(Coursework)(12251076)

Mini-dissertation 898	ISC 898	64
People management 884	PEM 884	16
Financial management 831	FBS 831	16
Strategic management 802	ISM 802	16
and		
Elective module		
Technology commercialisation 881	IKG 881	16
or		
Module from the MEM/MPM programme (subject to the approval of the head of department)		

(e) INDUSTRIAL AND SYSTEMS ENGINEERING

A limited number of appropriate modules from other departments are allowed.

BScHons (Applied Science) (Industrial Systems)(12243011)

	Code	Credits
The following modules are compulsory:		
Basic statistical methods 797	SHC 797	16

Research methodology 781	INI 781	16
Industrial analysis 780	BAN 780	16
Production management 781	BPZ 781	16
Business logistics 780	BLK 780	16

and

a maximum of 48 credits elected from the BEngHons programme.

MSc (Applied Science) (Industrial Systems)(12253011)

	Code	**Credits**
Dissertation 891	BIR 891	128

(f) MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

A limited number of appropriate postgraduate modules from other departments are allowed.

BScHons (Applied Science) (Metallurgy)(12243022)

	Code	**Credits**
32 credits from the following (compulsory):		
Basic extractive metallurgy 701	NHM 701	32
Basic physical metallurgy 701	NFM 701	32
Basic pyrometallurgy 701	NPM 701	32

and

a maximum of 32 credits from the following: (optional)

Basic statistical methods 797	SHC 797	24
Research methodology 781	INI 781	16
Project management 780	IPK 780	16

and

the balance of the credits(for a total of at least 128) chosen from the modules for the BEngHons programme, as approved by the head of department and after successful completion of the appropriate 701 module.

Option: Welding Technology

The following 128 credits are prescribed:

Welding metallurgy 700	NSW 700	32
Welding processes 700	NWP 700	32
Design of welded structures 700	NWP 701	32
Fabrication engineering 700	NFE 700	32

MSc (Applied Science) (Metallurgy)(12253022)

	Code	**Credits**
Dissertation 891	NIN 891	128

(g) MECHANICAL AND AERONAUTICAL ENGINEERING

A limited number of appropriate modules from other departments are allowed.

BScHons (Applied Science) (Mechanics)(12243021)

	Code	**Credits**
Structural mechanics 732	MSY 732	32
Thermoflow 732	MTV 732	32

(If a student fails any one of the above modules, this may be taken as grounds for termination of the registration of the student, in terms of General Regulation G.4 and G.19.)
and
at least 64 credits chosen from the modules as prescribed for the BEngHons programme, as approved by the head of department.

MSc (Applied Science) (Mechanics)(12253021)

	Code	Credits
Dissertation 891	MIR 891	128

(h) MINING ENGINEERING

A limited number of appropriate modules from other departments are allowed.

BScHons (Applied Science) (Mining)(12243044)

	Code	Credits
Basic mine environment engineering 701	PKB 701	16
Basic rock mechanics 703	PSZ 703	16
Underground mining methods 701	PMY 701	32
Surface-mining 703	PMY 703	16
Guided special studies 700	PSS 700	32
Explosives engineering 701	PRX 701	16
Total number of credits		**128**

All the modules above are compulsory for fulfilling the requirement for BScHons (Applied Science)(Mining).

MSc (Applied Science) (Mining Environmental Control)(12253023)
or
MSc (Applied Science) (Mine Strata Control)(12253024)

	Code	Credits
Dissertation 891	PYI 891	128

DOCTORAL DEGREES

Doctor of Philosophy in Engineering [PhD (Engineering)]

Eng. 25
Also consult the General Regulations G.45 to G.55 and G.57 to G.62.

(a) Subject to the stipulations of Regulations G.45 and G.62, no candidate is admitted to doctoral studies unless such a candidate holds a master's degree in Engineering or an equivalent master's degree.

(b) Unless otherwise decided by the Dean, on the recommendation of the supervisor, the PhD (Engineering) degree is awarded on the basis of a thesis and an examination on the thesis.

(c) Unless the Senate, on the recommendation of the supervisor, decides otherwise, a student, before or on submission of a thesis, must submit proof of submission of an article from/issued by an accredited journal, to the Head: Student Administration. The submitted article should be based on the research that the student has conducted for the thesis and be approved by the supervisor if the supervisor is not a co-author. The supervisor shall be responsible for ensuring that the paper is

taken through all the processes of revision and resubmission, as may be necessary. Conferment of the degree may be made subject to compliance with the stipulations of this regulation.

(d) The student must provide proof by means of his work, thesis and examination of advanced original research and/or creative work which makes a real and substantial contribution to the knowledge of engineering science and/or practice.

Doctor of Philosophy [PhD]

Eng. 26

Also consult the General Regulations G.45 to G.55 and G.57 to G.62.

(a) Subject to the stipulations of Regulations G.45 and G.62 a master's degree is required for admission to studies for a PhD.

(b) Unless otherwise decided by the Dean, on the recommendation of the supervisor, the PhD degree is awarded on the basis of a thesis and an examination on the thesis.

(c) Unless the Senate, on the recommendation of the supervisor, decides otherwise, a student, before or on submission of a thesis, must submit proof of submission of an article issued by an accredited journal, to the Head: Student Administration. The submitted article should be based on the research that the student has conducted for the thesis and be approved by the supervisor if the supervisor is not a co-author. The supervisor shall be responsible for ensuring that the paper is taken through all the processes of revision and resubmission, as may be necessary. Conferment of the degree may be made subject to compliance with the stipulations of this regulation.

(d) The student must provide proof by means of his work, thesis and examination of advanced original research and/or creative work which makes a real and substantial contribution to the knowledge of Engineering Science and/or Practice.

Doctor of Engineering [DEng] (Code 12260001)

Eng. 27

The degree DEng is awarded on the basis of publications. Subject to General Regulation G.56, the following applies:

1. **Admission**

   The degree is conferred on a candidate who can demonstrate that he/she enjoys international recognition in her/his field of expertise by virtue of the quality and impact of the publications that have been produced.

2. **Application**

   (a) A candidate must apply in writing to be considered for the degree.

   (b) Should a candidate wish to graduate at a particular ceremony, an application must be submitted before the closing date of the various graduation ceremonies, which is announced annually.

   (c) The application must be accompanied by

      (i) four sets of copies of the publications by virtue of which application is made;

      (ii) a declaration in which the candidate testifies that the publication/s submitted for the doctoral degree

- has/have not previously been submitted to this or any other tertiary institution for such a doctoral degree;
- is/are his or her own work, and with regard to such publication/s of which he or she is co-author, that his or her personal contribution to those works is clearly stated;
- take(s) place with due recognition given to the author's copyright in accordance with the case.

(iii) a summary of not more than 500 words that indicates the contribution that the work has made to the discipline.

3. **Registration**

A candidate must register in the manner determined by the University and pay the prescribed registration fee.

4. **Evaluation of the publications**

(a) The dean appoints a committee, chaired by the chairperson of the Research Committee and of which the head of the department concerned is a member, to make a recommendation to the faculty board as to whether the works have sufficient substance to be submitted for examination in terms of G.56.5(b).

(b) If the faculty board accepts the recommendation, the Postgraduate Committee appoints an examination panel for a particular candidate, subject to approval by the dean.

(c) The head of the department concerned compiles a list of names of potential examiners both inside and outside of South Africa from which the Postgraduate Committee chooses at least three external examiners from outside the University, all of whom must be recognised internationally as having made significant contributions in the field of study. Normally, at least two of these examiners would be from outside South Africa.

(d) No examiner should have any interest in the candidate or in any way be involved in the research that the candidate has done previously.

(e) External examiners must be from different institutions.

(f) As soon as a potential examiner has accepted his/her appointment as examiner, he/she is supplied with a formal letter of appointment as well as documentation on the policy of the University concerning examinations. Examiners must sign an acceptance form that is to be returned to the Head: Student Administration.

(g) A candidate passes if all the members of the examination panel accept the publications for the purposes of conferring the doctoral degree, and on condition that if all but one of the examiners accept the work, the dean, after consultation with the Postgraduate Committee, may appoint a knowledgeable and esteemed academic of stature from outside the University as additional examiner. If the additional examiner accepts the publications, the candidate passes. If such an examiner also rejects the publications, the doctorate is not conferred.

(h) A candidate is only considered once for a doctoral degree based on publications.

(i) The degree is not conferred with distinction.

(j) After a decision on whether the degree is to be conferred or not, has been reached, as indicated in (g) above, the Head: Student Administration has to

(i) address a letter to the examiners to thank them for their participation in the examination and for their recommendations;

(ii) inform the examiners of the final result and indicate to them what their further involvement, if any, will be in the remainder of the process;
(iii) inform the candidate and the head of the department of the final result.

ALPHABETICAL LIST OF MODULES IN THE SCHOOL OF ENGINEERING AND THE GRADUATE SCHOOL OF TECHNOLOGY MANAGEMENT

 # = Concurrent registration
() = Examination admission
dpw = discussions per week
GS = combined (final) mark (semester/year mark plus examination mark) of at least 40% - 49%
hpw = hours per week
LP = Lecturer's permission
lpw = lectures per week
ppw = practicals per week
spw = seminars per week
TDH = Permission by head of department
tpw = tutorials per week
hpw = hours per week

UNDERGRADUATE MODULES

BAN 313 Industrial analysis 313
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Mathematical statistics provides the basis for a number of important applications in the engineering environment. This module provides an introduction to the most important of these applications and will include the following syllabus themes: Monte Carlo simulation, decision analysis, forecasting and data-dependent modelling.

BES 220 Engineering statistics 220
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Engineering systems are often subjected to variation, uncertainty and incomplete information. Mathematical statistics provides the basis for effectively handling and quantifying the effect of these factors. This module provides an introduction to the concepts of mathematical statistics and will include the following syllabus themes: data analysis, probability theory, stochastic modelling, statistical inference and regression analysis.

BFB 320 Facilities planning 320
Academic organisation: Industrial and Systems Engineering
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
This module introduces the principles, approaches, methods, techniques and tools to

systematically determine facility requirements, determine the required space of and relationships between activities, develop and evaluate alternative plans and layouts and present the results. Aspects such as facilities location, manufacturing and service process design, capacity planning, materials handling, personnel facilities, storage and warehousing are also addressed. A structured facility design project forms an integral part of the module.

BGC 410 Quality assurance 410
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to quality and quality management systems. Statistical process control. Acceptance control.

BID 320 Information systems design 320
Academic organisation: Industrial and Systems Engineering
Contact time: 2 ppw 3 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Systems development planning, system requirement analysis, different approaches towards structured analysis and design of systems, process design, database design and normalisation, object-oriented design and modelling, information system application building and testing.

BJJ 210 Professional and technical communication 210
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

BLK 320 Industrial logistics 320
Academic organisation: Industrial and Systems Engineering
Prerequisite: (BOB 310)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 2

Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Role of logistics in the economy and organisation. Customer service. Forecasting. Logistics information systems and electronic information flow. Inventory management. Managing materials flow. Distribution channels. Transportation. Warehousing. Packaging. Strategic purchasing. Global logistics. Organising and controlling logistics. Supply chain management. Supply chain finance and performance measurement. SCOR reference models. Implementing logistics strategy.

BOB 310 Operational management 310
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to operations management, operations strategy and competitiveness. World-class and agile manufacturing. Operations planning in the service industries. The manufacturing management environment. Batching principles (EOQ & DEL). Manufacturing planning and control systems. Sales and operations planning. Capacity planning and control. Demand management. Master production scheduling. Materials requirements planning (MRP). Distribution requirements planning. Just-in-time (JIT) manufacturing. Synchronous manufacturing (Theory of constraints). Comparing MRP, JIT and TOC. Shop-floor scheduling and control. Integration and implementation of manufacturing planning and control systems. Enterprise Resource Planning (ERP) systems. Business process transformation.

BON 410 Operational research 410
Academic organisation: Industrial and Systems Engineering
Prerequisite: (BES 220), (BOZ 312)
Contact time: 3 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Review of basic probability, Markov chain models, Markov decision models. Queueing systems: M/M/1 queues (both finite and infinite capacity), etc; deterministic and stochastic inventory models. Competitive games: pure and mixed strategies, optimum strategy, two-person zero-sum games, graphical methods and applications, LP methods for games.

BOZ 312 Operational research 312
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to Operational research, and more specifically the branch of optimisation and its application to industrial problems. In the module the topics of linear and integer linear programming are introduced. The focus is on identifying and scoping appropriate problems, the subsequent formulation of problems, solution algorithms, and post-optimisation sensitivity analysis. Students are exposed to solving problems using optimisation software.

BPJ 410 Project 410
Academic organisation: Industrial and Systems Engineering
Prerequisite: Finalists only
Contact time: 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Choice of project topic. Appointment of project leader. Literature study, analysis and creation of alternatives.

BPJ 420 Project 420
Academic organisation: Industrial and Systems Engineering
Prerequisite: BPJ 410
Contact time: 2 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 24
Module content:
Narrowing of topic choice. Detailed solution of chosen alternative. Writing of final project report and presentation of project.

BPY 310 Practical training 310
Academic organisation: Industrial and Systems Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
During or at the end of the second year of study, students in industrial engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

BPY 410 Practical training 410
Academic organisation: Industrial and Systems Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
During or at the end of the third year of study, students in industrial engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

BPZ 220 Productivity 220
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 2 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Qualifying and quantifying productivity: efficiency, effectiveness, utilisation, profitability and competitiveness. Method study: critical examination and process flow charts and

diagrams. Work measurement: time study and activity sampling. Organisational behaviour: motivation, incentive schemes, group forming, work teams, job design and change management. Ergonomics.

BPZ 421 Business engineering 421
Academic organisation: Industrial and Systems Engineering
Prerequisite: Finalists only
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Integration of engineering functions; strategic planning; organisational structures; business management; systems engineering; work-flow management; process modelling; business architecture; change management and motivation; marketing management and industry exposure. Business management game project.

BSS 310 Engineering management 310
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Programme and systems engineering
Concepts: Application of project management, systems thinking, systems approach, product, system and project life cycles, project phases and specification practices. Development models: stage-gate development, project charter, systems engineering models, systems engineering management and life cycle characteristics. Planning and Scheduling: task definition, work breakdown structures, duration estimation, Gantt charts, critical path, resource handling. Costs and Budgets: cost estimates, project life cycle costs, work authorisation. Control: project organisation. Legal: contracts, intellectual property. Case studies and semester project.
Engineering economics
Decision making in an engineering environment. Allocation of cost. Money-time relationships (discreet interest formulae, tables, financial calculator, Excel). Bases for comparison of alternatives (present worth, annual worth,). Decision making among alternatives before and after tax (useful lives equal to study period, useful lives different among alternatives).

BSS 410 Systems engineering 410
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
A company's ability to remain competitive hinges increasingly on its ability to develop successful products. In practice this is often determined by how well the company performs systems engineering. Applying the principles of systems engineering allows designers to understand the big picture, i.e. how a product needs to perform technically as well as within its application domain, e.g. environmentally, human interfaces, and so on. This module equips the student with the relevant tools and process understanding to successfully apply systems engineering to product development. Some of these tools and processes include specification practices, requirements engineering, systems engineering management and verification and validation processes.

BUY 321 Simulation modelling 321
Academic organisation: Industrial and Systems Engineering
Prerequisite: (BAN 313)
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to simulation as technique. Simulation methodology. Formulation of problem situations by means of simulation models with the emphasis on discrete models. Input and output analysis. Introduction to simulation software.

CBI 410 Biotechnology 410
Academic organisation: Chemical Engineering
Prerequisite: (CKN321), (CMO320), (CPA310)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Characterisation and taxonomy of biological material. Biochemistry and the chemistry of life. Biological growth requirements, metabolism, growth kinetics and product formation. Enzyme chemistry and kinetics. Biological reactor design, operation and downstream processing.

CIO 310 Chemical engineering design 310
Academic organisation: Chemical Engineering
Prerequisite: (CTD 223)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Steady and unsteady state conductive heat transfer in one to three dimensions. Temperature distributions. Convective heat transfer. Application of boundary layer theory. Determination of film coefficients. Design of heat transfer equipment. Radiant heat transfer. Application of the mechanical energy balance to single phase Newtonian fluids in steady state systems. Adjustment for multiphase, non-Newtonian as well as pulsating systems. Orifice design. Optimal economic choice of pipe diameters, pumps and control valves.

CIR 113 Chemical engineering 113
Academic organisation: Chemical Engineering
Contact time: 2 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Dimensions, units and their conversion. The mol unit, density, concentration. Specific volume, bulk density, density of ideal mixtures. Temperatures and conversions. Pressure, absolute and gauge. Expression of concentration. Empirical formulae. Introduction to material balances: strategy for solving problems. Material balances without chemical reaction. Combinations of equipment.

CIR 123 Chemical engineering 123
Academic organisation: Chemical Engineering
Prerequisite: CIR 113, CHM 171GS
Contact time: 2 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Chemical reaction and stoichiometry, excess reactant, conversion, yield, selectivity. Material balances with recycle streams, bypass streams and purge streams. Gases, vapours and liquids: ideal gas law, SG and density of gases, Nm^3. Material balances where gases are involved. Fuels and combustion: coal analysis, combustion calculations.

CIR 211 Chemical engineering 211
Academic organisation: Chemical Engineering
Prerequisite: CIR 123
Contact time: 2 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Vapour pressure, phase changes, equilibrium. Vapour/gas equilibrium; Henry's law. Enthalpy and enthalpy balances. Heat of reaction. Data and data sources, steam tables. Enthalpy and combustion; flame temperature. Heats of solution and mixing. Miscible and immiscible liquid mixtures; dew point, bubble point. Simultaneous mass and enthalpy balances.

CIR 310 Chemical enigneering 310
Academic organisation: Chemical Engineering
Prerequisite: (CTD 223), (SWK 210), (CHM 215)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Materials science and processing aspects of engineering materials: metals, ceramic, polymers and composites. Generalised correlations for physical and thermodynamic properties. Phase equilibrium in multiphase reacting and non-reacting systems with due allowance for non-ideal mixture behaviour.

CJJ 210 Professional and technical communication 210
Academic organisation: Chemical Engineering
Prerequisite: CIR 123
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse

for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

CKN 321 Kinetics 321
Academic organisation: Chemical Engineering
Prerequisite: (CTD 223)
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Batch reactors; basic reaction kinetics; fitting of experimental reaction data; flow reactor basics.

CLB 321 Laboratory 321
Academic organisation: Chemical Engineering
Prerequisite: JSQ 216, CPN 321#, CKN 321#, (CMO 320), CIO310#
Contact time: 8 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Laboratory safety and general industrial safety practices. Techniques for planning of experiments.
Experimental work illustrating:
Analysis: Composition of coal and gas, heat of combustion, viscosity.
Mass transfer: Gas absorption, batch distillation, azeotropic distillation, fractional distillation and liquid-liquid extraction.
Heat transfer: Condenser, shell and tube heat exchanger, heat loss from insulated pipes.
Piping system design: Frictional energy loss through pipes and fittings.
Measuring equipment: Rate of flow, temperature. Reporting of laboratory results.

CMO 320 Mass transfer 320
Academic organisation: Chemical Engineering
Prerequisite: (CTD 223), COP 311#
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Separation by means of equilibrium stages. Design of flash distillation systems, distillation columns, absorbers and strippers by hand and computer calculations. Design of membrane separation systems.

COP 311 Transfer processes 311
Academic organisation: Chemical Engineering
Prerequisite: WTW 238, (WTW 263)
Contact time: 2 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Momentum transfer. Fluid statics. Control volume approach for conservation of mass,

energy, and momentum. Application to pumps and turbines. Navier-Stokes equations, derivation and applications. Laminar and turbulent boundary layer theory. Heat transfer: fundamentals of heat transfer. Differential equations of heat transfer. Steady state conduction. Introduction to unsteady state conduction. Convection heat transfer and the thermal boundary layer. Radiation heat transfer. Mass transfer: fundamentals of mass transfer. Diffusion and the diffusion coefficient. Differential equations of mass transfer. Steady state molecular diffusion in one or more dimensions.

COS 110 Program design: Introduction 110
Academic organisation: Computer Science
Prerequisite: COS 130 GS or COS 131 GS or COS 132 GS and [Level 5 (60-69%) Mathematics or WTW 133]
Contact time: 1 ppw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The focus is on object-oriented (OO) programming. Concepts including inheritance and multiple inheritance, polymorphism, operator overloading, memory management (static and dynamic binding), interfaces, encapsulation, reuse, etc. will be covered in the module. The module teaches sound program design with the emphasis on modular code, leading to well structured, robust and documented programs. A modern OO programming language is used as the vehicle to develop these skills. The module will introduce the student to basic data structures, lists, stacks and queues.

COS 131 Introduction to programming 131
Academic organisation: Computer Science
Contact time: 1 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Note: All students not registered for programmes in the School of IT need to enrol for this module.
The aim of this module is to acquire a sound knowledge of basic computer programming concepts and an introductory knowledge of data structures. The theory of these concepts, as well as design methodologies, will be investigated. Understanding rather than memorising is emphasised in order to stimulate creative thinking and the development of innovative skills amongst students in the field of computer programming. The C programming language is used to implement these concepts. At the end of the module a short introduction to object-oriented programming using C++ will be given. After completing this module, a student should be able to design and write structured, efficient programs using the C programming language, be familiar with the basic data structures, pointers and file processing, and have an introductory knowledge of advanced data structures and object-orientation.

COS 212 Data structures and algorithms 212
Academic organisation: Computer Science
Prerequisite: COS 110
Contact time: 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Data abstraction is a fundamental concept in the design and implementation of correct and efficient software. In prior modules, students are introduced to the basic data

structures of lists, stacks and queues. This module continues with advanced data structures such as trees, hash tables, heaps and graphs, and goes into depth with the algorithms needed to manipulate them efficiently. Classical algorithms for sorting, searching, traversing, packing and game playing are included, with an emphasis on comparative implementations and efficiency. At the end of this module, students will be able to identify and recognise all the classical data structures; implement them in different ways; know how to measure the efficiency of implementations and algorithms; and have further developed their programming skills, especially with recursion and polymorphism.

COS 216 Netcentric computer systems 216
Academic organisation: Computer Science
Prerequisite: COS 110
Contact time: 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
This module introduces the principles of netcentric computing that can be applied to the WWW and internet as well as to distributed applications. After completing this module, a student will have gained, as outcomes, knowledge of how to integrate various programming and web-based technologies. Particular outcomes include gaining knowledge on the concepts of client and server side programming, web-based applications, port and socket interaction, writing programmes that require remote function calls and achieving database connectivity using remote SQL calls. The supporting technologies of mark-up languages like HTML and scripting languages like JavaScript are also studied. In order to practically demonstrate that a student has reached these outcomes, students will be required to use, integrate and maintain the necessary software and hardware by completing a number of smaller practical assignments whereafter integrating all these technologies into a comprehensive and practical netcentric programming project is required.

COS 222 Operating systems 222
Academic organisation: Computer Science
Prerequisite: COS 130 or COS 131 or COS 132
Contact time: 1 ppw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Fundamental concepts of modern operating systems in terms of their structure and the mechanisms they use are studied in this module. After completing this module, students will have gained, as outcomes, knowledge of real time, multimedia and multiple processor systems, as these will be defined and analysed. In addition, students will have gained knowledge on modern design issues of process management, deadlock and concurrency control, memory management, input/output management, file systems and operating system security. In order to experience a hands-on approach to the knowledge students would have gained from studying the abovementioned concepts, students will have produced a number of practical implementations of these concepts using the Windows and Linux operating systems.

