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)

SCHOOL FOR THE BUILT ENVIRONMENT
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SCHOOL OF ENGINEERING

ACADEMIC PERSONNEL AS AT 30 SEPTEMBER 2013

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Jones, E.....Head: Student Administration

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 2014.

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 Director: Student Affairs.

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.

Leave of absence
If it is impossible for a registered student at the University of Pretoria to continue with his/her studies/research in a specific year, but he/she intends to continue in the following year, the student must apply in writing to the Dean of the relevant faculty for **leave of absence**. The application must include: full names, student number, address, reasons and period for leave of absence, for example the whole year, first semester (January to June) or second semester (July to December), name of supervisor (where applicable), and the student's intentions for the period after his/her leave of absence. However, in accordance with the policy of the University of Pretoria, leave of absence is not granted for more than two years. Any outstanding fees should be paid in full upon the student's return from his/her leave of absence.

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.11.

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. 13.1 and 13.2. 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 ENGAGE 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 (ENGAGE 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 information 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 under-graduate 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
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 sub minima in examination papers, time of supplementary examinations, etc.

Eng. 6
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. 7
Minimum study period
The minimum period of study for the degree is four years of full-time study.

Eng. 8
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 Introduction to Laboratory Measurements and Computer Simulations' 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. 9
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. 10

10.1 Pass with distinction

(a) A student graduates with distinction if:
   (i) no module of the third or fourth year of study of the four year programme or of the fourth or fifth year of the ENGAGE programme 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 for the four year programme and within the prescribed five years of the ENGAGE programme.

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

10.2 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, 2014. 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. 11

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. 12
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. 13.1 and 13.2 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. 13
Curricula

Eng. 13.1 Four-year Programmes
Please note:
The requirements for promotion from the one year of study to the next are given in **Eng. 14, Eng. 15** and **Eng. 16.**

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

Second semester

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

Recess training

WWP 121	Workshop practice 121	6

Second year of study
First semester

Module		Credits	Prerequisites
CHM 215	Chemistry 215	16	CHM 171/172, 181
CIR 211	Chemical engineering 211	8	CIR 123
CJJ 210	Professional and technical communication 210	8	CIR 123
JCP 203	Community-based project 203	8	
MPR 213	Programming and information technology 213	18	

SWK 210	Strength of materials 210	16	SWK122, WTW168/WTW 128
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
WTW 258	Calculus 258	8	WTW 158,168
	Total	**90**	

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
WTW 263	Numerical methods 263	8	WTW 161,168
	Total	**72**	

Third year of study
First semester

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

Note:

- Students who have not passed CIR 412 before 2012, have to register for CPA 310.

Second semester

CIO 320	Chemical engineering design 320	16	(CTD 223), (COP 311)
CKN 321	Kinetics 321	16	(CTD 223)
CLB 321	Laboratory 321	16	CJJ 210, CHM 226, CPN 321#, CKN 321# (CMO 320/310), CIO 310/320#
CPN 321	Process dynamics 321	16	CIO 310/320#, CKN 321#
MIA 320	Impact of engineering activity and group work 320	8	
	Total	**72**	

Recess training

CPY 311	Practical training 311	16	(CJJ 210), (CIR 211)

Fourth year of study
First semester

Module		Credits	Prerequisites
CBI 410	Biotechnology 410	16	(CKN 321), (CMO 320/310), (CPA 310)
CPB 410	Process control 410	16	(CPN 321 GS)
CPS 410	Process synthesis 410	8	CLB 321, CIR 310GS
CRO 410	Reactor design 410	16	(CKN 321 GS)
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.

Second semester

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

Recess training

CPY 411	Practical training 411	16	(CMO 320/310), CPY 311

(b) Civil Engineering

First year of study
First semester

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

Second semester

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

Recess training

SWP 121	Workshop practice 121	6	

Second year of study
First semester

Module		Credits	Prerequisites
JCP 203	Community-based project 203	8	
SGM 210	Geomaterials and processes 210	16	
SJJ 210	Professional and technical communication 210	8	
SWK 210	Strength of materials 210	16	SWK122, WTW168
SWK 211	Statics 211	16	SWK 122
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
WTW 258	Calculus 258	8	WTW 158,168
	Total	**80**	

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
WTW 263	Numerical methods 263	8	WTW 161,168
	Total	**72**	

Third year of study
First semester

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

Second semester

SBM 321	Civil building materials 321	16	
SGM 323	Geotechnical engineering 323	16	(SGM 311)
SHC 321	Hydraulics 321	16	(SHC 310)
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
	Total	**80**	

Fourth year of study
First semester

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

Second semester

SBZ 420	Civil engineering construction management 420	16	(SVC 412)
SCA 420	Computer applications in civil engineering 420	16	(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)
SEV 421	Environmental geotechnology 421	16	
	Total	**72**	