CPA 310 Particle technology 310
Academic organisation: Chemical Engineering
Prerequisite: (CIR 211), COP 311#
Contact time: 4 lpw 2 tpw

Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Humidification and dehumidification of air. Water cooling, drying, crystallisation, ion exchange, particle technology, particle movement in a fluid, sedimentation. Hydro-cyclones, flotation, filtration. Centrifuges. Fluidised bed technology. Mixing. Comminution. Pneumatic transport.

CPB 410 Process control 410
Academic organisation: Chemical Engineering
Prerequisite: (CPD 320) or (CPN 321)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Dynamic properties of equipment, instruments and processes. Mathematical modelling and computer simulation of processes in the time, Laplace and frequency domains. Linearisation and non-linear processes. Stability of control systems. Controller tuning. Methods for process identification. Digital process control. Z-transforms. Use of computers and microprocessors. Introduction to modern control theory: state-space approach.

CPJ 421 Design project 421
Academic organisation: Chemical Engineering
Prerequisite: (CPB 410), (CRO 410), BIE 310/BSS 310, CPS 420#, CPR 420#
Contact time: 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 32
Module content:
Application of chemical engineering principles for the complete design of a chemical plant.

CPN 321 Process dynamics 321
Academic organisation: Chemical Engineering
Prerequisite: CIO 310#, CKN 321#
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Application of the continuity equations, transport equations and phase relationships to describe time-dependent behaviour of processes. Linearisation and use of transfer functions. Stability analysis, effect of dead time and inverse response. Elements of a control loop. Control principles and mechanisms.

CPR 420 Chemical engineering practice 420
Academic organisation: Chemical Engineering
Prerequisite: CLB 321
Contact time: 1 tpw 2 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Design economics and process evaluation. Cost estimation and time-value of money.

Applied process control. Choice of control instrumentation. Plantwide control strategy. Development of P & ID's. Safety: Site plan and layout, area classification, hazard and operability analysis (HAZOP). Occupational Safety and Health Act, Engineering Profession of South Africa Act. Requirements to maintain continued competence and to keep abreast of up-to date tools and techniques. ECSA code of conduct, Continuing Professional Development, ECSA outcomes, ECSA process and reasons for registration as CEng and PrEng. Display understanding of the system of professional development. Accepts responsibility for own actions. Display judgment in decision making during problem solving and design. Limits decision making to area of current competence. Reason about and make judgment on ethical aspects in case study context. Discern boundaries of competence in problem solving and design. Case studies typical of engineering practice situations in which the graduate is likely to participate.

CPS 410 Process synthesis 410
Academic organisation: Chemical Engineering
Prerequisite: CLB 321
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Development of new processing plants; evaluating process alternatives; developing a process flowsheet using a process synthesis approach. Applying thermodynamic principles to obtain an optimal synthesis route.

CPS 420 Process analysis 420
Academic organisation: Chemical Engineering
Prerequisite: CPS 410
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Pinch analysis and exergy analysis. Optimisation techniques. Flowsheet optimisation. Economic evaluation of processes. Applications using computer packages.

CPY 311 Practical training 311
Academic organisation: Chemical Engineering
Prerequisite: (JSQ 216) and (CIR 211)
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
At the end of the second year of study, students in Chemical Engineering undergo at least six weeks of prescribed practical training in the industry. The student must also attend all excursions organised during the year by the department. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

CPY 411 Practical training 411
Academic organisation: Chemical Engineering
Prerequisite: (CMO 320), CPY 311
Contact time: 1 other per week

Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
At the end of the third year of study, students in chemical engineering undergo at least six weeks of prescribed practical training in the industry. The student must also attend all excursions organised during the year by the department. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

CRO 410 Reactor design 410
Academic organisation: Chemical Engineering
Prerequisite: (CKN 320) or (CKN 321)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Heterogeneous catalysis: diffusion in reaction for catalyst pores and different catalyst geometries. Inter and intraparticle heat and mass transfer processes. Reactor design: energy and continuity equation for different types of reactor: stirred tank, pipe, radial flow, slurry and fluidised. Modelling of non-ideal flow in reactors.

CSC 411 Research project 411
Academic organisation: Chemical Engineering
Prerequisite: CLB 321, CPB 410 # and CRO 410 #
Contact time: 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The execution of a complete literature study and research project on a chosen subject.

CSC 421 Research project 421
Academic organisation: Chemical Engineering
Prerequisite: (CSC 411)
Contact time: 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Interpretation of the research results of CSC 411. The writing of a project report and scientific article.

CSS 420 Specialisation 420
Academic organisation: Chemical Engineering
Prerequisite: CPJ 421#
Contact time: 4 ppw 2 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
A module to be selected from the list of available specialisation topics, including Process control, Chemical product design, Environmental engineering, Nuclear engineering, Polymer processing, Reactor design, and Water utilisation engineering.

CTD 223 Thermodynamics 223
Academic organisation: Chemical Engineering
Prerequisite: CIR 211, MPR 212/213, (WTW 258)
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Simple applications of the first and second laws of thermodynamics. The concepts of work, heat, enthalpy and entropy. Equations of state for gases and gas mixtures, the calculation of internal energy, enthalpy and entropy using the equations of state. Simple heat engine cycles. Refrigeration and gas liquefaction. Process efficiency by means of energy. Introduction to equilibrium composition principles in multiphase non-reacting systems with due allowance for non-ideality in the phases and the mixtures.

EAD 410 Electrical drives 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELX 311GS and EDF 320 GS
Contact time: 1 ppw 3 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Single and three-phase DC-AC invertors, PWM, 4-quadrant conversion, DC and AC variable speed drives and high frequency transformer design.

EAI 320 Intelligent systems 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: WTW 258
Contact time: 1 web-based period per week 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Practical application of neural networks, fuzzy logic, genetic algorithms and expert systems. Introduction to pattern recognition, optimisation and problemsolving using intelligent systems techniques.

EAS 410 Computer engineering: Architecture and systems 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMK 310 GS
Contact time: 1 tpw 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
A systems approach to advanced computer architecture. The features of RISC and SISC architecture, detailed examination of the instruction cycle. Multiprocessor techniques. SIMD, MIMD and SISD systems.

EBB 320 Control systems 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELI 220 GS
Contact time: 1 tpw 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16

Module content:
Modelling and simulation of physical systems. Block and signal flow diagrams. State variable formulation. Time and frequency domain analysis. Stability and sensitivity. Design methods, cascade (e.g. PID) and feedback controllers.

EBN 111 Electricity and electronics 111
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 3 lpw 1 tpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Electrical quantities, units, definitions, conventions. Electrical symbols, ideal and practical current and voltage sources, controlled sources. Ohm's law in resistive circuits, Kirchoff's current and voltage laws, resistors in series and parallel circuits, voltage and current division, mesh current and node voltage methods. Circuit theorems: Linearity, superposition, Thevenin and Norton equivalent circuits, sources transformation, power calculation, maximum power transfer. Energy storage elements: current, voltage, power and energy in inductors and capacitors, inductors and capacitors in series and parallel. Ideal operational amplifiers and applications: inverting and noninverting amplifiers, summing amplifiers, current sources, integrators.

EBN 122 Electricity and electronics 122
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Electrical quantities, units, definitions, conventions. Electrical symbols, ideal and practical current and voltage sources, controlled sources. Ohm's law in resistive circuits, Kirchoff's current and voltage laws, resistors in series and parallel circuits, voltage and current division, mesh current and node voltage methods. Circuit theorems: linearity, superposition, Thevenin and Norton equivalent circuits, sources transformation, power calculation, maximum power transfer. Energy storage elements: current, voltage, power and energy in inductors and capacitors, inductors and capacitors in series and parallel. Ideal operational amplifiers and applications: inverting and noninverting amplifiers, summing amplifiers, current sources, integrators.

EBT 410 Automation 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EBB 320 GS
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Plant automation issues. The steps taken to establish controllers for industrial processes. Static and dynamic properties of sensors and actuators. Obtaining models from process data. Plant automation platforms. Model-bases PID and internal model control. Turning and troubleshoot control loops. Unconstrained single-input-single-output model predictive control. Economic evaluation of automation systems.

EDC 310 Digital communication 310
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELI 220 GS
Contact time: 1 tpw 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Basic signals theory, Transform theory (Fourier, Laplace and Z-transform) and Linear systems. Overview of stochastic processes: Stationarity and ergodicity. Noise and channel models. Transmission effects. Definition of information and coding of analog information sources. Shannon's Channel Capacity Theorem. Introduction to channel (error) detection and correction coding: Block and convolutional coding. Maximum-likelihood sequence decoding: The Viterbi algorithm. Analysis of digital modulation techniques in AWGN. Optimal receiver design. Nyquist and partial-response systems. Power Spectral Density (PSD) of random data signals. Digital transmission through band-limited channels: ISI, Nyquist criteria and equalisers. Data communication standards and protocols. The focus will be on applications in the computer and network environments.

EDF 320 Power electronics 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELX 311, ELI 220GS
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Semiconductor components: Power diodes, silicon-controlled-rectifiers, bipolar transistors, power mosfets, IGBTs, emerging devices. Ancillary issues: Heat sinks, snubbers, gate drive circuits. Converter topologies: AC-DC converters, DC-DC converters; Applications: Sizing of converter components, isolated high-frequency power supplies.

EEO 420 Electrical engineering design 420
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EKK 320, EKK 410GS
Contact time: 1 tpw 2 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Lighting design; power cable design; power transformer design; protection design; power capacitor design; introduction to system level design; the system design process; design for operational feasibility; design project.

EES 424 Specialisation 424
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 tpw 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Specific niche areas from electronic engineering are addressed.

EHN 410 e-Business and network security 410
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Commerce via the Internet, electronic payment systems, virtual organisations and electronic business. Introduction to data security, system security, network security, user considerations, firewalls, encryption, access control and social engineering.

EIR 211 Electrical engineering 211
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EBN 111 or EBN 122 and WTW 161
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Circuit principles; sinusoidal voltage and currents, RMS values, phasors, complex impedance, power, transient analysis, three-phase circuits. Digital systems. Electronics: Diodes, Amplifiers, BJT's, FET's as switch and implementation of logic circuits. Electricity: transformers; electrical machines – (DC and AC), equivalent circuits, speed control, power generation, small-signal analysis and distribution – electrical energy sources, transmission and protection, power and energy metering and tariffs, power factor correction, lightning and surges.

EIR 221 Electrical engineering 221
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EBN 111 or EBN 122 and WTW 161
Contact time: 3 lpw 1 tpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Circuit principles; sinusoidal voltage and currents, RMS-values, phasors, complex impedance, power, transient analysis, three-phase circuits. Digital systems. Electronics: Diodes, Amplifiers, BJT's, FET's as switch and implementation of logic circuits. Electricity: transformers; electrical machines – (DC and AC), equivalent circuits, speed control, power generation, small-signal analysis and distribution – electrical energy sources, transmission and protection, power and energy metering and tariffs, power factor correction, lightning and surges.

EIW 121 Information technology practice 121
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 36 other per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
This module is offered at the end of the first year of study. The duration is at least two weeks during which the students receive practical training in computers and computer networks. The module may for practical reasons be offered in a different time slot (e.g. at the beginning of the next year of study).

EIW 221 Information technology practice 221
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 36 other per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
This module is offered at the end of the second year of study. The duration is at least two weeks during which the students receive practical training in computers and computer networks. The module may for practical reasons be offered in a different time slot (e.g. at the beginning of the next year of study).

EIW 320 Information technology practice 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIW 221
Contact time: 36 other per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
This module is offered at the end of the third year of study. The duration is at least two weeks during which the students receive practical training in computers and computer networks. The module may for practical reasons be offered in a different time slot (e.g. at the beginning of the next year of study).

EJJ 210 Professional and technical communication 210
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

EKK 320 Power system components 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211
Contact time: 1 tpw 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Single and three-phase basic concepts, Transformers: the ideal transformer, equivalent circuit, single- and three-phase transformers, auto-transformers, tap changing

transformers. Synchronous machines: equivalent circuit, real and reactive power control, two-axis machine model. Transmission lines, underground cables, capacitors, reactors, Single- and three-phase induction motors, load modelling.

EKK 410 Power system analysis 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EKK 320
Contact time: 1 tpw 1 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Power flow: bus admittance matrix, bus impedance matrix, Gauss Seidal and Newton Raphson methods. Fault analysis: balanced fault analysis, symmetrical components, unbalanced fault analysis. Power system protection: definite time, inverse-definite-minimum-time (IDMT), introduction to over-current and earth fault protection, distribution system protection, transmission system protection, reticulation system protection. Sizing of protection devices. High voltage control: over-voltages, transients.

ELI 220 Linear systems 220
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Frequency domain analysis of linear time-invariant systems. Laplace, Fourier and Z-transforms applied to periodic, aperiodic and sampled signals; exponential and trigonometric Fourier series. Nyquist sampling theorem, transfer functions, poles and zeros, bandwidth and rise time, frequency response, impulse response, Bode diagrams, natural frequency, natural and forced response. Instability and oscillations. Computer simulation.

ELO 320 Electronic engineering design 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMK 310 GS
Contact time: 2 lpw 2 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Design for manufacturing and maintainability, technical specifications and interface specifications, packaging technology, manufacturing processes, CAD-CAM principles, production facilities and techniques, industry standards, safety standards, environmental requirements, ergonomics and aesthetics, man/machine interfaces, material procurement, complete design and construction of a system (including electromagnetic compatibility).

ELX 311 Electrical machines 311
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16

Module content:
Magnetic circuits: flux, flux density, reluctance, hysteresis, MMF, magnetic energy. Conversion: Process, field energy, mechanical force in electromagnetic systems. Transformers: Types of transformers, ideal transformer, single- and three-phase transformer models, auto and instrument transformers, per unit system, voltage regulation and efficiency, three-phase circuit analysis. Principles of machines: torque, speed, efficiency and heat loss, circuit models. Machines: power transformers, DC motors, induction motors.

EME 310 Electromagnetic compatibility 310
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction:– electromagnetic spectrum, parameters of digital signals, circuit theory vs. microwave techniques; Transmission lines – lumped element model, transmission line equations, wave propagation, lossless lines, input impedance, short and open circuited and λ/4 lines, power flow, transients, S-parameters; Electrodynamic fields – plane waves, propagation in dielectrics and conductors, shields, Lenz's law, Faraday's law, Maxwell's equations, transformers, storage fields vs. radiation fields, near and far fields, mechanisms of radiation; Static electric and magnetic fields – sources of fields, voltage, electrostatic induction, capacitance, electric and magnetic dipoles, permittivity, permeability, conductivity, magnetic materials, etc.; Non-ideal components – non-ideal resistor, inductor, capacitor, wires, high-frequency measurements; Electromagnetic compatibility – spectrum of digital signals, interference, PCB layout, PCB shielding, grounding methods, power supply decoupling, ground loops, differential and common mode radiation, cable shielding.

EMK 310 Microprocessors 310
Academic organisation: School of Engineering
Prerequisite: ERS 220 GS
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Hardware-based introduction to system designing microprocessors. General micro-processor architecture assembly language and limited C embedded code development, with specific focus on a RISC (Microchip PIC 18) and MIPS (Microchip PIC 32) type processor, memory interfacing and address decoding, microprocessor input/output and interfacing, general programming concepts, general microprocessor system design principles, current trends and new processors exposure to development boards and integrated development environments.

EMR 100 Measurement techniques and computer modelling 100
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 other per week
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 4
Module content:
This module is presented at the end of the first semester. It lasts for one week. During this time electrical, electronic and computer engineering students receive training in

instrumentation and measurement techniques in the department's electronics laboratories, as well as in the use of computer simulation programs (such as Matlab) in the computer laboratories.

EMS 310 Modulation systems 310
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELI 220
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Spectral analysis using the Fourier and Z-transforms. Transform identities. Convolution and correlation. Linear system theory. Analog and hybrid modulation systems: AM, PM, FM, PAM, PCM, Delta-modulation, PWM. Carrier synchronisation. Communication channels and transmission effects. Sampled systems. Source digitisation (D/A conversion), quantisation noise. Introduction to information theory and source coding. Formatting and line codes. Spectral characteristics of random data signals. Introduction to digital modulation. Binary modulation techniques: PSK, FSK and ASK. Symbol synchronisation. PLL theory. Matched filter concepts. Analysis of digital modulation systems in AWGN. Simulation and practical implementation of simple digital communication building blocks and subsystems. The focus will be on analog modulation techniques as applied to radio communication systems.

EMZ 310 Electromagnetism 310
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: WTW 256 and WTW 258
Contact time: 3 lpw 1 tpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction: Waves and phasors, spectrum, complex numbers; Transmission lines – Lumped element model, transmission line equations, wave propagation, lossless line, input impedance, short and open circuited, λ/4, etc.; power flow, Smith Chart, matching, transients; Vector Analysis – Basic laws, orthogonal coordinate systems, transformations, gradient, divergence, curl, Laplacian; Electrostatics – Maxwell's equations, charge and current, laws of Coulomb and Gauss, scalar potential, properties of materials, conductors, dielectrics, boundary conditions, capacitance, electrostatic potential; Magnetostatics – Force and torque, Biot-Savart law, parallel conductors, Maxwell magnetostatcs, vector magnetic potential, magnetic properties, boundary conditions, inductance, magnetic energy.

EMZ 320 Microwaves and antennas 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMZ 310
Contact time: 1 tpw 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Maxwell-Faraday, time var field, transformer, stc, displacement, boundary cond, continuity, retarded potentials; Plane Wave Propagation – Timeharmonic fields, plane wave lossless media, polarisation, lossy media, good conductor, power density; Wave reflection and Transmission – Normal incidence, snell, fiber optics, oblique incidence,

reflectio and transmission, Wave guides; Radiation and antennas – Short dipole, characteristics of ant's, halfwave dipole, long dipole, eff area, Friis, Apertures, Arrays, Scanning; Sat Comm Syst and Radar Syst-Sat Comm, links, antenna beams, radar sensors, doppler monopulse.

ENE 310 Analogue electronics 310
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211GS or EIR 221GS
Contact time: 1 ppw 3 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Amplifier concepts: gain, input impedance, output impedance, bandwidth. Feedback, stability in amplifiers. Power dissipation and power efficiency. Bipolar and FET amplifier design: bias and frequency response of small signal loaded single stage, multistage, differential stage, and feedback amplifiers. Amplifier figure of merit parameters, including total harmonic design. Large signal power amplifiers. Power devices. Heat sinks.

ENE 410 Advanced electronics 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ENE 310 GS
Contact time: 3 lpw 1 tpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Operational circuits: instrumentation amplifies, logarithmic amplifiers, multipliers, oscillators, filters, translinear circuits and voltage regulators. Communication electronics: wideband amplifiers, tuned RF amplifiers, AM and FM modulators and demodulators, phase-locked loops.

ENR 320 Energy 320
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 ppw 3 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module consists of four parts: Energy system basics, solar energy systems, energy system modelling and optimisation, and advanced applications of energy systems. The first part (energy system basics) will include basic power and energy calculation, electricity tariff, energy efficiency and the energy audit. The solar energy part focuses on solar water heating, PV application and concentrating solar power. The third part about energy system modelling and optimisation includes the general modelling processes and optimisation basics, linear programming, and Matlab applications in energy optimisation. The last part on advanced applications of energy systems will be dynamically updated to cater for the national needs and international trends in energy efficiency, and the topics to be covered can be energy management for any one or more of the commercial, industrial, residential or transport energy systems.

EPE 321 Software engineering 321
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: COS 212
Contact time: 3 lpw 1 tpw 1 ppw

Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Software engineering deals with the application of engineering principles to develop and maintain high-quality software that is reliable and that works efficiently. Software engineering includes defining software requirements and performing software design, software construction, software testing, and software maintenance tasks. The module exposes students to various methodologies in the different stages of the software life cycle, the problems of group work, and software configuration management with versioning systems such as CVS. The student is exposed to object modelling techniques and languages such as UML, as well as advanced debugging and testing techniques

EPR 400 Project 400
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: All prescribed 3rd year modules passed
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 64
Module content:
This module entails the individual completion of an engineering project from concept to delivery. The student must demonstrate independent mastery of an engineering project. The module focuses on the formulation of an engineering problem, the development of appropriate technical specifications, project planning and management, and then completion of a technical project of given nature, scope and complexity. The nature of projects is either mainly design (design, synthesis and testing) with a smaller component of investigation (experimental work and data analysis), or, alternatively, mainly investigation with a smaller component of design. As final step in the project, the student evaluates the final outcome of the design or investigation against the specifications and he/she also evaluates the impact of the project (social, legal, safety and environmental). Oral and written technical communication is evaluated as an important part of the module.

EPR 402 Project 402
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: All prescribed third year modules passed
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 64
Module content:
This module entails the individual completion of an engineering project from concept to delivery. The student must demonstrate independent mastery of an engineering project. The module focuses on the formulation of an engineering problem, the development of appropriate technical specifications, project planning and management, and then completion of a technical project of given nature, scope and complexity. The nature of projects is either mainly design (design, synthesis and testing) with a smaller component of investigation (experimental work and data analysis), or, alternatively, mainly investigation with a smaller component of design.
As final step in the project, the student evaluates the final outcome of the design or investigation against the specifications and he/she also evaluates the impact of the project (social, legal, safety and environmental). Oral and written technical communication is evaluated as an important part of the module.

EPW 200 Practical wiring 200
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 36 other per week
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 4
Module content:
This module is presented during one of the recess periods during the second year. The duration is one week. During this period the student will become acquainted with relevant regulations and legislation and basic aspects of wiring practice. For practical reasons this module may be presented during another time slot, such as the beginning of the third year.

EPY 423 Practical training and report 423
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Four weeks practice-orientated experience at any institution of the student's choice (preferably in electrical, electronic or computer engineering). The student must acquire experience in the working environment and more specifically work ethics, ecology, economy, punctuality, knowledge of human nature, etc. One week after the commencement of the second semester the student must submit a report on the aspects of his/her work experience as determined by the head of the department.

ERA 284 Computer architecture 284
Academic organisation: School of Engineering
Prerequisite: COS 130 or COS 131 or COS 132 GS
Contact time: 3 lpw 2 ppw 1 tpw 1 web-based period per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The aim of this module is to gain a deeper understanding of computers by studying their underlying components. The CPU is studied in great detail, covering design decisions such as CISC/RISC architectures, paging and pipelining. Cache, memory and bus architectures will also be scrutinised. IO architectures will be covered (i.e. polling vs. interrupt driven or DMA). Topics such as parallel processing (SIMD) are also touched. A brief review of number systems, combinatorial circuits, and sequential circuits (latches, counters, etc.). To illustrate many of the concepts in practice, the practicals will cover an assembly language. This will cover topics like interrupts, IO and video memory.

ERD 320 Computer engineering design 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMK 310 GS
Contact time: 1 tpw 2 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Design for manufacturing and maintainability, technical specifications and interface specifications, packaging technology, manufacturing processes, CAD-CAM principles, production facilities and techniques, industry standards, safety standards, environmental requirements, ergonomics and aesthetics, man/machine interfaces, material procure-

ment, complete design and construction of a system (including electromagnetic compatibility).

ERP 420 Specialisation 420
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Specific niche areas from computer engineering are addressed.

ERS 220 Digital systems 220
Academic organisation: School of Engineering
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to digital circuit design, digital representations of numbers, device electronics in digital circuits, representation and simplification of logic functions, components of combinational circuits, analysis and design of combinational circuits, components of sequential circuits, analysis and design of sequential circuits, programmable components for combinatorial and sequential logic.