Recess training

SPY 410	Practical training 410	16	

(c) Computer Engineering

First year of study
First semester

Module		Credits	Prerequisites
COS 131	Introduction to programming 131	16	
EBN 111	Electricity and electronics 111	16	
FSK 116	Physics 116	16	
HAS 110	Humanities and social sciences 110	8	
WTW 158	Calculus 158	16	
	Total	**72**	

Second semester

COS 110	Program design: Introduction 110	16	COS 130/COS 131/COS 132
COS 222	Operating systems 222	16	COS 153 or COS 131 or COS 132
HAS 120	Humanities and social sciences 120	8	
SWK 122	Mechanics 122	16	WTW 158
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	Total	**72**	

Recess training

EIW 121	Information technology practice 121	8
EMR 101	Introduction to laboratory measurements and computer simulations 101	4

Second year of study

First semester

Module		**Credits**	**Prerequisites**
COS 212	Data structures and algorithms 212	16	COS 110
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
EJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
NMC 113	Materials science 113	16	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential equations 256	8	WTW 158, WTW 161,168
	Total	**80**	

Second semester

BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211 GS/EIR 221 GS
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
	Total	**64**	

Recess training

EIW 221	Information technology practice 221	8

Third year of study

First semester

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

Second semester

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

Recess training

EIW 320	Information technology practice 320	8	EIW 221

Fourth year of study
First semester

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

Second semester

EPR 402	Project 402	48	ERD 320 Finalists only
ERP 420	Specialisation 420	16	
	Total	64	

Recess training

EPY 423	Practical training and report 423	16	

(d) Electrical Engineering

First year of study
First semester

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

Second semester

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

Recess training

EMR 101	Introduction to laboratory measurements and computer simulations 101	4	

Second year of study
First semester

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

Second semester

BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211 GS/EIR 221 GS
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
	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	
ELX 311	Electrical machines 311	16	EIR 211
EMK 310	Microprocessors 310	16	ERS 220 GS, EIR 211/221GS
EMZ 310	Electromagnetism 310	16	WTW 238 GS, WTW 263 GS, EIR 211 GS/EIR 221 GS
ENE 310	Analogue electronics 310	16	ELI 220 GS
	Total	**72**	

Second semester

EBB 320	Control systems 320	16	ELI 220 GS
EDF 320	Power electronics 320	16	ELX 311, ELI 220 GS
EKK 320	Power system components 320	16	EIR 211
EWE 320	Electrical engineering design 320	16	EIR 211/221 GS
MIA 320	Impact of engineering activity and group work 320	8	
	Total	**72**	

Recess training

ESP 300	DSP programming 300	4	EPW 200

Fourth year of study
First semester

Module		Credits	Prerequisites
EAD 410	Electrical drives 410	16	ELX 311 GS, EDF 320 GS
EBT 410	Automation 410	16	EBB 320 GS
EKK 410	Power system analysis 410	16	EKK 320
EPR 400	Project 400	16	EWE 320/ELO 320 Finalists only
IPI 410	Engineering professionalism 410	8	
	Total	**72**	

Second semester

ENR 420	Energy 420	16	
EPR 400	Project 400	48	EWE 320/ELO 320 Finalists only
	Total	**64**	

Recess training

EPY 423	Practical training and report 423	16	

(e) Electronic Engineering

First year of study
First semester

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

Second semester

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

Recess training

EMR 101	Introduction to laboratory measurements and computer simulations 101	4	

Second year of study
First semester

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

Second semester

BES 220	Engineering statistics 220	8	
ELI 220	Linear systems 220	16	EIR 211 GS/EIR 221 GS
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
	Total	**64**	

Third year of study
First semester

Module		Credits	Prerequisites
BSS 310	Engineering management 310	8	
EMK 310	Microprocessors 310	16	ERS 220GS, EIR 211/221GS
EMS 310	Modulation systems 310	16	ELI 220
EMZ 310	Electromagnetism 310	16	WTW 238 GS, WTW 263 GS, EIR 211 GS/EIR 221 GS
ENE 310	Analogue electronics 310	16	ELI 220 GS
	Total	**72**	

Second semester

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

Fourth year of study
First semester

Module		Credits	Prerequisites
EBT 410	Automation 410	16	EBB 320 GS
ENE 410	Advanced electronics 410	16	ENE 310 GS
EPR 400	Project 400	16	EWE 320/ELO 320 Finalists only
ESP 411	DSP: programming and application 411	16	ESC 320 GS or EDC 310 GS
IPI 410	Engineering professionalism 410	8	
	Total	**72**	

Second semester

EES 424	Specialisation 424	16	ERS 220
EPR 400	Project 400	48	EWE 320/ELO 320 Finalists only
	Total	**64**	

Recess training

EPY 423	Practical training and report 423	16

(f) Industrial Engineering

First year of study
First semester

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

Second semester

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

Recess training

WWP 121	Workshop practice 121	6

Second year of study
First semester

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

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
WTW 263	Numerical methods 263	8	WTW 161,168
	Total	**64**	

Third year of study
First semester

Module		Credits	Prerequisites
BAN 313	Industrial analysis 313	8	
BER 310	Business law 310	16	
BOB 310	Operational management 310	16	
BOZ 312	Operations research 312	16	
BSS 310	Engineering management 310	8	
FBS 110	Financial management 110	10	
MVS 311	Manufacturing systems 311	16	
	Total	**90**	

Second semester

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

Recess training

BPY 310	Practical training 310	16

Fourth year of study
First semester

Module		Credits	Prerequisites
BGC 410	Quality assurance 410	16	
BON 410	Operations research 410	16	(BES 220), (BOZ 312)
BPJ 410	Project 410	16	Finalists only
BSR 410	Management accounting 410	16	(FBS 110)
IPI 410	Engineering professionalism 410	8	
	Total	**72**	

Second semester

ABV 320	Labour relations 320	8	
BIE 420	Engineering economics	8	
BPJ 420	Project 420	24	BPJ 410
BPZ 421	Business engineering 421	16	Finalists only
BSS 410	Systems engineering 410	16	
	Total	**72**	

Recess training

BPY 410	Practical training 410	16

(g) Mechanical Engineering

First year of study
First semester

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

Second semester

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

Recess training

WWP 121	Workshop practice 121	6

Second year of study
First semester

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

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 258 GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
	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
MSY 310	Structural mechanics 310	16	MOW 217, WTW 256
MTV 310	Thermoflow 310	16	
MTX 311	Thermodynamics 311	16	MTX 221
	Total	**72**	

Second semester

EIR 221	Electrical engineering 221	16	EBN 111/122, WTW 161
MIA 320	Impact of engineering activity and group work 320	8	
MKM 321	Continuum and computational structural mechanics 321	16	(MSY 310)
MOW 323	Machine design 323	16	(MOW 312)
MVR 320	Vibrations and noise 320	16	(MSD 210)
	Total	**72**	

Recess training

MPY 315	Practical training 315	16

Fourth year of study
First semester

Option – Mechanical and Aeronautical

Module		Credits	Prerequisites
IPI 410	Engineering professionalism 410	8	
MKM 411	Computational fluid dynamics 411	16	MTV 310
MOX 410	Design project 410	16	MOW 312GS, MOW 323GS
MSC 412	Research project 412	16	Finalists only
MTV 410	Thermoflow 410	16	
	Total	**72**	

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

Second semester
Option – Mechanical

MBB 410	Control systems 410	16	MVR 320 GS
MSC 422	Research project 422	24	Finalists only, MSC 412
MTV 420	Thermal and fluid machines 420	16	MTV 310, (MTX 311)
	One elective from the following:		
MAN 420	Porous flow 420	16	
MEG 421	Mechatronics 421	16	
MHM 420	Heat and mass transfer 420	16	
MII 420	Maintenance engineering 420	16	
MKI 420	Nuclear engineering 420	16	
MLV 420	Aeronautics 420	16	MTV 310
MOO 420	Optimum design 420	16	
MUU 420	Fossil fuel power stations 420	16	
MVE 420	Vehicle engineering 420	16	
MWN 420	Numerical methods 420	16	

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

	Total	**72**

or

Option – Aeronautical

MBB 410	Control systems 410	16	MVR 320 GS
MSC 422	Research project 422	24	Finalists only, MSC 412
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	**72**

Recess Training

MPY 415	Practical training 415	16

(h) Metallurgical Engineering

First year of study
First semester

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

Second semester

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

Recess training

WWP 121	Workshop practice 121	6	

Second year of study
First semester

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

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 258GS, 256
WTW 263	Numerical methods 263	8	WTW 161,168
	Total	**80**	

Third year of study
First semester

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

Second semester

MIA 320	Impact of engineering activity and group work 320	8	
NEX 320	Excursions 320	8	(NMP 310)
NHM 322	Hydrometallurgy 322	16	(NPT 220), (NEC 310)
NMM 320	Mechanical metallurgy 320	16	(NMC 223)
NPM 321	Pyrometallurgy 321	16	(NPT 220)
NVM 321	Refractory materials 321	8	(NPT 220), NPM 321#
	Total	**72**	

Recess training

NPY 316	Practical training 316	16	

Fourth year of study
First semester

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

Second semester

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

Recess training

NPY 416	Practical training 416	16	

(i) Mining Engineering

First year of study
First semester

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

Second semester

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

Recess training

PWP 121	Workshop practice 121	8	

Second year of study
First semester

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

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
WTW 263	Numerical methods 263	8	WTW 161,168
	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	
GLY 155	Introduction to geology 155	16	
MTV 310	Thermoflow 310	16	
NMP 310	Minerals processing 310	16	
PMY 311	Surface mining and geotechnics 311	16	
	Total	**72**	