ESC 320 Stochastic communications systems 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: WTW 258, WTW 256, WTW 238 and EMS 310
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Review of signal theory. Introduction to stochastic processes: stationarity and ergodicity. Noise models. Channel models and transmission effects. Comparison of analogue and digital modulation systems in noise. Signal space concepts and geometric representation of signals. Statistical communication theory: channel capacity theorem. Design and realisation of binary and multi-level digital modulation systems. Spectral efficiency. Optimal receiver design: matched filter (MF) and correlation-type receiver structures. Nyquist and partial-response (PR) systems. Digital transmission through bandlimited AWGN channels: inter-symbol-interference (ISI). Introduction to linear estimation: equaliser algorithms and design. Introduction to channel (error correction) coding: Symbol-by-symbol versus maximum likelihood sequence estimation (MLSE) techniques. Block and convolutional codes. The focus will be on applications in the cellular and mobile communication fields where stochastic processes such as noise and channel effects are of prime importance.

ESP 300 DSP programming 300
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EPW 200
Contact time: 36 other per week
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 4
Module content:
This module will deal only with the practical aspects of DSP applications: Universal

applications of DSP (Space, medical, commercial, telecommunications, military, industrial and scientific); ADC and DAC; Discrete Fourier-Transform (DFT); Fast Fourier-Transform (FFT); z-Transform; Correlation and Convolution; Digital filter design; FIR and IIR filters; Adaptive digital filters; Computer architecture for DSP; Analysis of finite wordlength effects; Data, audio and video processing and compression. Simulation (MATLAB) and real-time implementation of selected signal processing algorithms on DSP hardware. Programming and mapping of DSP algorithms onto DSP hardware.

ESP 411 DSP programming and application 411
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ESC 320 GS or EDC 310 GS
Contact time: 3 lpw 1 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Fourier-Transform: revise the Discrete Fourier-Transform (DFT); Fast Fourier-Transform (FFT). Digital filters; cyclic convolution; overlap-and-add as well as overlap-and-save methods; design of FIR- and IIR-filters (incorporating the effect of finite word lengths). Implementation: computer architecture and DSP processors; Mapping of DSP algorithms onto DSP hardware. Projects: simulation (in C) and real-time implementation of selected signal processing algorithms on DSP hardware.

GMI 210 Mineralogy 210
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Crystallography and internal order in minerals (space groups, unit cells, X-ray diffraction data). Bonding, mineral chemistry and solid solution (types of solid solution, calculation of mineral formulae and cation valency). Subsolidus reactions and defects in minerals (thermodynamic basis, defects, importance of subsolidus reactions). Classification and crystal structures of minerals. Mineralogical instrumentation and analysis. Major rock types and their classification. Mineralogical aspects of minerals processing.

IPI 410 Engineering professionalism 410
Academic organisation: Graduate School for Technology Management
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Requirements to maintain continued competence and to keep abreast of up-to date tools and techniques. ECSA code of conduct, Continuing Professional Development, ECSA outcomes, ECSA process and reasons for registration as CEng and PrEng. Displays understanding of the system of professional development. Accepts responsibility for own actions. Displays judgment in decision making during problem solving and design. Limits decision making to area of current competence. Reason about and make judgment on ethical aspects in case study context. Discerns boundaries of competence in problem solving and design. Case studies typical of engineering practice situations in which the graduate is likely to participate.

JCP 203 Community-based project 203
Academic organisation: Informatics
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
This module is integrated into all undergraduate academic programmes offered by the Faculty. Main objectives: execution of a community project aimed at achieving a beneficial impact on a section of society; awareness of personal, social and cultural values and an understanding of social issues; and development of life skills. Assessment: project proposal, written progress reports, peer assessment, assessment by community, presentation, report presented in the form of a blog.

JPO 110 Professional orientation 110
Academic organisation: EBIT Dean's Office
Prerequisite: Pass JPO 110. Conditional entry into JPO 120: JPO 110 mark between 45% and 49%.
Pass JPO 110 and JPO 120: Final combined mark for JPO 110 and JPO 120 at least 50%.
Contact time: 6 tpw 4 ppw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
A project-based approach is followed towards the development of skills needed for success in engineering. Skills include communication, information technology, technology, academic and life skills. The modules are presented in English.

JPO 111 ENGAGE Chemistry 1 111
Academic organisation: EBIT Dean's Office
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and chemical reasoning skills required by CHM 171/172.

JPO 112 ENGAGE Electricity and electronics 112
Academic organisation: EBIT Dean's Office
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by EBN 111/122.

JPO 113 ENGAGE Graphical communication 113
Academic organisation: School of Engineering
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, conceptual understanding, drawing skills and reasoning skills required by MGC 110.

JPO 114 ENGAGE Programming 1 114
Academic organisation: EBIT Dean's Office
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by COS 131.

JPO 115 ENGAGE Mathematical statistics 115
Academic organisation: School of Engineering
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, conceptual understanding, problem-solving skills and reasoning skills required by WST 111.

JPO 116 ENGAGE Mathematics 1 116
Academic organisation: EBIT Dean's Office
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and mathematical reasoning skills required by WTW 158.

JPO 120 Professional orientation 120
Academic organisation: EBIT Dean's Office
Prerequisite: Pass JPO 110. Conditional entry into JPO 120: JPO 110 mark between 45% and 49% .
Pass JPO 110 and JPO 120: Final combined mark for JPO 110 and JPO 120 at least 50%.
Contact time: 4 ppw 6 tpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
A project-based approach is followed towards the development of skills needed for success in engineering. Skills include communication, information technology, technology, academic and life skills.

JPO 121 ENGAGE Chemistry 2 121
Academic organisation: School of Engineering
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and chemical reasoning skills required by CHM 181.

JPO 122 ENGAGE Physics 122
Academic organisation: EBIT Dean's Office

Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and physical reasoning skills required by FSK 116/176.

JPO 123 ENGAGE Material science 123
Academic organisation: EBIT Dean's Office
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by NMC 113/123.

JPO 124 ENGAGE Programming 2 124
Academic organisation: School of Engineering
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by COS 110.

JPO 125 ENGAGE Mechanics 125
Academic organisation: EBIT Dean's Office
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by SWK 122.

JPO 126 ENGAGE Mathematics 2 126
Academic organisation: EBIT Dean's Office
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and mathematical reasoning skills required by WTW 161 and WTW 168.

JPO 127 ENGAGE Computers 127
Academic organisation: School of Engineering
Contact time: 3 tpw 1 lpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by ERA 284.

JPO 152 ENGAGE Physics 152
Academic organisation: School of Engineering
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by FSK116/176.

JPO 161 ENGAGE Chemistry 1 161
Academic organisation: School of Engineering
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by CHM 171/172.

MAN 420 Porous flow 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Flow through porous media is relevant to applications such as internal combustion engines, thermal insulation engineering, electronics cooling, filtration, water movement in geothermal reservoirs, heat pipes, underground spreading of chemical waste, nuclear waste repository, geothermal engineering, grain storage, enhanced recovery of petroleum reservoirs and biological science. Introduction to the physical models used in the study of fluid flow and heat transfer in porous materials. Understanding of the transport mechanisms.

MBB 410 Control systems 410
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MVR 320 GS
Contact time: 3 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to control systems. Modelling of dynamic systems. Transfer functions. Block diagrams and block diagram algebra. Linearisation of non-linear systems. Disturbance signals. Steady-state accuracy. Control systems characteristics. Analysis of control systems using Laplace transformations. Root loci. Bode diagrams. Design of compensators using bode diagram and root locus design techniques. Controls laboratory.

MEG 421 Mechatronics 421
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Sensors: limit switches, encoders, thermocouples, strain gauges, CCD cameras, various

sensors. Actuators: electric motors, pneumatic and hydraulic actuators, shape memory alloys. Signal conditioning: component interconnection, amplifiers, analogue filters, modulators and demodulators, analogue-digital conversion, sample-and-hold circuitry, multiplexers, software and hardware implementation of digital filters and Wheatstone bridge. Control: H-Bridge and PWM motor control, stepper motors, non-linear control of hydraulic and pneumatic actuators, PLCs, SCADA systems, industrial Fieldbus, micro-processor control.

MGC 110 Graphical communication 110
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 3 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Freehand sketching covering the following: perspective, isometric and orthographic drawings. Drawing conventions, graphical techniques and assembly drawings. Evaluation of drawings and error detection. True lengths of lines, projections and intersections. Practical applications of these techniques. Introduction to computer-aided drawings, including dimensioning, crosshatching and detailing. Introduction to basic manufacturing processes including primary (casting, forging and extrusion) and secondary (drilling, turning, milling, grinding, broaching and sawing) manufacturing procedures.

MHM 420 Heat and mass transfer 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Convection correlations; convection, evaporation and boiling; thermal radiation. Heat exchangers: types, regenerators and design. Mass transfer: Fick's Law, mass diffusion, mass convection, simultaneous heat and mass transfer, porous catalysts. High mass transfer rate theory. Mass exchangers.

MIA 320 Impact of engineering activity and group work 320
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Two exit learning outcomes (ELO) of ECSA are addressed and each must be passed in the same semester. ELO7: Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment. The history of engineering globally and in South Africa. Most important engineering projects globally and in South Africa. The impact of technology on society. Occupational and public health and safety. Occupational Health and Safety Act. Impacts on the physical environment. The personal, social, cultural values and requirements of those affected by engineering activity. The combination of social, workplace (industrial) and physical environmental factors are appropriate to the discipline of the qualification. ELO8: Demonstrate competence to work effectively on a small project as an individual, in teams and in multidisciplinary environments. Identifies and focuses on objectives. Works strategically. Executes tasks effectively. Delivers completed work on time. Effective team work: Makes individual contribution to team activity; performs critical functions; enhances work of fellow team

members; benefits from support of team members; communicates effectively with team members; delivers completed work on time. Multidisciplinary work by the following: Acquires a working knowledge of co-workers' discipline; uses a systems engineering approach; communicates across disciplinary boundaries. Report and presentation on team project. Tasks require co-operation across at least one disciplinary boundary. Students acquire a working knowledge of co-workers discipline. Students communicate between disciplinary boundaries.

MII 420 Maintenance engineering 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction: Definition and objectives, statistical concepts. Mathematics of failure: Reliability concepts, fitting distribution to failure data. Maintenance management: Investment decisions, maintenance profit impact. Maintenance structure: Preventive, time based, condition based, corrective, design out. Data analysis: Renewable, repairable systems, Laplace trend test, analysis methodology. Optimising maintenance strategies: Replacement/overhaul age, inspection frequencies, capital replacement, simulation. Reliability-Centred Maintenance (RCM). Maintenance systems: Components, structure, computer methods. Tribology: Friction laws, lubrication theory, contamination control. Maintenance Practice: Systems approach, management approach, modelling.

MJJ 210 Professional and technical communication 210
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

MKI 420 Nuclear engineering 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw 1 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Basic nuclear physics: definitions and concepts (nuclear reaction, binding energy, cross-sections, moderator, reflector, etc.). Basic reactor physics: diffusion equation and

boundary equations, group-diffusion methods, reactor kinetics. Reactor types: pressurised water reactors, boiling water reactors, gas-cooled reactors. Nuclear fuel cycle (including waste disposal). Reactor materials: fuels, moderators, coolants, reflectors, structures, systems or components. Reactor safety: biological effects of radiation, radiation shielding, principles of nuclear plant safety, also with reference to meteorology. Accidents.

MKM 320 Continuum mechanics 320
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (MSY 310), (MTV 310)
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to continuum mechanics. The continuum concept. Essential mathematical background. Einstein's summation convention. The stress tensor. Kinematics of deformation and the strain tensor. Lagrangian and Eulerian descriptions. Balance laws, field equations and constitutive equations. Application of continuum mechanics to linear elasticity and classical fluids. Hooke's law for isotropic media. Viscous flow and the Navier-Stokes equations.

MKM 410 Computational mechanics 410
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MKM 320 GS
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Review of continuum mechanics formulations. Discretisation of the problem domain. Grid types, structure and generation. Finite volume methods. Approximation of integrals. Discretisation of convective fluxes. Finite element methods. Galerkin method. Numerical integration. Time discretisation. Explicit and implicit methods. Solution of algebraic systems of equations. Finite element method in structural mechanics. Finite volume method for incompressible flows. Acceleration of computations.

MLV 420 Aeronautics 420
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MTV 310
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to aerodynamics and aeronautics. Fundamental physical quantities of flowing gas. Equations of state. Anatomy of an airplane. Atmospheriology. Basic aerodynamics. Elementary compressible flow. The Kutta-Joukowski Theorem. Introduction to viscous flow. Laminar and Turbulent Boundary Layers. Skin friction. Transition Flow Separation. Airfoil nomenclature. Lift, drag and moment coefficients. Pressure coefficients. Airfoil data. Wing properties. Circulation, downwash, and induced drag. Span efficiency. Stall. High-lift devices. Drag. Propeller theory. Elements of airplane and flight performance. Range, endurance and payload. Principles of static stability and control.

MOO 420 Optimum design 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to elements of computer-aided design. Formulation of the optimum design problem. Concepts used in optimum design. Linear and integer programming methods. Numerical methods used for unconstrained and constrained optimum design. Model reduction techniques. Application to interactive and practical design optimisation.

MOW 217 Manufacturing and design 217
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MGC 110 and SWK 122
Contact time: 3 lpw 4 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to design, economic implication, choice of materials, systems and safety factors, specifications, life cycle concepts. Friction, wear, thin film lubrication, plain bearings – theory and mounting, Rolling elements bearings, mounting of bearings, seals and applications. Surface finish, machining symbols, tolerances, limits and fits, Fastening methods. Shaft couplings, cam and crank shafts. Solid modelling. Introduction to strength of materials. Normal and shear stress. Shear force and bending moment diagrams. Transformation of stress/mohr circle. Hooke's law and Poisson's ratio. Failure theories, Torsion and bending of beams. Buckling.

MOW 227 Machine design 227
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 217
Contact time: 4 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Machine elements to be covered includes: Clutches and brakes, gear drives, chain drives, belt drives, governors, screw drives, flywheels, Hooke joints, mechanisms. The theory of machines as well as design aspects will be covered. The design of castings. The following strength of material aspects to be covered in the module: Stress concentrations. Static calculation of shafts. Fatigue. Bolted connections, Weld design.

MOW 312 Machine design 312
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 227
Contact time: 3 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
The following sections of the Occupational Health and Safety Act and codes will be covered: Pressure vessels, design of ropes and lifting systems. The design of gears and gear systems, springs and cams. The strength calculations including contact stresses as well general design will be covered. Tribology including lubrication and hydrodynamic bearings Ergonomics, Costing of design and related projects including testing as part of the design process. Welding processes.

MOW 323 Machine design 323
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (MOW 312)
Contact time: 5 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Systems engineering applied within design like functional analysis, maintenance concept. Development of a small product. This part of the module is done in group context and the deliverable is a prototype of the product as well as a complete report. Steel structures, applications and codes also incorporating finite element analysis.

MOX 410 Design 410
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 312GS and MOW 323GS
Contact time: 8 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
A comprehensive design in order to cover all the design aspects of functionality, analysis, ability to integrate, manufacturability and maintainability. Cost and reliability are included as inclusive factors.

MPR 213 Programming and information technology 213
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 4 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
Advanced spreadsheet applications: Named ranges, linear algebra, solution of systems of equations, regression, interpolation, optimisation and table manipulation. Basic structured programming: Looping, branching, subroutines, iteration, reading and writing data files. Development, coding and debugging of simple programs in a high level programming language. Programming principles are illustrated via mathematical concepts such as limits, differentiation, integration and linear algebra. Structured programming by making use of functions and available toolboxes. Basic graphical output (plotting is also covered). Different information resources, searching and management of information. Use of databases. Development of webpages. Hardware interaction and control of equipment and systems.

MPY 315 Practical training 315
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Prescribed practical training in industry during or at end of second year. Aim is exposure to engineering equipment and processes, working environment of craftsmen and personnel relations. Duration at least six weeks. Perform case study on personnel management and submit together with a satisfactory report on the practical training, to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

MPY 415 Practical training 415
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
During or at the end of the third year of study, students in Mechanical Engineering undergo prescribed practical training in the industry. The purpose is the execution of small projects on engineering assistant level with exposure to the various relevant functions in the organisation. The duration is at least six weeks. A case study on occupational safety must be done in this period and submitted to the department together with a satisfactory report on the practical training within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

MSC 412 Project 412
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: Finalists only
Contact time: 8 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The module involves the execution of a project that produces knowledge and understanding of a phenomenon and a recommended course of action. The project is undertaken under the supervision of a staff member with the student taking responsibility for the project. The student should be able to demonstrate competence in designing and conducting investigations and experiments. An acceptable process consists of but is not restricted to: (a) planning and conducting of investigations and experiments; (b) conducting of a literature search and critically evaluating material. The student should be able to demonstrate competence in engaging in independent learning through well-developed skills by: (a) reflecting on own learning and determining learning requirements and strategies; (b) sourcing and evaluating information; (c) determining learning requirements and strategies; (d) accessing, comprehending and applying knowledge acquired outside formal instruction; (e) critically challenging assumptions and embracing new thinking.

MSC 422 Project 422
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: Finalists only, MSC 412
Contact time: 8 other per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The module involves the execution of a project that produces knowledge and understanding of a phenomenon and a recommended course of action. The project is undertaken under the supervision of a staff member with the student taking responsibility for the project. This module follows onto MSC 412 and deals with the same topic in the same year. The student should be able to demonstrate competence in designing and conducting investigations and experiments. An acceptable process consists of but is not restricted to: (a) performing the necessary analyses; (b) selecting and using appropriate equipment or software; (c) construction and instrumentation of an experimental set-up; (d) taking measurements; (e) analysing, interpreting and deriving information from data; (f)

drawing conclusions based on evidence; (g) communicating the purpose, process and outcomes in a technical report, presentation and poster.

MSD 210 Dynamics 210
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: FSK 116 or FSK 176 and SWK 122 and WTW 256 #
Contact time: 3 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Kinetics of systems of particles, Newton's 2nd law generalised for a system of particles, rate of change of momentum and angular momentum relations, work-energy relations, conservation laws, steady mass flow. Plane kinematics of rigid bodies, rotation, translation, general 2D motion, relative motion analysis. Moments and products of inertia. Plane kinetics of rigid bodies, equations of motion, rotation, translation, general 2D motion, work-energy relations. Vibration and time response.

MST 313 Material studies 313
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: TKS 212 and TKS 222
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Unconventional construction materials: properties, applications.

MSY 310 Structural mechanics 310
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 217, WTW 256
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Asymmetrical bending. Energy methods: elastic strain energy, virtual work, bending deflection of beams. Buckling: characteristics for real struts, eccentric loading, initial curvature, combined loading. Experimental strain measurement: rosette strain, types of strain guages and application. Yield criteria for ductile and brittle materials; stress concentration. Application of equilibrium and strain-displacement relationships: beams and thick-walled cylinder. Linear elastic fracture mechanics, stress intensity factor and modes of crack tip deformation. Fatigue: stress cycles, Paris equation, damage, "rainflow" counting and weld fatigue.

MTV 310 Thermoflow 310
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction: Liquids and gases, pressure, viscosity, temperature, heat. Introduction to Navier-Stokes and continuity equations. Definitions and properties of fluids, fluid statics, fluid dynamics, Bernoulli equations. Flow measurements. Dimensional analysis: force, drag, Reynolds number, force coefficient, power. Flow in pipes and channels: friction

coefficients and Reynolds number, pressure drop; laminar, turbulent and transitional flow. Flow over bodies: drag and lift. Experimental techniques in fluid mechanics. Introduction to basic thermodynamic heat transfer concepts: conduction (steady state and transient heat conduction), extended surfaces, applications.

MTV 410 Thermoflow 410
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MTV 310
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Navier-Stokes and continuity equations. Euler equations, momentum equations. Conduction in two dimensions. Similarity and dimensional analysis. Convective heat transfer: forced convection (external and internal), natural convection. Boiling and condensation. Thermal radiation. Heat exchangers: classification, Parallel flow and counterflow heat exchangers; double-pass, multi-pass and cross-flow heat exchangers; LMTD method, Effectiveness-NTU method, selection of heat exchangers. Experimental techniques in heat transfer.

MTV 420 Thermal and fluid machines 420
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MTV 310, (MTX 311)
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
(i) Thermodynamics: Introductory thermodynamics with reference to power cycles. Energy systems and views, transformation of energy. Nuclear power.
(ii) Steam generators: Work fluids, fire-tube boilers, water-pipe boilers, heat exchange boilers, power nuclear reactors. Feedwater. Industrial uses of steam.
(iii) Combustion technique: Types of fuels – oil, coal, gas; their combustion methods. Ash and its properties. Air pollution.
(iv) Steam engines: Turbo machine theory; types of turbines – properties and uses. Blades, rotors, sealing, balancing. Parallel operation of turbo generators in a power network.
(v) Internal combustion engines: Spark ignition and compression ignition. Applications.
(vi) Classification: kinetic and positive displacement pumps and compressors. Incompressible and compressible flow. Pump, compressor and fan theory.
(vii) Equipment: functioning, properties, characteristics and use of well-known pumps and compressors.
(viii) Applications: specific speed, cavitation, water hammer. Pump connections: pipe system connections. Pumping of solids. Air-pressure systems.
(ix) Turbo machines: turbo machine theory. Impulse and reaction turbines. Analytical analysis. Characteristics: applications; integration of hydroturbines with power systems.

MTX 221 Thermodynamics 221
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: FSK 116 or FSK 176
Contact time: 1 tpw 3 lpw 1 ppw

Period of presentation: Semester 2
Language of tuition: Double medium **Credits:** 16
Module content:
Application overview. Concepts: system, control volume, property, state, process, cycles, mass, volume, density, pressure, pure substances, property tables, ideal gases. Work and heat. Internal energy, enthalpy, specific heat capacity. First Law of Thermodynamics for system and control volume. Conservation of mass. Processes: Adiabatic, isentropic, compressible and incompressible gases. Second Law of Thermodynamics for system and control volume. Entropy and enthalpy. Third Law of Thermodynamics. Introduction to vapour power, cooling and gas cycles. Experimental techniques in thermodynamics.

MTX 311 Thermodynamics 311
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MTX 221
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Third Law of Thermodynamics, availability and useful work. Ideal and real gases. Compressible flow: conservation laws, characteristics of compressible flow, normal shock waves, nozzles and diffusers. Power cycles: classification, internal combustion engine cycles (Otto and Diesel), vapour power cycles (Brayton, Rankine), refrigeration cycles (Reversed Carnot cycle, Reversed Brayton cycle, ammonia absorption cycle) and heat pump cycles. Mixtures of gases: perfect gas mixture, water/air mixtures and processes (psychrometry). Heating and cooling load calculations, basic refrigeration and air-conditioning systems. Combustion: fuels, air-fuel ratios, heat of formation, combustion in internal combustion engines.

MUU 420 Fossil fuel power stations 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module contains a comprehensive study of all mechanical systems and processes of a fossil fuel power station. Analysis of steam cycles, combined cycle power generation, fuels and combustion, the draught group, steam generators and turbines, condenser, feedwater and circulating water systems, coal and ash handling, compressor plant, water treatment, the importance of HVAC, control and instrumentation, control philosophies and environmental considerations.

MVE 420 Vehicle engineering 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Tyres: Construction, forces and moments, side force generation, rolling resistance, dynamic characteristics, tractive effort, slip, soft soil characteristics. Vehicle performance: equations of motion, supply and demand, forces acting on the vehicle, prediction of top speed, acceleration, braking, gradient ability and fuel consumption. Vehicle suspension systems: suspension concepts, kinematics, dynamic characteristics. Ride comfort:

springs, dampers, suspension models, human response to vibration. Handling: steering systems, low-speed handling, steady-state handling, dynamic handling, under/oversteer, handling tests.