Second semester

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

Recess training

PPY 320	Experiential training 320	16

Fourth year of study

First semester

Module		**Credits**	**Prerequisites**
GLY 254	Structural geology 254	12	GLY 151, GLY 152 or GLY 155
IPI 410	Engineering professionalism 410	8	
PEE 410	Mine environmental control engineering 410	16	MTV 310, Finalists only
PMY 410	Mining 410	16	PMY 320, Finalists only
PMY 423	Mine risk management – Health and safety 423	8	Finalists only
PNB 400	Industrial excursions 400	8	PNB 300, Finalists only
PSZ 410	Strata control 410	16	SWK 210, PMY 320, Finalists only
	Total	**84**	

Second semester

GLY 361	Ore deposits 361	18	GLY 254
PMZ 422	Mine design 422	42	PMY 410, PSZ 410, PEE 410, PNB 400, Finalists only
PNB 400	Industrial excursions 400	8	PNB 300, Finalists only
PSC 411	Project 411	10	PSC 321 Finalists only
	Total	78	

Recess training

PPY 418	Practical training 418	16

Eng. 13.2 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. 14, Eng. 15** and **Eng. 16**.

(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. 13.1.**

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

Second semester

FSK 176	Physics 176	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 122	Additional physics 122	8	
JPO 126	Additional mathematics 2 126	8	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JCP 203	Community-based project 203	8	
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
MGC 110	Graphical communication 110	16	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**72**	

Second semester

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

Third year of study
First semester

Module		Credits	Prerequisites
CHM 215	Chemistry 215	16	CHM 171/172, 181
CIR 211	Chemical engineering 211	8	CIR 123
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	SWK122, WTW168
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
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 111	Additional chemistry 1 111	8	
JPO 116	Additional mathematics 1 116	8	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

FSK 176	Physics 176	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 122	Additional physics 122	8	
JPO 126	Additional mathematics 2 126	8	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JCP 203	Community-based project 203	8	
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
MGC 110	Graphical communication 110	16	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**64**	

Second semester

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

Third year of study
First semester

Module		Credits	Prerequisites
SJJ 210	Professional and technical communication 210	8	
SGM 210	Geomaterials and processes 210	16	
SWK 210	Strength of materials 210	16	SWK122, WTW168
SWK 211	Statics 211	16	SWK 122
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
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	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 125	Additional mechanics 125	8	
JPO 126	Additional mathematics 2 126	8	
SWK 122	Mechanics 122	16	WTW 158
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JPO 112	Additional electricity and electronics 112	8	
JPO 114	Additional programming 1 114	8	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**56**	

Second semester

COS 110	Programme design: Introduction 110	16	COS 130/COS 131/COS 132
JPO 123	Additional materials science 123	8	
JPO 124	Additional programming 124	8	
NMC 123	Materials science 123	16	
WTW 263	Numerical methods 263	8	WTW161, 168
	Total	**56**	

Recess training

EIW 221	Information technology practice 221	8
EMR 101	Introduction to laboratory measurements and computer simulations 101	4

Third year of study
First semester

Module		Credits	Prerequisites
COS 212	Data structures and algorithms 212	16	COS 110
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
EJJ 210	Professional and technical communication 210	8	
JCP 203	Community-based project 203	8	
WTW 256	Differential equations 256	8	WTW 158, 161, 168
	Total	**56**	

Second semester

BES 220	Engineering statistics 220	8	
COS 222	Operating systems 222	16	COS 130/ COS 131/ COS 132
ELI 220	Linear systems 220	16	EIR 211 GS/EIR 221 GS
ERS 220	Digital systems 220	16	
WTW 238	Mathematics 238	16	WTW 258 GS, 256
	Total	**72**	

Recess training

EIW 320	Information technology practice 320	8	EIW 221

(d) Electrical Engineering

First year of study
First semester

Module		Credits	Prerequisites
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	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

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	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	Total	**64**	

Second year of study
First semester

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

Second semester

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

Recess training

EMR 101	Introduction to laboratory measurements and computer simulations 101	4
EPW 200	Practical wiring 200	4

Third year of study
First semester

Module		Credits	Prerequisites
COS 131	Introduction to programming 131	16	
EIR 211	Electrical engineering 211	16	EBN 111/122, WTW 161
EJJ 210	Professional and technical communication 210	8	
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 GS/EIR 221 GS
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
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	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

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	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	Total	**64**	

Second year of study
First semester

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

Second semester

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

Recess training

EMR 101	Introduction to laboratory measurements and computer simulations 101	4

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 GS/EIR 221 GS
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
CHM 171	General chemistry 171	16	
HAS 110	Humanities and social sciences 110	8	
JPO 110	Professional orientation 110	8	
JPO 111	Additional chemistry 1 111	8	
JPO 116	Additional mathematics 1 116	8	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