MVR 320 Vibration and noise 320
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (MSD 210)
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to vibration: basic concepts, classification, modeling elements. Single degree of freedom systems: undamped and damped free vibration, undamped and damped harmonic motion, non-periodic excitation, numerical integration. Multidegree of freedom systems: discretisation, eigenproblem, co-ordinate coupling. Vibration control: balancing, isolation, absorbers. Vibration and sound measurement: signal analysis, modal testing, vibration monitoring. Continuum systems: string, bar, rod. Sound and noise: metrics, measurement, legislation.

MVS 311 Manufacturing systems 311
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Basic knowledge of conventional manufacturing processes like casting, forming, machining and joining. Modern manufacturing of plastic products, powder metallurgy, micro-electronic manufacturing and non-traditional machining. Quality control by work-holding devices, measurement, inspection and testing and determination of process capability. Manufacturing automation, rapid prototyping and free form fabrication. Manufacturing systems design concepts like Jobshop, Flowshop, Leanshop with linked cells, Projectshop and continuous processing.

MWN 420 Numerical methods 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Solution of systems of linear algebraic equations. Both iterative and direct methods are treated. Solutions are applied to both small and large scale systems. Solutions of systems of nonlinear equations. Eigenvalue problems. Numerical approximation strategies. Numerical integration and differentiation. Numerical solutions to initial-value problems for ordinary differential equations, boundary-value problems for ordinary differential equations and partial-differential equations.

NEC 310 Electrochemistry 310
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 3 lpw 3 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

Module content:
Kinetics and thermodynamics of electrochemical reactions of metallurgical importance. Use of equilibrium diagrams to identify possible reactions products. Use of polarisation diagrams to describe reaction kinetics. Application of these principles to metallurgical examples, including corrosion, leaching and electrometallurgy. Influence of substrate composition, electrolyte composition, impurities, reaction products and agitation on kinetics.

NEX 320 Excursions 320
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMP 310)
Contact time: 6 ppw 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Attendance of and participation in excursions to metallurgical operations, including a five-day excursion tour during the last full week of the mid-year recess, and six half-day visits during the semester. Assessment is based on written reports and oral presentations. The plant visits include hydrometallurgical, pyrometallurgical, minerals processing and materials processing plants.

NHM 322 Hydrometallurgy 322
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NPT 220) and (NEC 310)
Contact time: 3 lpw 3 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Merits of hydrometallurgy relative to other extraction methods. Unit processes in hydrometallurgy. Chemical principles of hydrometallurgy. Chemistry of important metals and lixiviants. Application of chemical principles to: leaching; purification and upgrading of leach solutions (precipitation, solvent extraction, ion exchange, activated carbon); product recovery from solution (precipitation, reduction). Relevant analytical methods.

NHM 412 Hydrometallurgy 412
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NHM 322)
Contact time: 2 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Extraction routes and the extractive metallurgy of metals such as gold, copper, zinc, manganese, nickel, cobalt, uranium and the platinum group elements, from ores and secondary sources. Application of thermodynamics and reaction kinetics (including laboratory kinetic data) in understanding and optimisation of extraction routes, and sizing of reactors. Environmental impact of processing routes.

NJJ 210 Professional and technical communication 210
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8

Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

NMC 113 Materials science 113
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 4 lpw 1 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to materials: the family of materials, atomic structure and types of bonding, crystal types and space arrangement of atoms, directions and planes in crystals, defects in crystals, diffusion in solids. Mechanical properties of materials: stress and strain, mechanical testing (strength, ductility, hardness, toughness, fatigue, creep), plastic deformation, solid-solution hardening, recrystallisation.
Polymeric materials: polymerisation and industrial methods, types of polymeric materials and their properties. Corrosion of metals: mechanisms and types of corrosion, corrosion rates, corrosion control. The heat treatment of steel: Fe-C phase diagram, equilibrium cooling, hardening and tempering of steel, stainless steel. Composite materials: Introduction, fibre reinforced polymeric composites, concrete, asphalt, wood.

NMC 123 Materials science 123
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 4 lpw 1 ppw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to materials: the family of materials, atomic structure and types of bonding, crystal types and space arrangement of atoms, directions and planes in crystals, defects in crystals, diffusion in solids. Mechanical properties of materials: stress and strain, mechanical testing (strength, ductility, hardness, toughness, fatigue, creep), plastic deformation, solid-solution hardening, recrystallisation.
Polymeric materials: polymerisation and industrial methods, types of polymeric materials and their properties. Corrosion of metals: mechanisms and types of corrosion, corrosion rates, corrosion control. The heat treatment of steel: Fe-C phase diagram, equilibrium cooling, hardening and tempering of steel, stainless steel. Composite materials: Introduction, fibre reinforced polymeric composites, concrete, asphalt, wood.

NMC 223 Materials science 223
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: NMC 113 or NMC 123

Contact time: 4 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Phase diagrams, phases and solid solutions. The heat treatment of steel (phase equilibria, the diffusion-controlled and martensitic transformations of austenite, hardening and tempering, hardenability, the application of IT and CCT diagrams, heat treatments). Steel types and classification. Cast irons (white, grey, malleable and spherical graphite irons). Stainless steels (ferritic, martensitic, austenitic and duplex types).

NMC 313 Material science 313
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMC 223)
Contact time: 3 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Binary and ternary phase diagrams. Diffusion in alloys (steady-state and nonsteady-state, solid solutions, grain boundaries, homogenisation). Solidification (pure metals and alloys; ingots, castings and welds; segregation, porosity and eutectic solidification). Metallographic and analytical techniques (diffraction, electron micro-scopy). Precipitation and solid-solution strengthening (principles, and applications to aluminium, magnesium, copper and nickel-base alloys).

NMM 320 Mechanical metallurgy 320
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMC 223)
Contact time: 4 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Dislocations and deformation (defects in crystalline materials, movement and elastic energy of dislocations, different crystal lattices, origin of and strengthening by dislocations). Strength of engineering materials (tensile testing, plastic deformation of single crystals and polycrystalline materials, hardness, residual stress). Creep deformation (primary and secondary creep, stress and temperature dependence, creep rupture). Introduction to fracture mechanics (Griffith criterion, stress intensity, fracture toughness, fatigue). Failure analysis. Hot and cold rolling of metals.

NMP 310 Minerals processing 310
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 4 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Minerals processing in perspective (economic importance, economic nature of mineral deposits, mineral properties and analysis, mineral processing functions). Liberation analysis (importance and measurement of liberation; particle size analysis). Comminution (theories and principles, crushers, grinding mills). Screening and classification (industrial screening, cyclones). Concentration processes (gravity concentration, dense medium concentration). Froth flotation.

NMP 411 Minerals processing 411
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMP 310)
Contact time: 1 tpw 3 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
The sizing, application and efficiency determination of the most commonly used unit operations covering crushing, screening, classification, milling, gravity concentration, dense medium separation, magnetic separation and thickening.

NOP 421 Process design 421
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMP 411)
Contact time: 1 tpw 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Philosophy of design and the design process; phases of plant design and their interrelationships. Principles of project planning and management. Unit and process design, simulation, economic evaluation and optimising as applicable to the metallurgical industry. Execution of a process design project, submission of a report, oral presentations and construction of a scale model.

NPB 412 Process metallurgy and control 412
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NPM 321)
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Elements of metallurgical process control (principles, selection of proportional-integral controller, identification of controlled and manipulated variables and disturbances). Transient and steady-state heat transfer in metallurgy (formation of freeze layers, heating and cooling of components). Principles of reaction kinetics in pyrometallurgy (types and identification of rate-determining steps, quantification of overall reaction rate).

NPM 321 Pyrometallurgy 321
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NPT 220)
Contact time: 3 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Overview of pyrometallurgical process routes, types of reactions, and reactor designs. Review of relevant thermodynamic principles (equilibrium constants, Henrian and Raoultian activities and activity coefficients). Slag basicity and viscosity. Energy and reductants. Overview of pyrometallurgical separation principles (vapour-phase, solid-state and liquid-liquid routes). Examples of pyrometallurgical separation processes (ironmaking and steelmaking, sulphide smelting and converting, ferroalloys).

NPT 220 Process thermodynamics 220
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (CHM 171) or (CHM 172)
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
The first, second and third laws of thermodynamics, enthalpy and heat capacity. The criteria for equilibrium, Gibbs free energy, chemical potential, partial molar Gibbs free energy, activity, activity coefficient and the equilibrium constant. Solution thermodynamics of ideal and non-ideal solutions, as well as solution models. Ellingham, Kellogg and Pourbaix diagrams. The thermodynamic principles are applied to metallurgical processes. Applications also include stoichiometry and mass balance problems, as well as the calculation of energy balances.

NPW 411 Metals processing 411
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMC 313), (NMM 320)
Contact time: 3 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to welding and joining processes. Welding of carbon steels, stainless steels, aluminium and aluminium alloys. Development and qualification of welding procedure specifications. Liquid metal processing (casting processes, solidification of castings and mould design). Deformation processing (forging, extrusion and rolling), sheet metal processing and surface processing. The identification and prevention of defects.

NPY 316 Industrial training 316
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
During or at the end of the second year of study, students in Metallurgical Engineering undergo at least six weeks of prescribed training in industry. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Dean.

NPY 416 Industrial training 416
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
During or at the end of the third year of study, students in Metallurgical Engineering undergo at least six weeks of prescribed training in the industry. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

NSC 412 Literature survey 412
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: NEX 320
Contact time: 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Literature search (using electronic databases of publications, formulating search strategies). Hypothesis formulation and preliminary experimental planning (identifying research question and stating hypothesis, proposing critical experiments, evaluating feasibility of possible experimental approaches). Literature survey (critical evaluation of published information, synthesising available information into a coherent argument, written and oral reporting). Final experimental planning (formulation of experiments with attention to calibration, uncertainty, reliability and safety).

NSC 422 Project 422
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: NSC 411 or NSC 412
Contact time: 1 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Execution of a research project: experimentation (with attention to safety, reliability, calibration and reproducibility); analysis of results to yield data (with statistical analysis of uncertainty); interpretation of data (to test the stated hypothesis); written reporting of results (with updated literature survey, description of experimental approach, data obtained, conclusions, and scientific and industrial implications); oral and poster presentations.

NVM 321 Refractory materials 321
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NPT 220) and NPM 321 #
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Classification, requirements and properties of refractory materials. Manufacturing principles. Specification and testing of refractory materials. The main refractory systems, i.e silica, aluminosilicates, alumina, magnesia, magnesia-chrome, magnesia-carbon, doloma, zircon, zirconia, silicon carbide and graphite, and their applications. Principles of ternary phase diagrams and their application in refractory systems, and interactions between slag, metal and refractory materials.

PEE 410 Mine environmental control engineering 410
Academic organisation: Mining Engineering
Prerequisite: MTV 310
Contact time: 3 lpw 1 tpw 2 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Mine ventilation methods; primary and secondary ventilation methods, ventilation strategies for coal and hard rock mining environments including base metal mines. Mine

development ventilation methods, mine air control, different types of fans including fan performances and air dilution calculations. Refrigeration: Elementary refrigeration principles, including concepts and methods, chilled water systems, including cooling distribution methods. Elementary mine ventilation planning, basic planning parameters and elementary mine ventilation economics and the impact of incorrect design and applications on safety and health. Mine gases, their origin and gas/coal dust explosions. Aspects of the Mine Health and Safety act are also dealt with.

PJJ 210 Professional and technical communication 210
Academic organisation: Mining Engineering
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

PME 320 Mineral economics 320
Academic organisation: Mining Engineering
Contact time: 4 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
The objective is for the student to understand fundamental economic theory pertaining to the mineral and mining industry and its overall effects on the broader South African economy. The student will be able to interpret and understand company annual results. The student should be able to understand and apply the SAMREC/SAMVAL code during the evaluation and classification of resources and reserves. The student should understand the effect of supply and demand pertaining to the mineral and mining industry (micro and macro economic factors). To understand the unique aspects related to marketing of minerals with reference to the cyclic nature of the industry. Apply economic and engineering reasoning to specific problems in the minerals and mining industry so as to analyse and interpret the opportunities and threats facing this industry. To understand and apply the fundamentals of technical mine valuation, including mineral rights, prospecting methods, sampling, mass and mineral content of ore as well as management and control factors. The latter include controlling and managing of widths, stoping width versus tramming and milling width, ore dilution, mine call factor and cut-off grade.

PMY 311 Surface mining and geotechnics 311
Academic organisation: Mining Engineering
Contact time: 3 lpw 2 tpw

Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Surface mining methods: Introduction, classification of ore reserves and terminology. Earth moving: Loading shovels and methods, haulage trucks, productivity and tires, introduction to bucket wheel excavators, conveyor systems and in-pit crushers, in-pit crushing-conveying system, application of draglines and terminology. Introduction to mine planning, mine development phases, block modelling, methods of sequencing, stripping ratios and breakeven ratios. Introduction to mining environment, rehabilitation and closure, integrated environmental management, environmental impact studies, water management and rehabilitation planning and costing. Geotechnics include understanding discontinuities in rock mass, stereo nets, cohesion and friction. Rock behaviour pertaining to excavations, understanding plane, circular and wedge failures, Rock slope safety factors. Slope stabilisation, neutral line theory, effects of water in a slope, monitoring of slopes and instruments available for slope stability monitoring, Risk concepts pertaining to slopes and a case study is discussed. Aspects of the Mine Health and Safety Act are also dealt with.

PMY 320 Mining 320
Academic organisation: Mining Engineering
Prerequisite: PMY 311
Contact time: 3 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Mining 320 provides an overview of mining by covering the following subject-matter: history of mining in South Africa, underground mining systems, and a brief overview of mine environmental control and mine strata control. Then the module covers general mine layouts, mine plan reading, mine surveying, electricity supply, transport systems, water management systems, and mine fires. This feat is achieved through the study of various mining methods and case studies.

PMY 410 Mining 410
Academic organisation: Mining Engineering
Prerequisite: PMY 311, PMY 320
Contact time: 2 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Specific mining techniques. Shafts: Types, methods and equipment for sinking; economic considerations. Tunneling: Design, development techniques and equipment. Design and construction of large excavation. Design, construction, reinforcing and repair of ore passes. Fires in gold and coal mines: Causes, prevention, detection, combating and insurance. Flooding: Water sources, results, dangers, sealing and control.

PMY 423 Mine risk management – health and safety 423
Academic organisation: Mining Engineering
Prerequisite: PSX 310, PSZ 410
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8

Module content:
Selected topics in risk and safety management: Methodology and techniques of risk identification, risk assessment, and mitigation principles. Competence based safety: Human error model, risk perception, risk competency. Safety leadership: Transactional leadership and transformational leadership. Safety and mineral statistical structures and codes: SAMREC, SAMRASS, SIMRAC codes, functions and duties.

PMZ 422 Mine design 422
Academic organisation: Mining Engineering
Prerequisite: PMY 410, PMY 320, PSZ 410, PEE 410
Contact time: 4 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 42
Module content:
Students are required to design a mine at the conceptual business case level. Students are given a surface plan and borehole data from which they have to design a mine in teams of 3 to 5 students. They have access to a mining engineer in industry to assist with advice. The design has to incorporate a market analysis, layout design, working method, surface layout, environmental impacts and financial analysis. The design is submitted in book form and each team member has to do a presentation of the design.

PNB 300 Industrial excursions 300
Academic organisation: Mining Engineering
Contact time: 3 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 8
Module content:
The mining industry requires that students are exposed to the mining industry by visiting a collection of mines with the purpose of familiarising them with current trends in mining practice and mining methods. This module hopes to provide a “snapshot” of the mining industry as it is at the time of the tour. This tour requires attendance and participation in five one-day visits to mines. The excursions are organised during the first semester of the third year, and take place during the July recess at the end of the semester. Students are expected to submit a group report on the visits during the second semester.

PNB 400 Industrial excursions 400
Academic organisation: Mining Engineering
Prerequisite: PNB 300
Contact time: 3 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 8
Module content:
Attendance of and participation in industrial excursions organised during the year, including a ten-day excursion tour at the end of the first semester. Submission of reports and assignments as required.

PPY 220 Experiential training 220
Academic organisation: Mining Engineering
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
The student needs to undergo practical mine training for a period of at least 6 weeks to

be exposed to the mining environment, a report on this vacation work will be expected as per department guideline.

PPY 320 Experiential training 320
Academic organisation: Mining Engineering
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
The mining industry requires students to become exposed to mining by working on mines during the December recess period at the end of the second academic year. The student is required to work for a minimum period of six weeks on a mine, and then compile a report on the work completed for submission at a prescribed date in the first semester of the third academic year.

PPY 418 Practical training 418
Academic organisation: Mining Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Mining students must undergo at least six weeks prescribed practical training at a mine at the end of the third year of study. A satisfactory report on such work must be submitted to the department within one week after registration.

PRX 321 Explosives engineering 321
Academic organisation: Mining Engineering
Prerequisite: MTX 221
Contact time: 2 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
The importance of improved safety standards, cost-effectiveness and productivity has driven technical mining personnel to examine all facets of their operations. Increasingly, it has been realised that an efficient drilling and blasting program will impact positively throughout the mining operation, from loading to maintenance, hauling to crushing, ground support to scaling and grade control to recover with an invariable increase in the overall profitability through technical advanced projects. Through the safe, efficient and innovative use of explosives for rock breaking the mining engineer will make a positive contribution to the overall mining operation. Due to the nature of the topics discussed in this module, a number of case studies are used to emphasise the safe handling, application and destruction of explosives. The Mine Health and Safety Act is dealt with and the Explosives Act receives specific attention.

PSC 321 Introduction to project 321
Academic organisation: Mining Engineering
Contact time: 1 tpw 2lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Reporting technical information: typical report structure, literature survey, data presentation (tables, graphs, diagrams), referencing, presenting results, conclusions, and recommendations. Identification of a suitable subject for the final-year project. Planning of project execution.

PSC 411 Project 411
Academic organisation: Mining Engineering
Prerequisite: PSC 321
Contact time: 1 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
The project involves the execution of an analytical and/or experimental research project under guidance of a lecturer. During the second semester of the third year of study students must select a suitable research topic, to be approved by the head of department. Data for the approved project will be collected during the practical training period during the summer recess at the end of the third year of study. A comprehensive and detailed project report must be compiled and submitted for evaluation at a prescribed date in the first semester of the fourth year. The student must also prepare a presentation of the project for an oral examination at the end of the semester.

SBM 321 Civil building materials 321
Academic organisation: Civil Engineering
Contact time: 1 ppw 3 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The behaviour, properties and application of cement and concrete products, structural steel, structural timber, fibre reinforcing, polymers, masonry work, epoxies and bituminuous materials.

SBZ 221 Civil engineering measurement techniques 221
Academic organisation: Civil Engineering
Contact time: 1 ppw 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Measurement instruments and measurement techniques used in engineering applications. Theory of the Wheatstone bridge and the application of strain gauges to measurement instruments. Accuracy, precision, resolution, hysteresis and linearity. Load cells, pressure transducers, displacement transducers, stress cells and inclinometers.

SBZ 420 Civil construction management 420
Academic organisation: Civil Engineering
Prerequisite: (SVC 412)
Contact time: 1 ppw 4 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Planning, needs assessment and performance indicators for contracts. Civil Engineering Project: Client, consultant and contractors expectations and responsibilities. Tender process, construction process, Application of OHS Act and Mine, Health and Safety Act, Conditions of Contract and Claims, Insurances, Engineering Economics, Programming, Costing, 1509001: Quality Management Systems, Life cycle concepts, Maintenance cycle, Maintenance Management.

SDC 420 Design concepts 420
Academic organisation: Civil Engineering
Prerequisite: (SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
Contact time: 1 ppw 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Design integration is achieved within civil as well as functional shells. Fundamental understanding of both the functional, as well as the technical aspects, particular to the planning and design of multidisciplinary engineering projects is developed. Typical building projects, office complexes, retail and residential developments are used as examples. This module will address an understanding of the development of the footprints and building envelope. Concept designs obtained from the department of Architecture are used to introduce the student to design integration. The student functions within a team allowing an exchange of ideas. The development of conceptual design skills is achieved by focusing on the particular stages in the design process.

SDO 420 Detailed design 420
Academic organisation: Civil Engineering
Prerequisite: (SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
Contact time: 1 ppw 5 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 24
Module content:
The module focuses on design applications. The student is exposed to the application of the classic disciplines of structures, geotechnical, hydraulics and transportation in detail design. Supervisors select the most valuable application in each discipline. Typical examples include the following:
• Structures: Multi-storey buildings with reinforced concrete frames and slabs
• Hydraulics: Pump lines and stations
• Geotechnical: Slimes dams
• Transportation: Traffic impact studies, pavement design and analysis
The applications selected for each discipline may vary from year to year.

SEV 421 Environmental geotechnology 421
Academic organisation: Civil Engineering
Contact time: 1 ppw 4 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Regulatory framework, site investigation, site restoration, and waste disposal. Site characterisation methods. Waste types and properties. Subsurface contaminant transport. Multiphase fluid flow. Design of waste containment and waste disposal systems. Review of remedial alternatives with emphasis on in situ technologies. Case histories. Integrated environmental management processes. Environmental legislation in South Africa. Environmental impact, environmental auditing and risk analysis. ISO 140000: what it entails and how it is applied. Community participation.

SGM 210 Geomaterials and processes 210
Academic organisation: Civil Engineering
Contact time: 4 lpw 3 ppw
Period of presentation: Semester 1

Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Solar system; Earth structure and systems; plate tectonics; classification and contextual setting of rocks and minerals; rock cycle. Internal and external geological processes; landscape formation; influences of geological environment on mankind. Geological time and the Earth's history through time. Practicals involving identification and description of crystals, minerals and rocks.

SGM 221 Pavement materials and design 221
Academic organisation: Civil Engineering
Prerequisite: SGM 210 GS
Contact time: 1 tpw 2 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Geological origin. Soil tests and classification systems. Compaction, stabilisation. Bitumen and tar. Introduction to pavements. Overview of road building materials. Pavement design principles and methods.

SGM 311 Soil mechanics 311
Academic organisation: Civil Engineering
Prerequisite: (SWK 210)
Contact time: 3 lpw 2 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to soil mechanics. Introduction to clay mineralogy. Mass, volume relationships and phases of soil. Groundwater flow and permeability. Effective stress principles. Suction pressures in saturated as well as partially saturated soil. The Mohr circle and stresses at a point. The Mohr-Coulomb strength theory and the stress-strain properties of soil. The Boussinesq theory. Consolidation theory and soil settlement.

SGM 323 Geotechnical engineering 323
Academic organisation: Civil Engineering
Prerequisite: (SGM 311)
Contact time: 1 ppw 3 lpw 2 dpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Application of consolidation theory. Bearing capacity of soil and foundation design, Terzaghi and general methods. Horizontal stresses in soil and design of retaining structures, Rankine and Couloumb's methods. Slope stability including Bishop's method of slices. Introduction to site investigation.

SHC 310 Hydraulics 310
Academic organisation: Civil Engineering
Prerequisite: (SWK 210)
Contact time: 4 lpw 1 ppw 1dpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Fluid properties and fundamental principles of applied hydrostatic, hydrostatic forces on

bodies, buoyancy and stability of bodies. Kinematics, flow rate measurement and velocity determination. Pipe flow and real fluids. Basic principles of water purification and water treatment.

SHC 321 Hydraulics 321
Academic organisation: Civil Engineering
Prerequisite: (SHC 310)
Contact time: 1 tpw 1 ppw 4 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 16
Module content:
Pipe network analyses and municipal services. Components of water distribution networks. Pump selection and water hammer analyses. Free surface flows and model analyses.

SHC 410 Hydraulics 410
Academic organisation: Civil Engineering
Prerequisite: (SHC 310) and SHC 321 GS
Contact time: 1 tpw 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Sediment transportation, hydraulic structures, bridges and culvert hydraulics, stormwater handling. Hydrology, flood hydrology, creation of runoff records and the simulation of surface water resources, creation of stochastic sequences and the reliability analysis of surface water resources.

SIB 310 Timber design 310
Academic organisation: Civil Engineering
Prerequisite: SIN 223 GS
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Self-weight, imposed and wind loads. Principles of limit-states design. Timber as a structural material, design of tension, compression and bending members (laterally braced and unbraced), beam columns, trusses and bracing.

SIE 310 Civil engineering economics 310
Academic organisation: Civil Engineering
Contact time: 2 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Introduction to engineering economics: Basic guidelines, assessment of alternative investment possibilities. Equal annual cash flow, current value, internal rate of return, cost benefit relationship.
Economic evaluation of projects: Influence of depreciation on the economics of projects, determination of income tax implications of decisions, economic analysis of multiple alternatives, the influence of inflation on the economics of projects, application of the theory of probability for economics studies, economic studies on the replacement of equipment.

SIN 223 Structural analysis 223
Academic organisation: Civil Engineering
Prerequisite: WTW 161, WTW 168 and SWK 210
Contact time: 2 ppw 1 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Statically indeterminate beams. Euler buckling of columns with different boundary conditions. Virtual work. Analysis of statically indeterminate structures using the methods of super-position, slope-deflection and moment distribution (with sway and support displacement).

SIN 311 Structural analysis 311
Academic organisation: Civil Engineering
Prerequisite: SIN 223
Contact time: 1 ppw 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Analysis of symmetrical structures using slope-deflection equations or moment-distribution; three dimensional structures and grillages; plastic analysis of frames; matrix methods; influence lines.

SIN 323 Steel design 323
Academic organisation: Civil Engineering
Prerequisite: SIN 311 GS
Contact time: 2 lpw 1 tpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Stability of beams. Material properties. Analysis and limit states design of tension, compression and flexural members, and beam-columns. Design of trusses, simple framed structures and connections.

SIN 324 Reinforced concrete design 324
Academic organisation: Civil Engineering
Prerequisite: SIN 311 GS
Contact time: 2 lpw 1 tpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Properties of reinforced concrete. Principles of limit states design. Analysis and design of sections in flexure and in compression combined with flexure. Design for shear and torsion. Bond and anchorage. Serviceability requirements: Detailing and span-effective depth ratios. Design of footings and short columns.

SIN 411 Steel design 411
Academic organisation: Civil Engineering
Prerequisite: (SIN 323)
Contact time: 2 lpw 1 ppw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8

Module content:
Analyse and design composite steel beam and concrete slab construction, Moment connections, Elastic and plastic design of portal, industrial and building structures.

SIN 413 Reinforced concrete design 413
Academic organisation: Civil Engineering
Prerequisite: (SIN 324)
Contact time: 1 tpw 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Behaviour and design of beams, slabs (solid, ribbed and waffle slabs, flat plates and flat slabs), columns (slender columns and biaxial bending), footings (simple and combined footings) and stairs. Introduction to the design of prestressed concrete flexural members.

SJJ 210 Professional and technical communication 210
Academic organisation: Civil Engineering
Contact time: 2 lpw 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Communicate effectively, both orally and in writing, with engineering audiences and the community at large. Written communication as evidenced by: using appropriate structure, using of modern or electronic communication methods; style and language for purpose and audience; using effective graphical support; applying methods of providing information for use by others involved in engineering activity; meeting the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; fluent delivery, and meeting the requirements of the intended audience. Using appropriate academic or professional discourse for audiences ranging from engineering peers and management to lay persons. Typed reports range from short (300 - 1 000 words plus tables and diagrams) to long (10 000 - 15 000 words plus tables, diagrams, references and appendices), covering material at exit level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

SPV 420 Public presentation 420
Academic organisation: Civil Engineering
Prerequisite: (SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
Contact time: 1 tpw 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
The module focuses on three aspects of professional communication and presentation: a poster, a report and a spoken presentation. The student is expected to prepare examples of each. The work will be done in groups and individually. Issues of style, vocabulary, structure and graphical presentation of technical information will be considered.

SPY 410 Practical training 410
Academic organisation: Civil Engineering
Contact time: 1 other per week
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16

Module content:
During or at the end of the third year of study, students in civil engineering undergo at least 6 weeks of prescribed training in the industry. A satisfactory report on the practical training must be submitted to the Student Administration within one week of registration.

SSC 412 Research project 412
Academic organisation: Civil Engineering
Prerequisite: (SHC 321) (SIN 323) (SIN 324) (SGM 323) (SBM 321)
Contact time: 2 tpw 6 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 24
Module content:
In the first semester, two full days of the week must be used by final-year students for the execution of an analytical and/or experimental research project.

SVC 323 Transportation engineering 323
Academic organisation: Civil Engineering
Prerequisite: BES 220
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to transportation engineering; vehicle performance and motion; traffic analysis techniques; traffic data collection; capacity and level of service analysis; railway engineering; airport capacity; geometric road design; cross-section, horizontal and vertical alignment; urban streets; layout considerations and intersection design; traffic control; traffic safety.

SVC 412 Infrastructure planning 412
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (SVC 323), (BIE 310/SIE 310)
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to the basic concepts of urban and regional planning. The planning process, policy and institutional framework in which planning functions in SA. The interaction and co-operation of land and space, economy, politics and social aspects related to space in decision making. Interventions for sustainable development planning and design; definitions and rationale for land-use management and the strategic integrated development planning process. Infrastructure system evaluation, risk assessment, feasibility and decision analysis. Life cycle costing of infrastructure. Demand and supply analysis. Demand forecasting models.

SWK 122 Mechanics 122
Academic organisation: Civil Engineering
Prerequisite: WTW 158
Contact time: 4 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Equivalent force systems, resultants. Newton's laws, units. Forces acting on particles.

Rigid bodies: principle of transmissibility, resultant of parallel forces. Vector moments and scalar moments. Relationship between scalar- and vector moments. Couples. Equivalent force systems on rigid bodies. Resultants of forces on rigid bodies. Equilibrium in two and three dimensions. Hooke's law. Trusses and frameworks. Centroids and second moments of area. Beams: distributed forces, shear force, bending moment, method of sections, relationship between load, shear force and bending moment.

SWK 210 Strength of materials 210
Academic organisation: Civil Engineering
Prerequisite: SWK 122, WTW 168/WTW 128
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Stresses, strains and the mechanical properties of materials: Normal stress and shear stress, tension and compression, equilibrium in shear, factor of safety, design, shear strain, stress/strain diagram, Hooke's law, Poisson's Ratio and the shear stress/strain diagram. Axial loads: Elastic deformation, displacements, statically determinate and indeterminate structures and thermal effects. Torsion: Torsion of circular bars and power transmission bending of straight members and composite beams. Transverse shear: Shear in straight members and shear flow. Combined loads: Thin walled pressure vessels and stresses as a result of combined loads. Stress transformation: Plane stress transformation, principle stresses, maximum values and stress variation in prismatic beams. Strain transformation: Plane strain transformation, principle strains, maximum values, strain gauges and rosettes and the relationship between E, G and υ. Design of beams from section characteristics. Deflection of beams: The elastic curve, integration method, Macaulay's method and superposition.

SWP 121 Workshop practice 121
Academic organisation: Civil Engineering
Contact time: 1 other per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 6
Module content:
The module is offered at the end of the first year of study and lasts at least eight days during which the students receive training in the following workshops: formwork, scaffolding, masonry, welding and structural steel.

WWP 121 Workshop practice 121
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 other per week
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 6
Module content:
The module is offered at the end of the first year of study and lasts at least eight days, during which training is given in the following workshops: electronic projects, panel wiring, electrical motors and switch gear, general machines, welding, turning and sheet metal work. Each student's progress is assessed after each workshop.

POSTGRADUATE MODULES

NB Not all modules listed here are presented each year.
Please consult the departmental postgraduate brochure.

BAN 780 Industrial analysis 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BBA 780 Business architecture 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BDE 780 Design and analysis of experiments 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Principles of experimental design (Randomisation, Replication and Local Control) Completely Randomised Design (CRD), Randomised Block Design (RBD), Latin Square Design(LSD). Factorial Experiments (2n and 3n factorial experiments). Total and partial Confounding in Factorial designs. Balanced Incomplete Block Design (BIBD)

BEE 780 Ergonomics 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BGH 780 Quality management 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

BGW 780 Health and safety in the workplace 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BHM 780 Probability models 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BIS 780 Information systems 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BLK 780 Business logistics 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BMK 780 Megatronics 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

BOZ 780 Operations research 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

BPZ 781 Production management 781
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

BSI 780 Business engineering 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BTH 780 Reliability engineering 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

BUY 780 Simulation modelling 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

BVK 780 Supply chain design 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

CAM 780 Air quality control 780
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Air quality awareness and impacts of air pollutants.South African air pollution legislation. Meteorology and dispersion modelling. Measurement of air pollution – sampling and analysis. Equipment design of settling chambers and cyclones. Venturis and other wet cleaning equipment. Bag filters. Electrostatic precipitators. Incinerators, adsorption and absorption equipment.

CAM 787 Air quality control 787
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Air quality awareness and impacts of air pollutants.South African air pollution legislation. Meteorology and dispersion modelling. Measurement of air pollution – sampling and analysis. Equipment design of settling chambers and cyclones. Venturis and other wet cleaning equipment. Bag filters. Electrostatic precipitators. Incinerators, adsorption and absorption equipment.

CBO 700 Multivariable control system design 700
Academic organisation: Chemical Engineering
Contact time: 40 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

CBP 732 Bioprocessing 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Description of industrial biotechnology in a process engineering environment. Focus on specific applications in the mining, agricultural, paper and pulp, medical, pharmaseutical, veterinary, brewing and food industries. Principles including implications of bio-prospecting, biosafety, inoculum production, aseptic growth, quality control and product formulation as applicable to bioprocesses. Fermentation with various microbial groups, bioleaching, gene transfer, solid-substrate fermentation, enzymatic catalysis and immunology. Bioreactors, batch and continuous processing. Bioremediation.

CBT 700 Multivariable control system theory 700
Academic organisation: Chemical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CEM 780 Principles of environmental engineering 780
Academic organisation: Chemical Engineering

Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Engineering principles for environmental preservation and management, pollution control, life-cycle assessment, interactions in the macro and micro-environments, global and ecological systems, social-economic factors in environmental systems, predictive models for the current and future environment, environmental engineering as the driver of economic systems.

CEM 787 Principles of environmental engineering 787
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Engineering principles for environmental preservation and management, pollution control, life-cycle assessment, interactions in the macro and micro-environments, global and ecological systems, social-economic factors in environmental systems, predictive models for the current and future environment, environmental engineering as the driver of economic systems.

CFT 732 Fluoro-materials science and technology 732
Academic organisation: Chemical Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

CIP 732 Process integration 732
Academic organisation: Chemical Engineering
Contact time: 44 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CIR 702 Chemical engineering 702
Academic organisation: Chemical Engineering
Contact time: 8 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32

CIR 707 Chemical engineering 707
Academic organisation: Chemical Engineering
Contact time: 8 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32

CIR 787 Chemical Engineering 787
Academic organisation: Chemical Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

CKO 732 Cost optimization 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CML 732 Model-based control laboratory 732
Academic organisation: Chemical Engineering
Contact time: 12 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CMS 732 Carbon materials science and technology 732
Academic organisation: Chemical Engineering
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CPO 732 Product design 732
Academic organisation: Chemical Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CPP 732 Polymer processing 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CPW 732 Polymer materials science 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CRH 732 Reactor hydrodynamics 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

CRO 700 Reactor design 700
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CSK 732 Separation technology 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CSP 732 Process control system development 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

CYM 732 Additive technology 732
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

EAA 732 Digital image processing 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 20 lpw 2 ppw 2 web-based periods per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

EAD 732 Advanced classical optics 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Propagation and diffraction, linear optical systems theory, coherence, fundamentals of imaging, including MTF and basic aberration theory, some applications including: diffraction gratings, holography, gradient index media and periodic media.

EBB 732 Biosignals and systems 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Bioengineering: Bioelectricity and Electronics EBE732
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The objective of the module is to teach the engineering student how to apply engineering tools to the analysis of biological systems for the purpose of (i) developing understanding of the anatomy and physiology of specific biological systems from an engineering perspective, (ii) deriving appropriate mathematical descriptions of biological systems, and (iii) engineering applicable therapeutic interventions. We will expand on the single nerve fibre studies considered in bioelectricity and electronics: where the latter examined the biophysics of single excitable cells (and electrostimulation thereof), this module will develop it into an analysis of the characteristics of populations of neurons. We will systematically develop a systems-level perspective, working our way through the hierarchical organisation of neural encoding and computation. Furthermore, we will discuss how to measure characteristics and parameters of a particular system (the auditory system) and how to glean information about lower hierarchical levels from these measurements. This is a course in modelling and measurement, using tools from signal processing, control systems, dynamics, probability theory, systems engineering and psychoacoustics.

EBE 732 Bioelectricity and electronics 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
This module focuses on electrophysiology, using a quantitative approach. Topics covered in the first part of the module are: electrical properties of the nerve cell membrane, action potentials and the Hodgkin-Huxley model, cable theory, the neuromuscular junction, and extracellular fields. The second part of the module builds on this background to discuss the theory and practice of electrical nerve stimulation. Applications of the theoretical work is discussed, including functional electrical stimulation (e.g. electrostimulation used for standing and walking in paraplegics), and cochlear implants for the deaf.

EBI 732 Bioelectromagnetism and modelling 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Undergraduate Electromagnetism EMZ320 or equivalent
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The module provides an introduction to modelling of bioelectromagnetic systems using numerical methods. It focuses on the study of the interaction of electromagnetic fields with biological systems and application of this knowledge in the modelling of biological volume conduction problems. The finite element technique is used to analyse volume conduction problems. Students are introduced to an industry standard finite element software package, ANSYS, that is used to complete the practical component of the module.

EBO 780 Optimal control 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Introductory control module such as EBB320
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Optimal control of dynamic systems: continuous time systems, the Euler Lagrange equations, minimum time problems, the Pontryagin maximum principle; feasible control: computation of control input strategies for nonlinear systems such that the given control specifications are satisfied; feedback control of dynamic systems: dynamic programming for continuous time and discrete time nonlinear systems; applications in manufacturing systems; parametrisations of nonlinear/intelligent controller structures and applications of feasible control; linear systems: linear optimal control, linear optimal observers; application of feasible control in the computation of linear optimal output feedback controllers such that the design specifications are satisfied including: robustness against parameter variations, disturbance rejection, command following, frequency domain specifications.

ECR 732 Computational robotics 732
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

Module content:
The computational robotics module provides the background necessary to understand and develop intelligent robotic systems than can interact and move within the physical world. The module includes the following themes: introduction to state estimation (Gaussian and non-parametric filters), motion (robot kinematics) and perception (sensors and sensor fusion); uncertainty modelling; mobile robot localisation concepts; mapping; simultaneous localisation and mapping (SLAM); collision detection algorithms; overview of planning and control; spatial decomposition; geometric representations; topological representations; probabilistic reasoning; Bayesian networks; path and motion planning; dead reckoning; task planning and inference; Markov decision processes (MDP) and Partially observable markov decision processes (POMDP); Reinforcement learning (RL); introduction to mutli-agent systems (MAS); muti-agent planning and coordination.

ECV 732 Computer vision 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Digital image processing EAA732
Contact time: 2 ppw 2 web-based periods per week 20 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The objective of this module is to understand three-dimensional shape/space processing in human and machines. The module will examine 3D vision with topics selected from the following: geometric camera models; calibration; sources, shadows and shading; textures; stereopsis; affine and projective structure from motion; tracking with dynamic models; aspect graphs and range data; model-based, probabilistic and template based vision; object recognition and identification.

ECW 710 Wireless telephony 710
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The Centre for Radio and Digital Communications (CRDC), within the Department of Electrical, Electronic and Computer engineering, University of Pretoria in collaboration with Motorola has developed a unique Certificate Course in Wireless Telephony (CCWT). With the emergence of 2.5G and 3G technologies and the convergence between IT and Cellular technologies, training engineers for these developments in crucial. This programme offers the person with certain common telecommunication principles and training in fundamental mobile principles to a specific system generation. The practical/laboratory component attempts to firmly embed these “cutting edge” wireless communications learning outcomes.

EED 780 Power electronics 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Undergraduate level Power electronics
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Power semiconductors – basic structure, I-V characteristic physics of device operation, switching characteristics, SOA; passive components; converter topologies – AC-DC

rectifiers, DC-DC converters, DC-AC inverters, AC-AC converters and resonant converters; Dynamics and control – state space models, feedback control design; Ancillary issues - gate and base drives, snubber circuits and clamps, thermal modelling and heatsinking; Applications: electric utility applications, isolated switch-mode power supplies, optimising of the utility interface with power electronic systems.

EEO 732 Electro-optics 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Telecommunications ETK320 and Microwaves and antennas EMZ320 or BEng (Electronic Engineering)
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The module covers the different parts of photonic systems, such as an optical telecommunication system. The contents include: laser sources (laser principles, semiconductor lasers), modulators (electro-optic, magneto-optic, acousto-optic), media (free space propagation, Gaussian beams, optical fibre) and detectors (photo-conductive, photo-voltaic).

EES 732 Energy management 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Energy management theory, energy policy and strategic planning, load factor, diversity factor, load profiles, disaggregated load profiles, load duration plots, scatter plots, co-incident maximum demand, after-diversity maximum demand, seasonal swing, energy auditing, electricity pricing theory, electricity tariffs, energy norms, energy process modelling, demand-side management.

EEV 732 Power distribution engineering 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Utility source, medium voltage distribution, balanced and unbalanced fault conditions and selection of protective equipment: First cycle fault current calculations, contact parting symmetrical current calculations, power circuit breaker selection. Shunt capacitors: Selection, transients. Motors and motor starting, power quality issues: dips, harmonics, unbalance and flicker.

EFO 732 Optical communications 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
This module presents optical networks from a practical perspective. Strong emphasis is placed on contemporary topics such as fibre theory, components, transmission systems

and networks. Operational matters such as survivability, management and deployment considerations are also addressed. A substantial practical component will include optical time-domain reflectometry and familiarisation

EFR 716 Interferometry 716
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 16 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Theory: Michelson interferometer, Mach-Zehnder interferometer, Shack-Hartmann interferometer, Fabry-Perot interferometer, introduction to polarisation interferometry, introduction to interference microscopy, introduction to optical thin films.
Practical: alignment of optical flats, evaluation of optical surfaces, interpretation of interferograms obtained from a Fisba interferometer, interpretation of Newton fringes, application of a wedge interferometer to determine the thickness of a thin film.

EHS 732 Hardware and software parallel processing 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 2 ppw 2 web-based periods per week 20 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The fundamentals of both hardware and software parallel processing with topics selected from the following: models of computation; concurrency; general and specialised parallel architectures; consistency models; levels and types of parallelism; algorithmic parallelism; multiprocessor systems; shared memory systems and cache coherency; parallel programming languages; automatic parallelisation; application checkpointing.

EIN 732 Introduction to research 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 16 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32
Module content:
The aim of this module is to teach students to critically evaluate research literature, including conference papers and journal articles, in order to determine the current state of knowledge in a particular specialist area. It will also provide students with the principles of research to enable them to conduct research and prepare an original project in their particular specialist area.

EIT 732 Information fusion 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The information fusion module consists of the following themes: sensor systems, data fusion algorithms and architectures, classical inference and decision theory, Bayesian inference, Dempster-Shafer evidential reasoning, voting logic, artificial neural networks, fuzzy logic, single target tracking, multitarget tracking, multisensor multitarget tracking, multiple dissimilar sensor data fusion, sensor management and the evaluation of tracking systems.

EKS 732 Wireless sensor networks 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Computer networks ERN780
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
WSN consist of individual nodes interacting with their environment by sensing or controlling physical parameters; these nodes have to collaborate (using wireless communication) to fulfil their tasks. The module can be structured in two parts: architectures covering single node and network architectures, and communication protocols focusing on algorithms and protocols relevant to wireless sensor networks. The latter include the physical layer, MAC protocols, link-layer, naming and addressing, time synchronisation, localisation and positioning, topology control, routing protocols, data-centric and content-based networking, transport layer an QoS, and advanced application support (e.g. security).

ELB 780 Electronic warfare 780
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1 or semester 2
Language of tuition: English **Credits:** 32
Module content:
The following aspects of radar systems will be considered: Different types of radar including search radar, tracking radar, Synthetic Aperture Radar (SAR). The radar range equation. Radar Cross Section (RCS) and target characteristics such as scintillation and glint. Doppler processing and other coherent and noncoherent integration techniques. Range and Doppler ambiguities and high, medium and low PRF operation. Target detection including Constant False Alarm Rate (CFAR) processing. Pulse compression. Target tracking, including tracking filters and angular tracking systems such as monopulse. Environmental effects such as atmospheric attenuation and multipath. The radar frequency bands and their characteristics. High Range Resolution (HRR) techniques. The following aspects of communications systems will be considered: HF, VHF/UHF, satellite and other communications links. Modulation schemes used for communications. Resistance to interference and noise. System architectures and link establishment procedures. The following aspects of EW will be considered: Electronic Support (ES): Signal detection. Parameter estimation including Direction Finding (DF)/ Angle of Arrival (AoA) estimation and PRI tracking. Emitter classification. Electronic Attack (EA): Vulnerabilities of radar and communications systems. Non-coherent (noise) jamming. Coherent jamming with Digital Radio Frequency Memory (DRFM) systems. High Power Microwave (HPM) and Electromagnetic Pulse (EMP). Electronic Protection (EP): The relationship between good system design and EP. Low Probability of Detection (LPD) and Low Probability of Intercept (LPI) techniques.

EMA 780 Antenna theory 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Microwaves and antennas EMZ320 or equivalent
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Types of antennas and radiation mechanisms, parameters of antennas, radiation

integrals, near and far field radiation, duality theorem, wire antennas, antenna arrays, mutual coupling and mutual impedance, surface equivalence theorem, reaction theorem, moment methods in antenna analysis, travelling wave antennas, microstrip antennas, horn antennas, physical optics, reflector antennas, antenna synthesis.

EMB 732 Multivariable control systems 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Introductory control module such as EBB320
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Introduction to linear dynamic systems: Modes, stability, controllability, observability, multivariable poles and zeros, state-space and transfer function descriptions. Singular values and singular value decomposition. Feedback performance specifications in the frequency domain. Synthesis via state space methods. Optimal control techniques, model predictive control.

EME 732 Analogue electronic design 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Analogue electronic design EME732 (E5), 3rd year Electronics or equivalent or permission from the lecturer
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The integrated circuit (IC) or “chip” is the motor of the present electronic revolution. The ever-increasing impact of electronics is driven mainly by large-scale ICs such as processor and memory chips. The electronic circuit techniques used in these chips can only be understood on a deep level by a study of classical analogue electronics aimed at integrated circuit design for fabrication in CMOS, bipolar and BiCMOS processes. In addition, analog circuit techniques perform an essential role in the interfaces between the “real world” and digital systems. Examples are: voltage references, amplifiers, filters, level-converters, buffers. Important topics in this respect are feedback and stability theory as specialised for electronic circuits. The module includes: IC fabrication technology, models for IC transistors, transistor current sources and amplifiers, output stages, operational amplifiers, frequency response and stability of feedback amplifiers, nonlinear and computational circuits.

EMK 732 Communication electronics 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Introduction to radio communication systems, small signal amplifiers, multistage amplifiers, differential amplifiers, network noise, intermodulation distortion, noise factor and sensitivity, frequency selective networks, impedance matching, high frequency amplifiers, broadbanding techniques, AGC, oscillators, phase-locked loops, PLL applications, frequency synthesizers, power amplifiers, modulators and demodulators, frequency mixers.