FSK 176	Physics 176	16	
HAS 120	Humanities and social sciences 120	8	
JPO 120	Professional orientation 120	8	JPO 110
JPO 122	Additional physics 122	8	
JPO 126	Additional mathematics 2 126	8	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JCP 203	Community-based project 203	8	
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
MGC 110	Graphical communication 110	16	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**64**	

Second semester

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

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
MPR 213	Programming and information technology 213	18	
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
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
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	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

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	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JCP 203	Community-based project 203	8	
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
MGC 110	Graphical communication 110	16	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**64**	

Second semester

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

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
MPR 213	Programming and information technology 213	18	
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
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
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	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

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	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JCP 203	Community-based project 203	8	
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
MGC 110	Graphical communication 110	16	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**64**	

Second semester

JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW161, 168
	Total	**56**	

Third year of study
First semester

Module		Credits	Prerequisites
GMI 210	Mineralogy 210	16	
MPR 213	Programming and information technology 213	18	
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
NJJ 210	Professional and technical communication 210	8	
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
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	
WTW 158	Calculus 158	16	
	Total	**64**	

Second semester

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	
WTW 161	Linear algebra 161	8	
WTW 168	Calculus 168	8	WTW 158 GS
	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	
JCP 203	Community-based project 203	8	
JPO 112	Additional electricity and electronics 112	8	
JPO 113	Additional graphical communication 113	8	
MGC 110	Graphical communication 110	16	
WTW 258	Calculus 258	8	WTW 158, 168
	Total	**64**	

Second semester

JPO 123	Additional materials science 123	8	
JPO 125	Additional mechanics 125	8	
NMC 123	Materials science 123	16	
SWK 122	Mechanics 122	16	WTW 158
WTW 263	Numerical methods 263	8	WTW161, 168
	Total	**56**	

Third year of study
First semester

Module		Credits	Prerequisites
MPR 213	Programming and information technology 213	18	
MSD 210	Dynamics 210	16	SWK 122, FSK 116/176, WTW 256#
PJJ 210	Professional and technical communication 210	8	
SWK 210	Strength of materials 210	16	SWK122, WTW168
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. 14
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 only 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. 14.(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 enroll 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. 15

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 enroll 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. 16

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. 17

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. 18

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		
(iii)	Computer Engineering	12250211	ERI 890		
(iv)	Control Engineering	12250231	CVD 800		
(v)	Electrical Engineering	12250031	EIR 890		
(vi)	Electronic Engineering	12250091	EIN 890		
(vii)	Engineering Management			12250172	IGB 898
(viii)	Environmental Engineering	12250221	CVD 800		
(ix)	Geotechnical Engineering	12250212	SGI 890		
(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			12250262	IGB 898
(xvii)	Structural Engineering	12250121	SIN 890		
(xviii)	Technology Management	12250251	ITB 890	12250252	IGB 898
(xix)	Transportation Engineering	12250111	SVI 890		
(xx)	Water Utilisation Engineering	12250101	CVD 800		
(xxi)	Water Resources Engineering	12250161	WBK 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. 17 (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. 19

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)

Module	Code	Credits
Bioprocessing 732	CBP 732	32
Fluoro-materials science and technology 732	CFT 732	32
Process integration 732	CIP 732	32
Chemical engineering 702	CIR 702	32
Carbon materials science and technology 732	CMS 732	32
Product design 732	CPO 732	32

Polymer processing 732	CPP 732	32
Polymer materials science 732	CPW 732	32
Bio-reaction engineering 732	CRH 732	32
Research Orientation 700	CRO 700	32
Separation technology 732	CSK 732	32
Additive technology 732	CYM 732	32

BEngHons (Control Engineering)(12240231)

Module	**Code**	**Credits**
Multivariable control system design 700	CBO 700	32
Multivariable control system theory 700	CBT 700	32
Model-based control laboratory 732	CML 732	32
Process control system development 732	CSP 732	32

BEngHons (Environmental Engineering)(12240221)

Module	**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:		
Process integration 732	CIP 732	32
Separation technology 732	CSK 732	32
Industrial waste engineering 780	WAI 780	32

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

Module	**Code**	**Credits**
Dissertation 800	CVD 800	128

(b) CIVIL ENGINEERING

Students who have obtained an engineering degree or equivalent may apply for admission to these BEngHons post-graduate programmes.