EMM 780 Microwave theory 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Microwaves and antennas EMZ320 or equivalent
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Review of EM theory and transmission lines, analysis of transmission lines and waveguides, microwave network analysis, impedance matching, power dividers, couplers and hybrids, microwave filters.

ENB 732 Numerical Bayesian methods 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The numerical Bayesian module consists of the following themes: introduction to Bayesian inference, Markov chains, the Metropolis Hastings algorithm, Gibbs sampling, slice sampling, hybrid Monte Carlo, reversible jump Monte Carlo, an introduction to particle filters, the Extended Kalman filter (EKF), Sampling Importance Resampling (SIR), Sequential Importance Sampling (SIS), the Rao-Blackwellized particle filter.

ENO 732 Energy optimisation 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
In this module, a brief introduction about energy systems, energy system modeling and optimisation, and Matlab applications in energy optimisation problems are given. Practical industrial (as well as residential) energy management problems such as the load shifting for geysers, conveyor belts and pumping systems in terms of time-of-use tariff and/or maximum demand charge are covered.

EOD 732 Optical design 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Review of thin lenses, image formation and first-order properties of imaging systems, optical transfer functions, aberration theory, imaging systems: telescopes, microscopes, etc., optical design methodology.

EOP 732 Detection and estimation 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Theory of bayesian inference ETB732
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

Module content:
Binary hypotheses, M hypothesis, decision criteria, performance. Estimation theory: Random parameters, Bayes estimation, multiple parameter estimation. Composite hypotheses. The general gaussian problem. Performance bounds and approximations. Representations of random processes. Detection of signals-estimation of signal parameters, including detection in non-white noise, sufficient statistics. Signals with unwanted parameters, the composite hypothesis problem.

EPT 732 Research project: Theory 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32
Module content:
This module will cover the essential theoretical background of the student's proposed M Eng topic and include inter alia the following:
(i) Field definition and descriptions
(ii) In-depth study into background and theory relevant to the problem to be addressed
(iii) Problem definition and description
(iv) Mathematical simulations of the problem

EPT 733 Research project: Design and laboratory 733
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32
Module content:
This module will include extensive laboratory experiments to test the principles and possible solutions of the proposed M Eng research project and will include inter alia the following. These will include hardware and/or software experiments:
(i) Introduction to instrumentation and measuring techniques in general and specifically as applied in the field of research.
(ii) Structured laboratory work to introduce the specific problem investigated for the research undertaken.
(iii) Structured laboratory work to test the proposed solution for the problem addressed.
(iv) Confirmation experiments.

ERA 780 Software architecture 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Students should be familiar with software development lifecycle concepts, and been part of at least one significant software development effort. Preliminary reading material will be provided at the onset of the module.
Contact time: 16 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Please take note that ERA780/SWS780 is a 16 credit module.
The architecture of a software system can be defined as the collection of significant design decisions made early on in the development of that system. The decisions concern the components comprising the system, repeating-patterns of system-wide aspects, and the platforms on which the system will be built. Once made and subsequently followed, these decisions affect the development, deployment, use and

ongoing enhancement of that system profoundly. This module discusses software architecture, including the representation of designs, definitions, styles and patterns of architecture, including model-driven architecture, formal modelling and analysis, and architectural description languages.

ERC 732 New generation networks 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Computer Networks ERN 780 or BEng (Computer Engineering) UP or equivalent.
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The module in Next Generation Networks will cover evolution of communications networks towards multiservice networks and convergence. Topics be covered include the current PSTN architecture, convergence of enabling technologies, NGN architectures and APIs, softswitches, and modelling and simulation of multiservice networks. The main objective of the module is to prepare students for advanced research in next generation communications networks.

ERD 716 Introductory radiometry and photometry 716
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 16 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Credits: 16 (must be combined with Introduction to the Science of measurement to form a 32 credit module)
Introduction to laboratory equipment, solar cell, imaging radiometry, spectral radiometry, atmospheric transmittance, wavelength calibration of a monochromator, photometric measurements, measurement of colour.

ERD 732 Software construction 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Students should be familiar with concepts of software development lifecycle.
Contact time: 16 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Modern software development is faced with challenges involving scale, complexity and urgency. Not only are computer systems becoming more encompassing and participating in ever more complex processes – in addition, we are expected to develop and deliver them in ever-diminishing time. This module is an overview of these challenges and recommended practices to overcome them. The field of Software Engineering consists of approaches that are concerned with making the design, development, deployment and ongoing operation of software a set of predictable, repeatable, robust, value-producing, requirements-meeting disciplines. The aim of this module is to give a perspective on these software engineering disciplines, with the concepts illustrated by case studies from various domains.

ERN 780 Computer networks 780
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Review of computer networks infrastructure: The review will cover elementary concepts in computer networks; covering data communications, wide area networks, and local area networks.
Networking protocols: This section will explore both the architectural principles and mechanisms required for the exchange of data among computers, workstations, servers, and other data processing devices. Much of the material in this part relates to the TCP/IP protocol suite. Recent developments and state-of-art issues will also be focused upon.
Applications, service models and convergence of networks: This section will look at the application layer and explore various service models in the context of convergence. Students will be introduced to various Next Generation Networks technologies and issues.
Modelling and simulation: This section will cover research issues in computer networks. Students will be introduced to modelling, simulation techniques and tools.

ERP 732 Pattern recognition and neural networks 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 20 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The conceptual basis for statistical pattern recognition: Hypothesis testing, probability density (parameter) estimation, supervised learning, non-parametric techniques, linear discriminant functions, clustering, unsupervised learning. Neural networks: Single and multi-layer “threshold” networks, radial basis function networks, error functions, parameter optimisation algorithms. Applications: learning and generalisation, pre-processing and feature extraction, topics in speech recognition, image understanding.

ERR 732 Real-time and reactive systems 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 20 lpw 2 ppw 2 web-based periods per week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The fundamentals of real-time and reactive systems with topics selected from the following: classic theory of real-time and reactive systems; models of computation; real-time operating systems; process interactions; theory of optimal process and task scheduling; inter-process communication; real-time software design; verification and validation of real-time systems; deadlock management; time handling; system reliability: fault prevention and fault tolerance.

ERS 780 Software management and economics 780
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

Module content:
Software management and economics goals and issues. Software life cycle process models. Software cost and schedule estimation; trade-off and management option analysis. Business-case and economic analysis of software products. Relevant microeconomic concepts: production functions, economies of scale, present value, constrained optimisation, statistical decision theory, risk, and the value of information. Software risk management. Theories of management and their application to software projects. People considerations: motivation, leadership, teambuilding, group dynamics. Software life cycle planning and control; software process model determination; development and content of project plans; project monitoring and control. CMM, software quality.
Practical: IBM's Project management and financial management course.

ERT 732 Advanced topics of energy research 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The module focuses on the research training on supply side, energy transmission, and demand side. Some related research papers and our finished projects will be taught. Energy optimisation techniques will be trained throughout the module. The teaching material also includes some of our newest research projects so that students are getting involved in most advanced research progresses.
The expected learning outcomes are: (i) ability to identify if a problem is important to be investigated; (ii) ability to search references for research problems; (iii) ability to use energy management tools to model a research problem; (iv) ability to identify suitable optimisation algorithms for an optimisation problem arising from an energy management mathematical model; (v) ability to write research reports.

ERV 780 Advanced micro processor system design 780
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Systems approach to embedded systems design, specifically hardware/software co-design, including the following topics: microprocessor and embedded systems architectures; instruction set architectures (ISAs) and bus architectures; software development tool-chains; firmware design; advanced digital design (synchronous/ asynchronous clocking, large scale FSM design, synchronisation, design for test, test-bench generation, formal verification/validation).

ESD 732 Electro-optical systems design 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Introduction to electro-optical system design, optical radiometry and photometry, atmospheric effects, advanced radiometry, signatures and camouflage, performance analysis, electro-optical system analysis, spectral band considerations.

ESR 732 Digital radio techniques 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Digital communications ETD732
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Analog vs digital radio techniques, review of baseband and bandpass sampling concepts, overview of DSP-principles, Z-Transform and digital filter design, digital modulation techniques and performance analysis, radio link power analysis and design, generic radio configurations, low noise amplifier and radio front-end design, high-speed A/D and D/A components and design, automatic gain (power) control, direct versus superheterodine downconversion methods, IF-sampling techniques, digital radio receiver design, analog vs digital (carrier and symbol) synchronisation methods, doppler tracking, analysis and design of diversity techniques, multiple-input/multiple output (multi antenna element) systems, space-time coding, modular embedded system design and rapid prototyping (RF, CMOS and FPGA implementation techniques and technologies), computer-aided design software, tools and techniques.

ETA 732 Adaptive systems 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Digital communications ETD732
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Adaptive systems ETA732 covers the fundamentals of adaptive systems within the context of adaptive signal processing. The basic linear filtering problem with associated models and filter structures is introduced. Furthermore, the topics of stationary processes and models, spectrum analysis, eigen analysis, Wiener filters, linear prediction, Kalman filters, stochastic gradient methods and least squares methods are covered. Blind adaptive methods are presented within the context of the blind deconvolution problem. Lattice filter methods are covered as an extention to the basic topics of this module. Adaptive systems ETA732 will supply the student with valuable tools for the solution of statistical detection and estimation problems in the diverse fields of communications, control, radar, sonar, seismology and biomedical engineering.

ETB 732 Theory of Bayesian inference 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Probability, entropy and inference. Motivational examples of Bayesian inference, maximum likelihood and clustering, exact marginalisation, Laplace's method, Monte Carlo methods, variational methods, introduction to neural networks, “learning is inference”, Boltzmann machines, supervised learning in multilayer networks.

ETD 732 Digital communications 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1

Language of tuition: English **Credits:** 32
Module content:
Digital Communications ETD 732 is a first-semester graduate course in Electronic Engineering, presented by the Signal Processing and Telecommunications Group, in collaboration with the Centre for Radio and Digital Communication (CRDC). The content of the course is as follows: Introduction to digital communications, digital communications applications and services. Review of: probability and stochastic processes, source coding, characterisation of communication signals and systems and optimum receivers for the AWGN channel. Advanced synchronisation systems: Carrier and symbol recovery. Shannon's channel capacity theorem and introduction to coding. Signal design for band-limited channels. Digital modulation techniques. Communication through band-limited linear filter channels. Introduction to adaptive equalisation. Spread spectrum signals for digital communications. Simulation of digital communication systems. Digital realisation of digital communication subsystems. Digital communication laboratory.

ETE 780 Electrical drives 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Undergraduate level Power electronics and Electric machines.
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Power semiconductor devices and power electronic converters for drive applications. Theory of three-phase induction motor and synchronous motor machines. Adjustable speed induction motor drives: open-loop and closed-loop control, scalar and vector control, transient analysis of induction motor drives and introduction to vector/field-oriented control. Adjustable speed synchronous motor drives: Open-loop and closed-loop control, self-controlled permanent magnet synchronous motor drives. Introduction to spiral vector theory and analysis.

ETH 780 Information security 780
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Number theory: prime numbers, congruences, modular arithmetic, Euclid's algorithm, Fermat's theorem, Euler's theorem, Euler's phi-function. Block ciphers: Feistel cipher, DES, AES. Public key cryptography: RSA, Diffie-Hellman, digital signatures. Hash functions: MD 5, SHA-1, MAC, HMAC. Protocols: identification, authentication, key exchange, X.509. PGP, S/MIME, IPSec, SSL, VPN. Authentication protocols, key distribution, key management, random number generation.

ETK 732 Coding theory 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Digital communications ETD732
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
The module ETK780 Coding theory addresses the analysis and design of block, convolutional and concatenated coding schemes for mobile fading channels. Information

theory concepts, such as channel capacity and cutoff rates are addressed. Galois fields and mathematical operations are investigated. The construction of binary FIR and IIR convolutional codes, and non-binary dual-k convolutional codes are considered, followed by an in-depth discussion on the classic Viterbi algorithm. Binary block codes considered in this module include cyclic, Hamming and binary BCH block codes. Classic block code decoding algorithms, such as ML, syndrome and Meggit decoders are investigated. Non-binary Reed-Solomon block codes, as well as the Berlekamp-Massey decoding algorithm are presented. The Viterbi decoding of linear block codes, using BCJR trellises are investigated. The concept of coding for fading channels are considered, with the focus on aspects such as interleaving and employing channel state information in channel decoders. Classic concatenated coding schemes are considered. Iteratively decoded concatenated coding schemes, including iteratively decoded parallel, serial and hybrid concatenated coding and coded modulation are investigated. This includes an in-depth study of iteratively decoded concatenated coding scheme building blocks, such as puncturers, interleavers, recursive systematic convolutional codes and MAP decoders. Several promising fields of channel coding currently receiving much interest, such as multilevel coding, space-time coding and bit-interleaved coded modulation, are also considered.

ETP 732 Topics in photonics 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The purpose of the Topics in Photonics module is to create the opportunity for experts to give lectures on specialised topics in the filed of photonics, thus providing students with the opportunity to capitalise on the specialised knowledge of experts that are not permanently affiliated to the University.

ETR 732 Mobile communication 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Introduction to wireless, cellular, digital PCS mobile radio communication. Radio propagation and cellular engineering concepts. Digital MODulation-DEModulation (MODEM) techniques (cellular modulation standards). Error control coding for fading channels. Access technologies (FDMA, TDMA, CDMA, OFDMA, SDMA and hybrids). Spread-spectrum systems and concepts. Diversity techniques for mobile wireless radio systems. Cellular and wireless systems engineering (mobile cellular design). Adaptive equalisers for fading channels.

ETT 732 Telecommunication systems engineering 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Telecommunication systems engineering ETT 732 is a first-semester graduate course in Electronic Engineering, presented by the Signals and Telecommunications Group. This

module provides an Introduction to telecommunication concepts, tele-communication systems, virtual private networks (VPN), advanced intelligent networks (AIN), local number portability (LNP), computer-to-telephony integration (CTI), signalling system 7 (SS7), CTI technologies and application, ISDN, frame relay, ATM, ATM and frame relay internetworking, data over power lines, xDSL, microwave and radio-based systems, local multipoint distribution services (LMDS), specialised mobile radio (SMR), cellular communication, GSM, personal communication services (PCS), wireless data communication (Mobile IP), satellite communication (Networking, LEO), Sonet and SDH, wave division multiplexing (WDM), the internet (TCP/IP, VoIP, networking, management)

IBD 780 Decision analysis 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IEE 780 Technological entrepreneurship 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IIX 780 Engineering logistics 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IKK 780 Quality management 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

IKN 780 Engineering economics 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ILE 780 Life cycle engineering 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IMC 780 Maintenance management 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

INI 781 Research methodology 781
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

INV 780 Innovation strategy 780
Academic organisation: Engineering and Technology Management
Contact time: 22 other per week 16 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IPK 780 Project management 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

ISE 780 Systems engineering 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IVV 781 Operations management 781
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

MAH 780 Fluid-structure interaction 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Design of structures subjected to fluid flow, i.e., high-rise buildings, chimney stacks, tube in heat exchangers, overhead powerline bundles, bridge piers, risers, pipe lines under sea, stays, masts, chemical-reaction towers, offshore platforms and aircraft components.

MAN 780 Porous flow 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Transport through porous media has raised considerable attention in recent decades due to its relevance in a wide range of applications such as vehicle engines, thermal insulation engineering, electronics cooling, filtration, water movement in geothermal reservoirs, heat pipes, underground spreading of chemical waste, nuclear waste repository, geothermal engineering, grain storage, enhanced recovery of petroleum reservoirs and biological science. This module gives an introduction to the physical

models used in the study of fluid flow and heat transfer in porous materials, and will give an understanding of the transport mechanism.

MAY 780 Aircraft propulsion systems 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Types of engines; energy flow through jet engines; turbojet engine components, diffuser, compressor, combustion chamber, turbine, exhaust system; turbojet with afterburner; turbofan engine; engine thrust and performance parameters; gas turbine engine cycle analysis; thrust augmentation; ram and pulse jet engines; rocket propulsion.

MBA 780 Solar energy 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
In this module the different solar-thermal systems will be introduced and analysed with the heat transfer and thermodynamics principles that apply. The main focus will include; sun-earth geometrical relations, solar radiation, energy requirements in buildings, energy storage, heating and cooling processes, bulk solar thermal power generation systems, life cycle costing and large scale plant specifics and quantification.

MBB 780 Control systems 780
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: Working knowledge of MATLAB/OCTAVE
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to state space methods, full state feedback design, disturbances and tracking systems, linear observers, compensator design by the separation principle, linear quadratic optimum control, Kalman filter, linear quadratic Gaussian compensator.

MBT 780 Topology and shape optimisation 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
The topology optimisation method solves the basic engineering problem of distributing a limited amount of material in a design space. Material distribution methods, based on the use of mathematical programming and Numerical Schemes are used to determine the optimum architecture of a system and is used to identify possible shape and lay-outs of material. Applications of this optimisation method include optimisation of structural members, but can also be extended to flow and heat transfer optimisation.

MCM 780 Composite materials 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Fundamental concepts of composite materials; manufacturing methods; design criteria of laminated composite materials; determining mechanical properties of composite materials: anisotropic elasticity and laminate theory, beams and columns of composite materials, plates and panels, transverse shear deformation effects, twisting and stretching shear coupling, composite shells; hygrothermal effects; strength and failure theories.

MEE 780 Finite element methods 780
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: A working knowledge of MATLAB/OCTAVE or FORTRAN77
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Stress and the differential equilibrium equation. Isoparametric formulation. Numerical integration. Reduced integration. Convergence, stability and accuracy. The Patch test. Membrane elements: assumed stress mixed interpolations. 3-D elements. Error estimates and mesh refinement. Sensitivity analysis.

MEE 781 Advanced finite element methods 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MEE 780
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Non-linear statics: Overview of non-linear effects: geometric, material and boundary conditions. Continuum mechanics: tensors, indicial notation, deformation gradients, stress and strain measures, transformations and rotations, stress-strain relationships, constitutive models. Principles of virtual work. Solution methods: direct iteration, Newton methods, incremental/iterative procedures. Lagrange engineering strains. Large displacement finite element analysis of continua: total Lagrangian formulation. Small strain plasticity: Additive decomposition, flow rule, hardening laws, continuum and consistent tangents.

MEG 780 Mechatronics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Sensors: mechanical and optical limit switches, encoders, thermocouples, strain gauges, CCD cameras, IR sensors, piezo-electric sensors, capacitive sensors, torque sensors, tactile sensors, gyroscope and ultrasonic sensors. Actuators: DC motors, stepper motors, AC motors, pneumatic actuators, hydraulic actuators, memory shape alloys. Signal conditioning: component interconnection, amplifiers, analogue filters, modulators and demodulators, analogue-digital conversion, sample-and-hold circuitry, multiplexers,

software and hardware implementation of digital filters and Wheatstone bridge. Control: H-Bridge motor control, PWM motor control, control of stepper motors, non-linear control of hydraulic and pneumatic actuators, PLCs, SCADA systems, industrial Fieldbus, micro-processor control.

MEV 781 Vibration-based condition monitoring 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: Working knowledge of MATLAB/OCTAVE
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Vibration measurement: conventional and optical technique, digital signal processing in vibrations, vibration monitoring: diagnostics and prognostics, artificial intelligence in vibration monitoring, human vibration.

MHM 780 Advanced heat and mass transfer 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Convection correlations: high speed flows, boundary layers, similarity, conservation equations, scale analysis. Thermal radiation: physics, exchange between surfaces, solar, directional characteristics, spectral characteristics, radiation through gasses. Convection, evaporation and boiling: film condensation, film evaporation, pool boiling, forced-convection boiling and condensation, flow regime maps, phase change at low pressures, heatpipes. Heat exchangers: types, regenerators, heat exchanger design. Mass transfer: Fick's Law, mass diffusion, mass convection, simultaneous heat and mass transfer, porous catalysts. High mass transfer rate theory. Mass exchangers.

MIC 780 Condition-based maintenance 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Theory and practical applications of condition based maintenance techniques. Pitfalls of the various condition based maintenance techniques. Acoustic emission, wear debris monitoring, oil analysis, thermography and non-destructive testing.

MII 781 Reliability-based maintenance 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MIR 781 Reliability engineering 781
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Component reliability: Weibull analysis, Limitations of Weibull analysis – when not to use it. System reliability and availability: reliability/availability modelling, the availability block diagram (ABD), Cut sets, capacity constraints, m-out-of-n systems and storage capacity, Fault trees, Failure modes, Effects and criticality analysis (FMECA). Failure and repair

rate data: Reliability engineering's red herring: "We don't have the data", Some data banks that are in fact useful, Data synthesis: the method of paired comparisons, Paper on The use of NERC-GADS data in determining standards for system design, Case study in and exercise in data synthesis.

MIP 780 Maintenance practice 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Failure characteristics and analysis. Maintenance economics – Budgeting and cost control. Life cycle partnering and maintenance contracting. Legal aspects and case study. Performance measurement and benchmarking. Maintenance programming – Network analysis. Variability analysis. Maintenance strategy, plan, and protocol design – a new look at RCM. Maintenance tactic selection techniques. Introduction to condition-based maintenance. Tribology and contamination control presented with case studies. Maintenance Maturity Indexing and Variable Relationships development.

MIP 781 Maintenance practice 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MIP 780 Maintenance practice 780 (recommended)
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Maintenance process modelling and configuration management. Maintenance audit systems. Systems thinking and complexity analysis as applied to the maintenance environment. Risk analysis. "Fit" analysis. Management information systems. CMMS and implementation. Maintenance Finance and Cost types. Project selection techniques. Employee competence analysis and motivation of maintenance workers. Work priority modelling.

MIR 781 Reliability engineering 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to probabilistic distributions, computation of system reliability, building reliability models and optimisation of system reliability; Fault Tree Analysis; Failure Modes, Effects and Criticality Analysis (FMECA), Monte Carlo Simulation; probability-based design.

MIT 780 Tribology 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 10 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Friction – Theory and laws of friction, friction behaviour of different materials. Lubrication and theory, hydrodynamic lubrication, elastohydrodynamic lubrication, boundary

lubrication. Lubricants – wear – wear theory, wear mechanisms, particle properties. Surface modification and coverings, filtration, choice of filtration limits. Design and wear – determining wear rates, role of operational parameters, choice, role and effect of material choice, lubrication techniques. Tribological aspects of: bearing design, gear design, design of sliding elements.

MLD 780 Aerodynamics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Panel methods, Green's identity, different 2-D panel methods, airfoil design and analysis, 3-D vortex systems, vortex lattice methods for 3-D potential flow, boundary layer methods, theory of boundary layers, some finite difference methods, separation, computer methods, compressible potential flow, Mach waves and shock waves, Prandtl Glauert equations, subsonic, supersonic and transonic flow on thin airfoils, finite difference methods applied to small perturbation equation.

MLG 780 Gas dynamics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Fundamentals of compressible flow, one dimensional flow, oblique shock and expansion waves, quasi-one-dimensional flow, differential conservation equations for invicid flows, unsteady wave motion, linearised flow, conical flow, 3D flow, transonic flow, hypersonic flow.

MLR 780 Air conditioning and refrigeration 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Comfort and indoor air quality. Psychometrics. System types and selection. Cooling and heating load calculations: conduction, radiation, convection, internal loads and thermal storage. Design of air handling unit, ducts, plant and reticulation. Control systems. Introduction to integrated system simulation.

MLT 780 Aeronautical structures 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Review of the stress, displacement and thermal analysis of structures. Structural analysis for static and dynamic loads: aerodynamic, pressure, landing and thermal. A study of the characteristics of flight vehicle materials and the design of fuselages/wings with reference to component manufacturing techniques.