BEngHons (Water Resources Engineering)(12240161)

At least 128 credits from the following:

Module	**Code**	**Credits**
At least 72 credits from the following:		
Flood hydrology 792	SHC 792	24
Free surface flow 794	SHC 794	24
Pipe flow 795	SHC 795	24
Pump systems 785	SHW 785	24
and		

the remainder of the credits from the following:		
Concrete technology 794	SGC 794	24
Hydraulic design 793	SHC 793	24
Water resource analysis and management 796	SHC 796	24
Applied statistical methods and optimization 798	SHC 798	24
Numerical methods for Civil Engineers 780	SIK 780	24
Finite element applications in Civil Engineering 780	SIR 780	24
Infrastructure management 790	SSI 790	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
Industrial waste engineering 780	WAI 780	32
Biological water treatment 780	WBW 780	32
Chemical water treatment 780	WCW 780	32
Water quality management 780	WQB 780	32

BEngHons (Geotechnical Engineering)(12240212)

At least 128 credits from the following:

Core modules:	**Code**	**Credits**
Analytical soil mechanics 787	SGS 787	24
Theoretical soil mechanics 788	SGS 788	24
Specialised geotechnical testing 789	SGS 789	24
Electives:		
Engineering geology 703	IGL 703	16
Engineering geology 704	IGL 704	16
Applied statistical methods and optimization 798	SHC 798	24
Numerical methods for Civil Engineers 780	SIK 780	24
Finite element applications in Civil Engineering 780	SIR 780	24

BEngHons (Structural Engineering)(12240121)

At least 128 credits from the following:

Module	**Code**	**Credits**
At least 96 credits from the following:		
Concrete technology 794	SGC 794	24
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:		
Applied statistical methods and optimization 798	SHC 798	24
Numerical methods for Civil Engineers 780	SIK 780	24
Finite element applications in Civil Engineering 780	SIR 780	24
Infrastructure management 790	SSI 790	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:

Core modules:	**Code**	**Credits**
Applied statistical methods and optimization 798	SHC 798	24
Electives:		
Pavement design 793	SGC 793	24
Concrete technology 794	SGC 794	24
Road rehabilitation technology 797	SGC 797	24
Numerical methods for Civil Engineers 780	SIK 780	24
Finite element applications in Civil Engineering 780	SIR 780	24
Infrastructure management 790	SSI 790	24
Transportation planning 789	SVC 789	24
Transportation studies 790	SVC 790	24
Transportation special 791	SVC 791	24
Traffic engineering 792	SVC 792	24
Multimodal transport 788	SVV 788	24
Geometric design and safety 791	SVV 791	24

MEng (Water Resources Engineering)(12250161)

Module	**Code**	**Credits**
Dissertation 890	WBK 890	128

MEng (Geotechnical Engineering)(12250212)

Module	**Code**	**Credits**
Dissertation 890	SGI 890	128

MEng (Structural Engineering)(12250121)

Module	**Code**	**Credits**
Dissertation 890	SIN 890	128

MEng (Transportation Engineering)(12250111)

Module	**Code**	**Credits**
Dissertation 890	SVI 890	128

(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.

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

Module	Code	Credits
Advanced classical optics 732	EAD 732	32
Intelligent Systems 732	EAI 732	32
Advanced Topics in Intelligent Systems	EAI 733	32
Optimal control 780	EBO 780	32
Cellular wireless telephony 710	ECW 710	32
Electro optics 732	EEO 732	32
Interferometry 716	EFR 716	16
Introduction to research 732	EIN 732	32
Electronic warfare 780	ELB 780	32
Solid-state lighting	ELV 732	32
Antenna theory 780	EMA 780	32
Multivariable control systems 732	EMB 732	32
Microwave theory 780	EMM 780	32
Optical design 732	EOD 732	32
Detection and estimation 732	EOP 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32
Introductory radiometry and photometry 716	ERD 716	16
Electro-optical systems design 732	ESD 732	32
Digital radio techniques 732	ESR 732	32
Adaptive systems 732	ETA 732	32
Digital communications 732	ETD 732	32
Coding theory 732	ETK 732	32
Topics in photonics 732	ETP 732	32
Mobile communications 732	ETR 732	32
Telecommunication systems engineering 732	ETT 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.

Module	Code	Credits
Intelligent Systems 732	EAI 732	32
Advanced Topics in Intelligent Systems	EAI 733	32
Introduction to research 732	EIN 732	32
Wireless sensor networks 732	EKS 732	32
Electronic warfare 780	ELB 780	32
Solid-state lighting	ELV 732	32
Detection and estimation 732	EOP 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32
New generation networks 732	ERC 732	32
Computer networks 780	ERN 780	32
Information security 780	ETH 780	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 enroll for a master's or a PhD in Bioengineering.

Module	Code	Credits
Biosignals and systems 732	EBB 732	32
Bioelectricity and electronics 732	EBE 732	32
Bioelectromagnetism and modelling 732	EBI 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
Introduction to research 732	EIN 732	32
Analogue electronic design 732	EME 732	32
Communication electronics 732	EMK 732	32
Research project: Theory 732	EPT 732	32
Research project: Design and laboratory 732	EPT 733	32

MEng (Electrical Engineering)(12250031)

Module	Code	Credits
Dissertation 890	EIR 890	128

MEng (Electronic Engineering)(12250091)

Module	Code	Credits
Dissertation 890	EIN 890	128

MEng (Computer Engineering)(12250211)

Module	Code	Credits
Dissertation 890	ERI 890	128

MEng (Bioengineering)(12250201)

Module	Code	Credits
Dissertation 890	EIB 890	128

MEng (Microelectronic Engineering)(12250191)

Module	Code	Credits
Dissertation 890	EEY 890	128

MEng (Software Engineering)(12250202)

Module	**Code**	**Credits**
Dissertation 890	EPR 890	128

(d) ENGINEERING AND TECHNOLOGY MANAGEMENT

BEngHons (Technology Management)(12240251)

At least 128 credits from the following:

Core modules:	**Code**	**Credits**
Decision analysis and risk management 780	IBD 780	16
Technological entrepreneurship 780	IEE 780	16
Quality management 780	IKK 780	16
Organisation and innovation 780	INV 780	16
Project management 780	IPK 780	16
Systems engineering 780	ISE 780	16
Operations management 781	IVV 781	16
and		
Electives /Ad hoc modules		
Asset management 780	IBB 780	16
Engineering logistics 780	IIX 780	16
Maintenance management 780	IMC 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).

Module	**Code**	**Credits**
Dissertation 890	ITB 890	128
or		

MEng (Technology Management)(12250252)

Core modules	**Code**	**Credits**
Financial management 831	FBS 831	16
Mini-dissertation	IGB 898	64
Technology management 802	ITB 802	16
People Management 884	PEM 884	16
Electives		
Technology commercialisation 881	IKG 881	16
or		
Module from the MEM/MPM programme (subject to the approval of the head of department)		16

MEng (Engineering Management)(12250172)
MSc (Engineering Management)(12251074)

Minimum requirements: 192 credits of coursework modules and a mini-dissertation (64 credits).
Total: 256 credits.

Module	Code	Credits
Mini-dissertation 898 (MEng)	IGB 898	64
Mini-dissertation 898 (MSc)	ISC 898	64
and		
Core modules		
Financial management 830	FBS 830	16
Maintenance management 801	IIB 801	16
Research methodology 800	INI 800	16
Project management 803	IPK 803	16
Production and operations management 801	IPP 801	16
Systems engineering and management 801	ISE 801	16
Technology management 801	ITB 801	16
People management 883	PEM 883	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		
Decision analysis and risk management 801	IRI 801	16
Strategic management 801	ISM 801	16
Electives		
Engineering service management 801	IGB 801	16
Marketing management 801	IIM 801	16
Engineering logistics 801	IIX 801	16
Quality management 801	IKK 801	16
Information management 884	ILB 884	16
Legal aspects of project management 803	ILC 803	16
Life cycle management of SHE 802	ILE 802	16
New ventures and entrepreneurship 801	IOE 801	16
or		
Domain: Asset and Maintenance Management		
Electives		
Engineering asset management 801	IAM 801	16
Reliability engineering 801	IBI 801	16
Engineering logistics 801	IIX 801	16
Legal aspects of project management 803	ILC 803	16
Life cycle management of SHE 802	ILE 802	16
Decision analysis and risk management 801	IRI 801	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		
Engineering asset management 801	IAM 801	16
Engineering service management 801	IGB 801	16
Marketing management 801	IIM 801	16
Engineering logistics 801	IIX 801	16
Legal aspects of project management 803	ILC 803	16
New ventures and entrepreneurship 801	IOE 801	16
Decision analysis and risk management 801	IRI 801	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		
Engineering logistics 801	IIX 801	16
Information management 884	ILB 884	16
Legal aspects of project management 803	ILC 803	16
Decision analysis and risk management 801	IRI 801	16

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

Module	**Code**	**Credits**
Mini-dissertation 898 (MEng)	IGB 898	64
Mini-dissertation 898 (MSc)	ISC 898	64
and		
Core modules		
Project human resource management 801	IHR 801	16
Research methodology 800	INI 800	16
Project finance and cost management 802	IPF 802	16
Project procurement management 801	IPJ 801	16
Introduction to project management 801	IPM 801	16
Project quality management 801	IQM 801	16
Project risk management 801	IRM 801	16
Project system engineering 802	ISE 802	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
Marketing management 801	IIM 801	16
Engineering logistics 801	IIX 801	16
Information management 884	ILB 884	16
Legal aspects of project management 803	ILC 803	16
Life cycle management of SHE 802	ILE 802	16
New ventures and entrepreneurship 801	IOE 801	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		
Engineering logistics 801	IIX 801	16
Information management 884	ILB 884	16
Legal aspects of project management 803	ILC 803	16
Project management practice 801	IMP 801	16
Domain: Construction Management		
Strategic project management 804	ISM 804	16
Construction management I 803	KBS 803	16
Construction management II 804	KBS 804	16
Construction management III 805	KBS 805	16
Electives		
Engineering logistics 801	IIX 801	16
Legal aspects of project management 803	ILC 803	16
Project management practice 801	IMP 801	16
New ventures and entrepreneurship 801	IOE 801	16