MOI 781 Structural control 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MBB 780 Control systems 780
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Application of control techniques in order to actively control the dynamics of structures like beams and plates; pole placement technique, PID control, optimal control, feed-back control and feed-forward control; using tools like SIMULINK that can be used to simulate active control.

MOO 780 Optimum design 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to design and elements of computer aided design. Optimum design problem formulation. Optimum design concepts. Linear programming methods. Integer programming. Numerical methods for unconstrained and constrained optimum design. Model reduction. Interactive and practical design optimisation.

MOX 780 Design 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
The objective of the module is to enable the engineer to plan and control design and development projects. System engineering. All aspects, from the concept phase to phasing out of the projects as well as supporting theory are covered. Technology forecasting: explanation and application. Project viability studies: explanation and application. Applicable practicals and assignments are used to equip the student to apply the theory. Student's conducting a techno-economic study is used to integrate the different aspects of the subject.

MOX 781 Specialised design 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows the Head of the Department of Mechanical and Aeronautical Engineering to arrange a short course on a specialised nature in mechanical or aeronautical engineering, typically (but not limited to) a course presented by a visiting academic. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of a specialised and advanced nature, at the level of the other postgraduate modules offered by the Department.

MOX 782 Specialised design 782
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows the Head of the Department of Mechanical and Aeronautical Engineering to arrange a short course on a specialised nature in mechanical or aeronautical engineering, typically (but not limited to) a course presented by a visiting academic. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of a specialised and advanced nature, at the level of the other postgraduate modules offered by the Department.

MSM 780 Numerical thermo-flow 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Fluid Mechanics refresher (governing equations, boundary conditions, application of inviscid, laminar and turbulent flow). Methods of weighted residuals (finite element, finite volume and difference methods). Mesh generation and boundary conditions: Types of mesh structured and unstructured mesh generation and application (inviscid flow, heat conduction etc.) Heat conductions: Governing equations, discretisation, finite approximation, solution methods (Gauss-Seidel, Tri-diagonal matrix algorithm) etc. This module is suited to postgraduate students doing research in thermofluids and who wants to use available CFD codes or who wants to write their own codes to solve fluid mechanics, heat and mass transfer problems.

MSM 781 Numerical thermoflow 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MSM 780 Numerical thermoflow 780
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
The Efficient Solvers: Background, muligrid theory and detailed description of the algorithm. Finite Volume method: Understand the governing equations, general form of the transport equations, Gauss's theorem and the finite volume discretisation. Iterative solution algorithm: Pressure-velocity coupling, types of grids, unsteady flows, multiple phases. Finite Volume Discretisation: Diffusion term, convection term and source term for steady flows. Convection-diffusion problems: Boundary conditions, higher order discretisation, accuracy/stability. Solution Algorithm for Pressure-Velocity coupling: SIMPLE, SIMPLER, SIMPLEC & PISO. Laminar, transitional and turbulent flow: Background and theory. Turbulence modelling and examples: Definition of turbulence, turbulence modelling approaches, turbulence models (zero-equation models, one equation, two equation, Reynolds Stress Model (RSM), Large Eddy Simulation, wall function approach), turbulence modelling guidelines. Recent CS developments: Current state of the art in turbulence modelling etc. Viscous boundary meshes: Background and objectives, internal and external flow, turbulence modelling considerations.

MSS 781 Independent study 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

MSS 782 Independent study 782
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows a student to study a certain body of knowledge in mechanical or aeronautical engineering, as specified by a lecturer in the Department of Mechanical and Aeronautical Engineering, on an individual basis, under the supervision of that lecturer. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of an advanced nature, at the level of the other postgraduate modules offered by the Department. Normal requirements for assessment that include the use of an external examiner apply to this module also.

MSV 780 Fatigue 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Fatigue principles addressing both elasticity and plasticity; notch effects; variable amplitude loading conditions; multi-axial fatigue and weld fatigue.

MSX 780 Fluid mechanics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Mathematical preliminaries: historical overview, scalar, vector and tensor algebra (in context of partial differential equations), Green's lemma and the Divergence theorem, Eularian/Lagrangian representations, derivative of a function, Reynolds transport theorem. Governing equations: viscous compressible and incompressible flow, derivation of conservation of mass, derivation of conservation of momentum, boundary conditions, mathematical characteristics, non-dimensionalisation. Viscous compressible and incompressible flow: derivation of conservation of mass, derivation of conservation of momentum, boundary conditions, mathematical characteristics, non-dimensionalisation.

MSX 781 Advanced fluid mechanics 781
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MSX 780 Fluid mechanics 780
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Exact solutions: potential flow, Couette flow, Poiseuille flow and combined Couette-

Poiseuille flow, laminar boundary layers (similarity solutions for flat plate flow). Stability of laminar flows: introduction, linearised stability, transition to turbulence, approximate prediction of transition. Turbulent flow: Reynolds averaged equations, two-dimensional turbulent-boundary-layer equations, velocity profiles, turbulent flow in ducts, flat plate flow, turbulence modelling.

MSY 732 Structural mechanics 732
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 42 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

MSY 781 Specialised structural mechanics 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows the Head of the Department of Mechanical and Aeronautical Engineering to arrange a short course on a specialised nature in mechanical or aeronautical engineering, typically (but not limited to) a course presented by a visiting academic. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of a specialised and advanced nature, at the level of the other postgraduate modules offered by the Department.

MSY 782 Specialised structural mechanics 782
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows the Head of the Department of Mechanical and Aeronautical Engineering to arrange a short course on a specialised nature in mechanical or aeronautical engineering, typically (but not limited to) a course presented by a visiting academic. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of a specialised and advanced nature, at the level of the other postgraduate modules offered by the Department.

MSY 783 Experimental structural dynamics 783
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: A working knowledge of MATLAB/OCTAVE
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Spatial, modal and response models of structures, frequency response functions and the relationships between spatial, modal and response models for single degree of freedom systems and multi-degree of freedom systems, modal analysis, operational modal analysis, updating finite element models.

MTV 732 Thermoflow 732
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 42 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

MTV 780 Specialised thermoflow 780
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows the Head of the Department of Mechanical and Aeronautical Engineering to arrange a short course on a specialised nature in mechanical or aeronautical engineering, typically (but not limited to) a course presented by a visiting academic. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of a specialised and advanced nature, at the level of the other postgraduate modules offered by the Department.

MTV 781 Specialised thermoflow 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module allows the Head of the Department of Mechanical and Aeronautical Engineering to arrange a short course on a specialised nature in mechanical or aeronautical engineering, typically (but not limited to) a course presented by a visiting academic. The total volume of work that is to be invested in this module by an average student must be 160 hours. The body of knowledge studied must be of a specialised and advanced nature, at the level of the other postgraduate modules offered by the Department.

MTX 780 Thermodynamics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8

MTX 781 Advanced thermodynamics and energy systems 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Fundamental concepts of thermodynamics, total flow exergy, restricted dead state and unconstrained equilibrium state, heat transfer, fluid flow and chemical irreversibilities, thermodynamic optimisation, irreversibility distribution ratio, lost exergy, application of entropy generation minimisation (EGM) technique to the fundamentals of power generation, solar power, wind power, and low temperature refrigeration.

MUA 782 Reactor coolant flow and heat transfer 782
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MUA 783
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Design of reactor coolant system, heat sources in reactor systems, heat transmission principles, heat transmission in systems with internal sources, temperature distribution along path of reactor coolant flow, heat transfer characteristics of fluids, heat transfer to boiling liquids, heat transfer characteristics of gasses

MUA 783 Reactor engineering science 783
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Atomic structure, nuclear energy and nuclear forces, nuclear fission, nuclear reactions and radiation, energy removal, nuclear reactor systems, radiation protection, radiation shielding, meteorology, reactor safety analysis.

MUA 784 Reactor physics 784
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MUA 783 Reactor engineering science 783#
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Probability concepts and nuclear cross sections, multiplication factor and neutron flux, slowing-down process in the infinite medium, diffusion theory the homogeneous one-velocity reactor, Fermi age theory: the homogeneous multivelocity reactor, transport theory, reflected reactors, reactor kinetics, heterogeneous reactors, control-rod theory.

MUA 785 Reactor materials engineering 785
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MUA 783 Reactor engineering science 783#
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Overview of the functions of the various classes of nuclear materials, elastic deformation, yielding and use of texture in nuclear components, atomic processes in plastic deformation and radiation damage, strength of engineering materials.

MUA 786 Reactor materials engineering 786
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MUA 785 Reactor materials engineering 785
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

Module content:
Creep deformation, fracture processes and metallurgical fracture mechanics, fatigue fracture in nuclear materials, fabrication processes of nuclear materials.

MUA 787 Reactor stress analysis 787
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MUA 783 Reactor engineering science 783
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
General considerations, simple tension, bending in straight beams, torsion, plane stress and strain, strain energy, experimental stress analysis, rotational symmetry, stresses in flat plates, thermal stresses, beams on elastic foundations, buckling, design considerations.

MUU 781 Fossil fuel power stations 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module contains a comprehensive study of all mechanical systems and processes of a fossil fuel power station. The module will include the analysis of steam cycles, combined cycle power generation, fuels and combustion, combustion mechanisms, combustion equipment and firing methods, the draught group, steam generators, steam turbines, condenser, feedwater and circulating water systems, coal handling, ash handling, compressor plant, water treatment, the importance of HVAC, control and instrumentation, control philosophies and environmental considerations.

MVI 780 Vehicle dynamics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Tyres: Characteristics and tyre models used in simulation of ride comfort and handling. Road inputs: Classification of roads. Road profiles. Road roughness. Suspension components: springs, dampers. Controllable suspension systems. Modelling aspects. Human reaction: Human response to vibration. Driver models. Human reaction times. Vertical vehicle dynamics (ride comfort): Vibration levels in a vehicle. Simulation of ride comfort. Effect of seat characteristics on vibration levels. Test and evaluation procedures. Lateral vehicle dynamics (handling): Simulation of steady state and dynamic handling. Rollover propensity. Test procedures. Computer applications: Application of computer codes in the analysis of vehicle dynamics.

MWN 780 Numerical methods 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

Module content:
Solving systems of linear algebraic equations using direct and iterative methods from small to large scale systems. Numerical solutions of nonlinear systems of equations. Solving eigenvalue problems. Numerical approximation strategies. Numerical differentiation. Numerical Integration. Numerical solutions to initial-value problems for ordinary differential equations. Numerical solutions to boundary-value problems for ordinary differential equations. Numerical solutions to partial-differential equations.

MWX 781 Nano and micro heat transfer 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 21 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
The applications of transport processes pose new challenges in emerging areas like electronic cooling, Micro-Electro-Mechanical Systems (MEMS) and micro biological sciences. This involves devices where heat, species and fluid flows are involved within very small dimensions. Topics covered: Statistical thermodynamics, quantum mechanics, thermal properties of molecules, kinetic theory, micro/nanofluidics; thermal transport in solid micro/nanostructures, electron and phonon scattering, size effects, quantum conductance, electronic band theory, tunneling, nonequilibrium heat conduction, analysis of solid state devices such as thermoelectric refrigeration and optoelectronics; nanoscale thermal radiation and radiative properties of nanomaterials, radiation temperature and entropy, surface electromagnetic waves, near-field radiation for energy conversion devices.

NEL 700 Electrometallurgy 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
At the end of the module, students should be able to conceptualise and design new electrometallurgical processes and improve the operation of existing processes through an understanding of the basic principles of the thermodynamics and kinetics of electrochemistry, measurement techniques used in electrochemistry, and considering the principles of electrochemical reactor design, different electrode and cell configurations, role of additives to electrolytes, role of impurities in the electrowinning process, the steps involved in electrocrystallisation processes and present practices used for the electrowinning of metals such as copper, nickel, cobalt, zinc, manganese and gold.

NFE 700 Fabrication engineering 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module looks at quality assurance and control in welded fabrication and manufacture, and introduces various standards and codes of manufacture used in the welding industry. Measurement, control and recording in welding, the principle of fitness for purpose, as well as health and safety issues are addressed. Control of residual stresses and distortion during welding, non-destructive testing, repair welding, and the

economics of welding are considered. This module also examines plant facilities, welding jigs and fixtures. Special emphasis is placed on the design and implementation of welding procedure specifications, procedure qualification records and quality control plans. A number of case studies are examined.

NFM 700 Physical metallurgy 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
The module deals with the basic understanding of phase transformations in alloys, and its relationship with microstructure and mechanical properties of alloys. Included are transformation processes such as solidification; nucleation, growth and coarsening of precipitates; the use of carbides and intermetallic compounds in steels; static and dynamic recrystallisation; grain growth and the use of grain boundary engineering; the martensite, bainite and pearlite transformations; thermomechanical processing and some elements of quantitative metallography. The module is practice-orientated; the current best fundamental understanding of these transformation processes covered, and its role in engineering application demonstrated. The module is fully documented on CD-ROM from the latest literature and is largely intended for that research student who is embarking on a physical metallurgical research project.

NFM 701 Basic physical metallurgy 701
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module serves as a bridge into full postgraduate studies in physical and mechanical metallurgy for students who do not have a formal first degree in these subjects. The following topics are covered in this module: phases in alloys, diffusion, solidification, the precipitation of second phases in alloys and the recrystallisation and grain growth of single phase alloys, aluminium and its alloys, copper and its alloys, nickel base alloys, the iron-carbon phase diagram, the heat treatment of steels, dislocations and the deformation of metals, engineering strength of metals and alloys, creep deformation, introduction to fracture mechanics and fatigue and failure analysis. This module will, therefore, enable the student to understand the fundamentals that govern alloy design, heat treatment, physical and mechanical properties and behaviour of materials during heat treatment and under stress and will enable the correct selection of alloys for a particular use, the prescription of heat treatments and further mechanical processing of these alloys to achieve the required metallurgical and mechanical properties.

NHB 700 Heat treatment 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
The emphasis is on the practice of the heat treatment of steels, covering the following topics: introduction and fundamental aspects of the Fe-C system; alloying elements; tempering of martensite; pearlite and bainite formation, hardenability; annealing,

normalizing, hardening and tempering; stress relieving, use of CCT and TTT diagrams, HSLA steels, tool steels; stainless steels, heat treatment furnaces and their atmospheres, induction hardening, carburisation, nitriding, mechanical testing, non-destructive examination and heat treatment, hydrogen embrittlement, temper embrittlement, quantitative metallography for quality control, heat treatment for fracture toughness and heat treatment case studies. The module is partly available on CD-ROM with up-to-date references to the latest literature.

NHM 700 Hydrometallurgy 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
The aim with this module is to enable the students to understand the design and operation of hydrometallurgical processes for the beneficiation of minerals and metals. The theoretical basis of the solution chemistry underlying hydrometallurgical processes, the purification and concentration options available, and the metal recovery processes such as precipitation, hydrogen reduction, and electrowinning are reviewed. This is then followed by the consideration of the engineering aspects and the technical application of hydrometallurgical processes for a number of ores relevant to South Africa

NHM 701 Basic extractive metallurgy 701
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module covers the fundamental principles of hydrometallurgy and minerals processing. In the minerals processing part of the module, students are given perspective on the scope of and functions in mineral processing, different unit operations and processing options for different deposits. Themes are comminution, classification, concentration, and solid-liquid separation. In the hydrometallurgy portion the merits and limitations of hydrometallurgy when compared with other metallurgical processes (e.g. pyrometallurgy) are considered; and different feed materials for hydrometallurgical processes; different unit processes in hydrometallurgy; fundamental thermodynamic and kinetic concepts as used in leaching; different leach reactors and their applications; solution purification and metal recovery processes; selecting a suitable flowsheet for a given feed material to produce a final metal product are discussed.

NKR 700 Corrosion 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
The aim with this module is to facilitate the development of the students in corrosion engineering by considering the electrochemical fundamentals of corrosion processes as well as their experimental and practical implications for corrosion diagnosis and control. The practical manifestations of the broad types of corrosion are reviewed and the skills of the students to utilise corrosion control methodologies such as chemical and electrochemical control, protective coatings and material selection to control corrosion are developed.

NLO 700 Literature survey 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 32
Module content:
The refereed literature on a specific topic (normally related to subsequent research towards a master's degree) is studied and summarised in a written report. The important skills are finding appropriate papers, reading and comprehending these, and using the information in the paper to construct your own view on the research topic. There are no formal contact sessions. The written survey must be submitted at the end of October, with an oral presentation of 20-30 minutes in the week following submission of the survey.

NMM 700 Mechanical metallurgy 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
We cover the interaction between the internal structure of metals – on the atomic and microscopic scales – and their mechanical properties. Practically important topics such as elastic and plastic stress analysis, dislocations and deformation, room and high temperature deformation processes, mechanical property/microstructure relationships for low and medium Carbon steels and for micro-alloyed and HSLA steels, fatigue processes, stress corrosion cracking, creep deformation processes and fracture mechanics are covered in depth, and illustrated with case studies. The module is largely available on CD-ROM with references to the latest literature.

NMP 700 Minerals processing 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
Principles and advanced theory of comminution, classification and density separation are covered.

NMP 701 Applied theory of sampling for minerals processing 701
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module covers both the theory and practice of sampling, primarily with respect to the minerals processing industry. As sampling is statistical in nature, basic statistics relevant to sampling theory will be considered. The module will then focus on the theory of sampling with specific reference to managing large and small scale variability. The effect of interpolation errors, periodic errors and increment weighting errors will be considered under large scale variability. Under small scale variability the determination and management of various errors that result in small scale variability will be covered, as well as the compilation of sampling protocols that can minimise these errors. The module will also examine the evaluation of dry and wet sampling equipment with respect to the

different bias generators, as well as the implementation of sampling protocols in practice. Ore types covered during the course include coal, iron ore, gold and platinum.

NNR 700 Nuclear reactor materials 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
In this module the mechanical behaviour of metals and alloys at room and high temperature is addressed but with special emphasis on nuclear materials used in commercial power reactors. In particular these materials' behaviour under deformation, creep, fracture, fatigue and also corrosion in irradiation conditions for in-core materials as well as their behaviour under the unique environmental conditions for out-of-core materials is covered.

NPA 700 Metallurgical analysis 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The focus is on solving metallurgical problems with the aid of hi-tech metallurgical analytical techniques. The two main metallurgical areas addressed are the microstructure-property relationships in metals, and surface engineering of metals. The techniques highlighted in this module include SEM, TEM, thermomechanical simulation, AES (Auger spectroscopy), XPS (ESCA) and AFM (Atomic Force Microscopy). Lectures cover the theory of these techniques, with practical demonstrations of the apparatus. Assignments – typical industrial metallurgical problems – must be completed, using the instrumentation under the guidance of the technical experts.

NPM 700 Pyrometallurgy 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
We aim to provide you with practice in using fundamental principles to analyse pyrometallurgical processes – to be able to go from understanding to process improvement. To this end, the necessary fundamentals of reaction equilibria (including activity descriptions), reaction kinetics, and mass and energy balances are reviewed. Practical examples illustrate the use of these principles. In the final block, we analyse a number of practical processes in more detail. Throughout, the emphasis is on quantification, and at least half of the contact time is devoted to computer-based calculations.

NPM 701 Basic pyrometallurgy 701
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32

Module content:
In this module you will develop the skills required to analyse the equilibria of pyrometallurgical processes. Solving such a problem requires skills in thermodynamic analysis, and knowledge of the typical processes (and the conditions within these processes) which are used to extract and refine metals like iron (steel), copper, titanium, chromium, manganese, and aluminium. The aim is to enable you to analyse a current or proposed process with regards to feasibility, and to propose processing conditions (e.g. temperature, slag composition) which will achieve the required equilibrium state. This also applies to refractory systems, where the primary aim will be to evaluate whether a given refractory material is suitable for a given application, or the impact of certain impurities on the refractory material.

NSF 700 Froth flotation 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
Fundamentals of sulphide and coal flotation are covered, including the chemistry of sulphide mineral flotation; natural and induced hydrophobicity; physical and chemical interactions in coal flotation; review of sulphydryl and oxydryl collectors and their absorption mechanisms; the role of activators/depressants and pH regulators as well as an investigation of frothers and froth stability, with reference to recent industrial developments. Aspects of flotation practice are addressed: Experimental methods for laboratory and plant trials; basic and complex flotation circuits with examples from recent developments; control in flotation plants: reagents/conditioning. Finally, relevant interfacial surface chemistry is covered: the role of water in flotation; mechanisms and thermodynamics of collector activity.

NSW 700 Welding metallurgy 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module examines the basic physical metallurgy and heat treatment of various metals and alloys, and the application of various mechanical testing techniques, microstructural analysis and corrosion testing to characterise metals and alloys. The structure and properties of welds in carbon steels, stainless steels, cast irons, copper and copper alloys, nickel and nickel alloys, aluminium and aluminium alloys and other materials (Ti, Mg, Ta and Zr) are discussed. Defects are discussed and various techniques to avoid the formation of these defects in welds are considered.

NVM 700 Refractory materials 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
The objective is to convey a fundamental understanding of the principles that are involved in the manufacture, selection and use of refractories. Relevant thermodynamic principles are reviewed, with emphasis on the thermodynamic properties of oxide materials, metals

and slags, and how these affect refractory performance. Phase diagram use in refractory selection and prediction of slag-metal-refractory interactions is covered. A section on manufacture covers the types of raw materials, design and formulation, handling, manufacturing routes, and quality control (including practical mineralogy). Finally, design properties of refractories for the ferrous, cement, aluminium, copper, platinum and ferro-alloy industries are reviewed.

NWP 700 Welding processes 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module examines arc physics, electrotechnics as applied to weld power sources, and power source design. The fundamental principles, applications, consumables and process variables of various arc welding processes, oxy-gas welding techniques, resistance welding processes, power beam processes and solid-state welding techniques are considered. Brazing and soldering, cutting, surfacing and metal spraying techniques are discussed. The module also looks at the welding of plastics, ceramics and composites, and at the mechanisation and use of robotics in the welding and joining industries. Practical training is included in this module.

NWP 701 Design of welded structures 701
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
This module examines welded joint design, the basics of weld design and the role of fracture mechanics in joint design. The behaviour of welded structures under different types of loading are considered, with special focus on the design of welded structures with predominantly static loading and the design of dynamically loaded welded structures. The design of welded pressure equipment, aluminium alloy structures and reinforcing-steel welded joints is considered.

PFZ 780 Financial mine valuation 780
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PGT 780 Programming languages 780
Academic organisation: Computer Science
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 1

PHS 781 Slope stability 781
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PIN 780 Software engineering 780
Academic organisation: Computer Science
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 1

PIN 781 Advanced software engineering 781
Academic organisation: Computer Science
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 1

PKB 701 Basic environmental engineering 701
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Year
Language of tuition: English **Credits:** 16

PKB 711 Airflow and fans 711
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PKB 712 Heat and refrigeration 712
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

PMY 701 Underground mining methods 701
Academic organisation: Mining Engineering
Contact time: 10 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 32
Module content:
PMY 701 provides an overview of mining by covering the following subject matter: history of mining in South Africa, surface-mining methods, underground mining methods, and a brief overview of mine environmental control and mine strata control. Then the module covers general mine layouts, mine plan reading, mine surveying, electricity supply, transport systems, water management systems, and mine fires. Specific mining techniques. Shafts: Types, methods and equipment for sinking; economic considerations. Tunneling: Design, development techniques and equipment. Design and construction of large excavation. Design, construction, reinforcing and repair of ore passes. Fires in gold and coal mines: Causes, prevention, detection, combating and insurance. Flooding: Water sources, results, dangers, sealing and control.

PMY 703 Surface mining 703
Academic organisation: Mining Engineering
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

Module content:
Mining methods for open pits and strip mine operations. Basic mine planning, scheduling and economic cut-off limits with regards to waste stripping and ore grade. Continuous and discontinuous operations: Selection and management of truck-based loading and transport systems. Selection and management of conveyor-based loading and transport systems. Dragline selection, operation, management and strip mining practices. Slope stability in surface mines, plane, wedge and circular/non-circular failures.

PMZ 780 Advanced design: Mining 780
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

POY 783 Open-pit mining 783
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PRX 701 Explosives engineering 701
Academic organisation: Mining Engineering
Contact time: 10 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
History of explosives, types of explosives: primary and secondary explosives, thermodynamics of detonation, strength of explosives. Methods and techniques, explosive initiating systems, application of explosives in rock breaking; the effects of geology and drilling. Surface and underground blasting, controlled blasting, vibration control, air blast. Ethics and regulatory compliance. Equipment and calculations.

PRX 784 Rock breaking: Drilling and explosives 784
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: Afrikaans **Credits:** 16

PRX 785 Advanced explosives engineering 785
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module contents:
Types of commercial explosives. Properties of explosives. Explosive initiating systems, application of explosives in rock breaking; Surface and underground blast designs and specialised blast designs; the effects of geology on blast results. Fragmentation, blasting and environmental control. Blast assessment. Ethics and regulatory compliance. Safety in blasting.

PSS 700 Guided special studies 700
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Year
Language of tuition: English **Credits:** 32

PSZ 703 Basic rock mechanics 703
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Year
Language of tuition: English **Credits:** 16

PSZ 786 Strata control: Hard-rock mining 786
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

PSZ 787 Strata control: Hard-rock service excavations 787
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 1
Language of tuition: Afrikaans **Credits:** 16

PSZ 788 Strata control: Collieries 788
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PSZ 790 Rock support pillars 790
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

SGC 792 Civil engineering special 792
Academic organisation: Civil Engineering
Contact time: 20 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGC 793 Pavement design 793
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGC 794 Concrete technology 794
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGC 795 Geotechnical design special 795
Academic organisation: Civil Engineering
Contact time: 20 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGC 796 Stabilised materials and compaction 796
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 24

SGC 797 Road rehabilitation technology 797
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGC 798 Asphalt technology 798
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGM 784 Soil mechanics special 784
Academic organisation: Civil Engineering
Contact time: 20 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGM 785 Basic soil mechanics 785
Academic organisation: Civil Engineering
Contact time: 20 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGM 786 Basic pavement materials and design 786
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGS 780 Advanced geotechnical design 780
Academic organisation: Civil Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 8

SGS 785 Geotechnical laboratory testing 785
Academic organisation: Civil Engineering
Contact time: 20 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SGS 786 In situ soil testing and monitoring 786
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 791 Statistical methods 791
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 792 Flood hydrology 792
Academic organisation: Civil Engineering
Contact time: 26 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 793 Hydraulic design 793
Academic organisation: Civil Engineering
Contact time: 26 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 794 Free surface flow 794
Academic organisation: Civil Engineering
Contact time: 26 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 795 Pipe flow 795
Academic organisation: Civil Engineering
Contact time: 32 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 796 Water resource analysis and management 796
Academic organisation: Civil Engineering
Contact time: 26 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHC 797 Basic statistical methods 797
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHW 785 Pump systems 785
Academic organisation: Civil Engineering
Contact time: 10 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHW 786 Basic applied hydraulics 786
Academic organisation: Civil Engineering
Contact time: 24 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHW 787 Basic fundamental hydraulics 787
Academic organisation: Civil Engineering
Contact time: 24 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIC 790 Basic structural analysis 790
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIC 791 Basic steel structures 791
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIC 792 Basic concrete structures 792
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIN 776 Steel design 776
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIN 777 Structural mechanics 777
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIN 778 Reinforced concrete design 778
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIN 779 Timber design 779
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIN 790 Structural analysis 790
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SIN 791 Prestressed concrete design 791
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVC 780 Maintenance (Special) 780
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVC 789 Transportation planning 789
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVC 790 Transportation studies 790
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVC 791 Transportation (Special) 791
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVC 792 Traffic engineering 792
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVV 788 Multimodal transport 788
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVV 789 Basic transportation and traffic engineering 789
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

SVV 791 Geometric design and safety 791
Academic organisation: Civil Engineering
Contact time: 40 contact hours per semester
Period of presentation: Year
Language of tuition: English **Credits:** 24

WAI 780 Industrial waste engineering 780
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Identification of source materials, physical and chemical properties of waste. Release and transport mechanisms from source to air, groundwater, soil. Primary pathways of contaminants including sorption, volatilisation, biotic and abiotic transformations. Toxicology: absorption, distribution, biochemical transformation, and secretion of chemicals. Acute and chronic toxicity quantification and evaluation of risk. Hazard identification, exposure assessment, toxicity assessment and risk characterisation. Minimum requirements for the handling, classification and disposal of hazardous waste. Minimum requirements for waste disposal by landfill. Minimum requirements for water monitoring at waste management facilities. Recycling and resource management. Waste prevention, minimisation and optimisation.

WAI 787 Industrial waste engineering 787
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Identification of source materials, physical and chemical properties of waste. Release and transport mechanisms from source to air, groundwater, soil. Primary pathways of contaminants including sorption, volatilisation, biotic and abiotic transformations. Toxicology: absorption, distribution, biochemical transformation, and secretion of chemicals. Acute and chronic toxicity quantification and evaluation of risk. Hazard identification, exposure assessment, toxicity assessment and risk characterisation. Minimum requirements for the handling, classification and disposal of hazardous waste. Minimum requirements for waste disposal by landfill. Minimum requirements for water monitoring at waste management facilities. Recycling and resource management. Waste prevention, minimisation and optimisation.

WBW 780 Biological water treatment 780
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

WBW 787 Biological water treatment 787
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

WCW 780 Chemical water treatment 780
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

WCW 787 Chemical water treatment 787
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

WQB 780 Water quality management 780
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

XUW 710 Postgraduate course: Other universities 710
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

XUW 720 Postgraduate course: Other universities 720
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32

BIR 890 Dissertation: Industrial engineering 890
Academic organisation: Industrial and Systems Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

BIR 891 Dissertation 891
Academic organisation: Industrial and Systems Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

CIR 890 Dissertation: Chemical engineering 890
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

CVD 800 Dissertation 800
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

CVD 807 Dissertation 807
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

EER 891 Dissertation 891
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

EEY 890 Dissertation: Micro-electronic engineering 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

EIB 890 Dissertation: Bioengineering 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

EIN 890 Dissertation: Electronic engineering 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

EIR 890 Dissertation: Electrical engineering 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

EPR 890 Dissertation 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

ERI 890 Dissertation: Computer engineering 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

IAM 801 Asset management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IBD 804 Decision analysis 804
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IBI 801 Reliability engineering 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IGB 801 Engineering services management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IGB 802 Advanced enineering services management 802
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IGB 898 Mini-dissertation 898
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: English **Credits:** 64

IHR 801 Project human resource management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IIB 801 Maintenance management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IIX 801 Engineering logistics 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IKG 881 Technology commercialisation 881
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

IKK 801 Quality management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ILB 884 Information management 884
Academic organisation: Informatics
Contact time: 14 lpw 22 other per week 6 dpw 2 web-based periods per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ILC 803 Legal aspects of project management 803
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

ILE 802 Life cycle management of SHE 802
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IMP 801 Project management practice 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

INI 800 Reseach methodology 800
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IOB 801 Developmental management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8

IOE 801 New ventures and entrepreneurship 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IPF 802 Project financial and cost management 802
Academic organisation: Financial Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IPJ 801 Project procurement management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IPK 803 Project management 803
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IPM 801 Introduction to project management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IPP 801 Production and operations management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IQM 801 Project quality management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

IRI 801 Risk management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

IRM 801 Project risk management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ISC 898 Mini-dissertation 898
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: English **Credits:** 64

ISE 801 Systems engineering and management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ISE 802 Project systems engineering 802
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ISM 801 Strategic management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

ISM 802 Strategic management 802
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

ISM 804 Strategic project management 804
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

ISM 832 Condition-based maintenance 832
Academic organisation: Engineering and Technology Management
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

ITB 801 Technology management 801
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

ITB 890 Dissertation: Technology management 890
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

ITB 895 Dissertation 895
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: English **Credits:** 128

KBS 803 Construction management 803
Academic organisation: Engineering and Technology management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

KBS 804 Construction management 804
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

KBS 805 Construction management 805
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

MIR 890 Dissertation: Mechanical engineering 890
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

MIR 891 Dissertation 891
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

NIN 890 Dissertation 890
Academic organisation: Materials Science and Metallurgical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

NIN 891 Dissertation 891
Academic organisation: Materials Science and Metallurgical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

PYI 890 Dissertation 890
Academic organisation: Mining Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

PYI 891 Dissertation 891
Academic organisation: Mining Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

SGI 890 Dissertation 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

SHC 880 Computer applications for civil engineering 880
Academic organisation: Civil Engineering
Contact time: 30 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

SHC 885 Advanced hydraulics 885
Academic organisation: Civil Engineering
Contact time: 30 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32

SHC 886 Advanced hydrology 886
Academic organisation: Civil Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32

SIN 886 Advanced structural design 886
Academic organisation: Civil Engineering
Contact time: 30 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32

SIN 887 Advanced structural analysis 887
Academic organisation: Civil Engineering
Contact time: 30 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32

SIN 890 Dissertation: Structural engineering 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

SIN 896 Mini-dissertation 896
Academic organisation: Civil Engineering
Period of presentation: Semester 2
Language of tuition: English **Credits:** 64

SSC 890 Mini-dissertation 890
Academic organisation: Civil Engineering
Period of presentation: Semester 1
Language of tuition: English **Credits:** 64

SSC 898 Mini-dissertation: Transportation engineering 898
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 16

SSI 882 Guided special studies 882
Academic organisation: Civil Engineering
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32

SST 890 Dissertation 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

SST 896 Mini-dissertation 898
Academic organisation: Civil Engineering
Period of presentation: Semester 1
Language of tuition: English **Credits:** 64

SVI 890 Dissertation 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

SVI 896 Mini-dissertation 896
Academic organisation: Civil Engineering
Period of presentation: Semester 1
Language of tuition: English **Credits:** 64

SVV 882 Advanced transportation (I) 882
Academic organisation: Civil Engineering
Contact time: 30 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32

SVV 883 Advanced transportation (II) 883
Academic organisation: Civil Engineering
Contact time: 30 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32

WBK 890 Dissertation: Water resource engineering 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

BIR 990 Thesis: Industrial engineering 990
Academic organisation: Industrial and Systems Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

BIT 990 Thesis: Industrial systems 990
Academic organisation: Industrial and Systems Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

CCT 990 Thesis: Chemical technology 990
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 360

CET 990 Thesis: Environmental technology 990
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

CIR 990 Thesis: Chemical engineering 990
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

CIR 991 Thesis: Environmental engineering 991
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

EIC 990 Thesis: Biosystems 990
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

EIN 990 Thesis: Electronic engineering 990
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

EIR 990 Thesis: Electrical engineering 990
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

ERI 990 Thesis: Computer engineering 990
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 360

IGB 990 Thesis: Engineering management 990
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

IPK 990 Thesis: Project management 990
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

ITB 990 Thesis: Technology management 990
Academic organisation: Engineering and Technology Management
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MIN 990 Thesis: Metallurgical engineering 990
Academic organisation: Materials Science and Metallurgical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MIR 990 Thesis: Mechanical engineering 990
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MIR 998 Thesis: Mechanics 998
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MTG 990 Thesis: Metallurgy 990
Academic organisation: Materials Science and Metallurgical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MYI 990 Thesis: Mining engineering 990
Academic organisation: Mining Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MYL 990 Thesis: Mining 990
Academic organisation: Mining Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

SIR 990 Thesis: Civil engineering 990
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

VIN 990 Thesis: Transportation engineering 990
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

WBC 990 Thesis: Water utilisation 990
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

WBI 990 Thesis: Water utilisation engineering 990
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

Alphabetical list of modules offered by the Faculty of Law

BER 310 Business law 310
Academic organisation: Mercantile Law
Contact time: 4 lpw Yes
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to law. General principles of contract law. Specific contracts: purchase contracts, job contracting. Representative law. General aspects of business law. Dispute resolution – mediation and arbitration.

Alphabetical list of modules offered by the Faculty of Economic and Management Sciences

ABV 320 Labour relations 320
Academic organisation: Human Resource Management
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 20
Module content:
The theoretical basis of labour relations
In this section the basic concepts, historical context and theoretical approaches to the field of labour relations will be discussed. The institutional framework in which labour relations operates, will be addressed with particular emphasis on the structural mechanisms and institutional processes. The service relationship that forms the basis of labour relations practices, will also be analysed.
Labour relations practice
In this section students are taught the conceptual and practical skills related to practice aspects such as handling of grievances, disciplining, retrenchments, collective bargaining, industrial action and dispute resolution.

FBS 110 Financial management 110
Academic organisation: Financial Management
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 10
Module content:
Purpose and functioning of financial management. Basic financial management concepts. Accounting concepts and the use of the basic accounting equation to describe the financial position of a business. Recording of financial transactions. Relationship between cash and accounting profit. Internal control and the management of cash. Debtors and short-term investments. Stock valuation models. Depreciation. Financial statements of a business. Distinguishing characteristics of the different forms of businesses. Overview of financial markets and the role of financial institutions. Risk and return characteristics of various financial instruments. Issuing ordinary shares and debt instruments.

WST 111 Mathematical statistics 111
Academic organisation: Statistics
Prerequisite: At least 5 (60-69%) in Mathematics in the Grade 12 examination
Contact time: 1 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Characterisation of a set of measurements: Graphical and numerical methods. Random sampling. Probability theory. Discrete and continuous random variables. Probability distributions. Generating functions and moments.

Alphabetical list of modules offered by the Faculty of Natural and Agricultural Sciences

CHM 171 General chemistry 171
Academic organisation: Chemistry
Contact time: 1 dpw 1 ppw 1 web-based period per week 4 lpw Yes
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
General introduction to inorganic, analytical and physical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical reactions, redox reactions, solubilities and solutions, atomic structure, periodicity. Molecular structure and chemical bonding using the VSEPR model. Principles of reactivity, electrochemistry, energy and chemical reactions, entropy and free energy.
Appropriate tutorial classes and practicals.

CHM 172 General chemistry 172
Academic organisation: Chemistry
Contact time: 1 dpw 1 ppw 1 web-based period per week 4 lpw Yes
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
General introduction to inorganic, analytical and physical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical reactions, redox reactions, solubilities and solutions, atomic structure, periodicity. Molecular structure and chemical bonding using the VSEPR model. Principles of reactivity, electrochemistry, energy and chemical reactions, entropy and free energy.
Appropriate tutorial classes and practicals.

CHM 181 General chemistry 181
Academic organisation: Chemistry
Contact time: 1 dpw 1 ppw 1 web-based period per week 4 lpw Yes
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
General physical-analytical chemistry: Physical behaviour of gases, liquids and solids, intermolecular forces, solutions, chemical equilibrium, acids and bases, buffers, precipitation. Organic chemistry: Structure (bonding) and functional groups, nomenclature, isomerism, introductory stereo-chemistry, introduction to chemical reactions and chemical properties of organic compounds.
Appropriate tutorial classes and practicals.

CHM 215 Chemistry 215
Academic organisation: Chemistry
Prerequisite: CHM 171 or CHM 172 and CHM 181
Contact time: 1 dpw 1 ppw 1 web-based period per week 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Organic chemistry. Chemical properties of organic (including aromatic) compounds. Functional group transformation and synthesis. Physical chemistry. Colloid chemistry. Surface chemistry and processes at solid surfaces. PVT properties of real gases.

CHM 226 Chemistry 226
Academic organisation: Chemistry
Prerequisite: CHM 171 or CHM 172 and CHM 181
Contact time: 2 lpw 6 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 8
Module content:
Theory: Introduction to instrumental chemical analysis. Integration of electronic, chemical, optical and computer principles for the construction of analytical instrumentation. Detail discussion of principles and some instrumental methods from three disciplines within analytical chemistry, namely electrochemistry, spectroscopy and chromatography. This includes potentiometry, (AA) atomic absorption, (ICP) atomic emission, ultraviolet (UV), and infrared (IR) spectroscopy, potentiometric and photometric titrations, gas chromatography, liquid chromatography as well as combinations of these techniques. Practical: IR spectroscopy, UV spectroscopy, AA spectroscopy, potentiometric titration, gas chromatography.

FSK 116 Physics 116
Academic organisation: Physics
Prerequisite: WTW 114 # and refer to Regulation 1.2
Contact time: 1 dpw 1 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introductory mathematics: Symbols, exponents, logarithms, angles in degrees, radial measure, goniometry, differentiation, and integration. Motion along a straight line: position and displacement, acceleration. Vectors: adding vectors, components, multiplying vectors. Motion in two and three dimensions: projectile motion, circular motion. Force and motion: Newton's Law, force, friction. Kinetic energy and work: work, power. Potential energy: Centre of mass, linear momentum. Collisions: impulse and linear momentum, elastic collisions, inelastic collisions. Rotation: kinetic energy of rotation, torque. Oscillations and waves: Simple harmonic motion, types of waves, wavelength and frequency, interference of waves, standing waves, the Doppler effect. Temperature, heat and the first law of thermodynamics.

FSK 176 Physics 176
Academic organisation: Physics
Contact time: 1 dpw 1 ppw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introductory mathematics: Symbols, exponents, logarithms, angles in degrees, radial measure, goniometry, differentiation, and integration. Motion along a straight line: position and displacement, acceleration. Vectors: adding vectors, components, multiplying vectors. Motion in two and three dimensions: projectile motion, circular motion. Force and motion: Newton's Law, force, friction. Kinetic energy and work: work, power. Potential energy: Centre of mass, linear momentum. Collisions: impulse and linear momentum, elastic collisions, inelastic collisions. Rotation: kinetic energy of rotation, torque. Oscillations and waves: Simple harmonic motion, types of waves, wavelength and frequency, interference of waves, standing waves, the Doppler effect. Temperature, heat and the first law of thermodynamics.

GLY 155 Introduction to geology 155
Academic organisation: Geology
Prerequisite: Refer to Regulation 1.2
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Solar system; structure of solid matter; minerals and rocks; introduction to symmetry and crystallography; important minerals and solid solutions; rock cycle; classification of rocks. External geological processes (gravity, water, wind, sea, ice) and their products (including geomorphology). Internal structure of the earth. The dynamic earth – volcanism, earthquakes, mountain building – the theory of plate tectonics. Geological processes (magmatism, metamorphism, sedimentology, structural geology) in a plate tectonic context. Geological maps and mineral and rock specimens.

GLY 161 Historical geology 161
Academic organisation: Geology
Prerequisite: GLY 151 GS and GLY 152 GS
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 8
Module content:
Principles of stratigraphy and stratigraphic nomenclature; geological dating and international and South African time scales; Africa framework and tectonic elements of South Africa; introduction to depositional environments. Overview of the historical geology of South Africa, from the Archaean to the present: major stratigraphic units, intrusions and tectonicmetamorphic events - their rock types, fossil contents, genesis and economic commodities. Principles of palaeontology and short description of major fossil groups: fossil forms, ecology and geological meaning. Geological maps and profiles; rock samples.

GLY 254 Structural geology 254
Academic organisation: Geology
Prerequisite: CMY117, GLY 155 and 1 of GLY161, GLY162 and WTW114/WTW158 or PHY114/PHY114
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 12
Module content:
Integrated theoretical and practical course dealing with the principles of rock deformation and analysis of deformed rocks. Stress, strain and rheology, joints, experimental rock deformation, fault systems and Anderson's theory of faulting. Folds and interference folding, tectonic fabrics, shear zones, progressive deformation. Stereographic projection and structural analysis.

GLY 361 Ore deposits 361
Academic organisation: Geology
Prerequisite: Five of the second year modules: GLY253, GLY254, GLY255, GLY261, GLY262, GLY265
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 18
Module content:
Systematic review of major metallic and non-metallic ore types and examples in South Africa and world-wide; ore type models (grades, tonnages); geometry of ore bodies; mining. Ore samples and ore mineralogy. Mapping techniques.

SUR 210 Surveying 210
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 4 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and levelling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

SUR 220 Surveying 220
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 16
Module content:
Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and leveling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

WTW 158 Calculus 158
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 tpw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 158, WTW 114, WTW 134.
Introduction to vector algebra. Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, applications. The mean value theorem, the rule of L'Hospital. Indefinite integrals, integration.

WTW 161 Linear algebra 161
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 161, WTW 126.
Vector algebra with applications, matrix algebra, systems of linear equations, the vector space Rn, bases, determinants. Mathematical induction. Complex numbers and factorisation of polynomials. Conic sections. This module also includes a formal technique mastering programme.

WTW 168 Calculus 168
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 GS or WTW 158 GS
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 168, WTW 128, WTW 138.
Integration techniques, improper integrals. The definite integral, fundamental theorem of Calculus. Applications of integration. Elementary power series and Taylor's theorem. Vector functions, space curves and arc lengths. Quadratic surfaces and multivariable functions.

WTW 238 Mathematics 238
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 256 and WTW 258 GS
Contact time: 2 tpw 4 lpw Yes
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Linear algebra, eigenvalues and eigenvectors with applications to first and second order systems of differential equations. Sequences and series, convergence tests. Power series with applications to ordinary differential equations with variable coefficients. Fourier series with applications to partial differential equations such as potential, heat and wave equations.

WTW 256 Differential equations 256
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 158, WTW 161 and WTW 168
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Theory and solution methods for linear differential equations as well as for systems of linear differential equations. Theory and solution methods for first order non-linear differential equations. The Laplace transform with application to differential equations. Application of differential equations to modelling problems.

WTW 258 Calculus 258
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 158 and WTW 168
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Calculus of multivariable functions, directional derivatives. Extrema. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green. Surface integrals and the theorems of Gauss and Stokes.

WTW 263 Numerical methods 263
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 161 and WTW 168
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Numerical integration. Numerical methods to approximate the solution of non-linear equations, systems of equations (linear and non-linear), differential equations and systems of differential equations. Direct methods to solve linear systems of equations.

Alphabetical list of modules offered by the Faculty of Humanities

HAS 110 Humanities and social sciences 110
Academic organisation: Faculty of Humanities
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Social Sciences: Perspectives on contemporary society
An introduction to long-standing questions about the nature of human societies and contemporary challenges. Topics to be discussed include globalisation and increasing connectedness; rising unemployment, inequality and poverty; rapid urbanisation and the modern city form; transformations in the nature of work; environmental degradation and tensions between sustainability and growth; shifts in global power relations; the future of the nation-state and supra-national governance structures; and possibilities for extending human rights and democracy. Critical questions are posed about modern selfhood, sociality, culture and identity against the background of new communications technologies, ever more multicultural societies, enduring gender, class and race inequities, and the emergence of new and the resurgence of older forms of social and political identity. These issues are approached from the vantage of our location in southern Africa and the continent, drawing on social science perspectives.

HAS 120 Humanities and social sciences 120
Academic organisation: Faculty of Humanities
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Humanities: Text, culture and communication
Successful communication of ideas, values and traditions depends on understanding both the literal and implied meanings of texts. In this module students are introduced to a variety of texts, including original literary and visual texts, with a view to developing an understanding of how textual meanings have been constructed and negotiated over time. Students are encouraged to understand themselves as products of – and participants in – these traditions, ideas and values. Appropriate examples will be drawn from, among others, the Enlightenment, Modernism, Existentialism, Postmodernism and Post-colonialism.

E&OE