(e) INDUSTRIAL AND SYSTEMS ENGINEERING

An appropriate bouquet of 8 modules must be selected in consultation with the Head of Department to comply with the requirements for one of the following domains of specialisation:

- Resource Optimisation (RO)
- Supply Chain Engineering (SCE)
- Business Process Management (BPM)

BEngHons (Industrial Engineering)(12240011)

Module	**Code**	**Credits**
Advanced aspects of operations research 780	BAO 780	16
Solution algorithms in operations research 780	BAR 780	16
Enterprise architecture 781	BBA 781	16
Supply chain information and decision technology 780	BCI 780	16
Novel industrial and systems engineering 780	BCS 780	16
Design and analysis of experiments 780	BDE 780	16
Inventory modelling 780	BEE 780	16
Applied engineering statistics 780	BES 780	16
Quality management 780	BGH 780	16
Health and safety in the workplace 780	BGW 780	16
Probability models 780	BHM 780	16
Information systems 780	BIS 780	16
Lean supply chain strategies and systems 780	BLC 780	16
Supply chain processes 781	BLK 781	16
Process optimization	BMK 781	16
Operations research 780	BOZ 780	16
Manufacturing planning and control systems 782	BPZ 782	16
Business engineering 780	BSI 780	16
Reliability engineering 780	BTH 780	16
Simulation modelling 780	BUY 780	16
Supply chain design 780	BVK 780	16
Research methodology 781 (Compulsory)	INI 781	16

Not more than 4 appropriate modules are allowed from other departments.

Non-Industrial Engineers

The following curriculum must be followed:

Module	Code	Credits
Industrial analysis 780 (Compulsory)	BAN 780	16
Enterprise architecture 781	BBA 781	16
Novel Industrial and systems engineering 780	BCS 780	16
Design and analysis of experiments 780	BDE 780	16
Inventory modelling 780	BEE 780	16
Applied engineering statistics 780	BES 780	16
Quality management 780	BGH 780	16
Health and safety in the workplace 780	BGW 780	16
Probability models 780	BHM 780	16
Information systems 780	BIS 780	16
Business logistics 780 (Compulsory)	BLK 780	16
Supply chain processes 781	BLK 781	16
Operations research 780 (Compulsory)	BOZ 780	16
Production management 781 (Compulsory)	BPZ 781	16
Manufacturing planning and control systems 782	BPZ 782	16
Reliability engineering 780	BTH 780	16
Simulation modelling 780	BUY 780	16
Supply chain design 780	BVK 780	16
Research methodology 781 (Compulsory)	INI 781	16

A maximum of 3 approved modules may be selected from other departments

MEng(Industrial Engineering)(12250011)

Module	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)

Module	Code	Credits
Electrometallurgy 700	NEL 700	32
Fabrication engineering 700	NFE 700	32
Physical metallurgy 700	NFM 700	32
Heat treatment 700	NHB 700	32
Hydrometallurgy 700	NHM 700	32
Corrosion 700	NKR 700	32
Literature survey 700	NLO 700	32
Mechanical metallurgy 700	NMM 700	32
Minerals processing 700	NMP 700	32
Applied theory of sampling for minerals processing 700	NMP 701	32
Nuclear reactor materials 700	NNR 700	32
Metallurgical analysis 700	NPA 700	16
Pyrometallurgy 700	NPM 700	32
Froth flotation 700	NSF 700	32

Welding metallurgy 700	NSW 700	32
Refractory materials 700	NVM 700	32
Mathematical modelling of metallurgical processes and materials 700	NWM 780	32
Welding processes 700	NWP 700	32
Design of welded structures 700	NWP 701	32
Option: Welding Engineering		
The following 128 credits are prescribed:		
Fabrication engineering 700	NFE 700	32
Welding metallurgy 700	NSW 700	32
Welding processes 700	NWP 700	32
Design of welded structures 700	NWP 701	32

MEng (Metallurgical Engineering)(12250061)

Module	**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)

Module	**Code**	**Credits**
Fluid-structure interaction 780	MAH 780	16
Porous flow 780	MAN 780	16
Aircraft turbomachinery 780	MAY 780	16
Solar energy 780	MBA 780	16
Control systems 780	MBB 780	16
Topology and shape optimisation 780	MBT 780	16
Composite materials 780	MCM 780	16
Finite element methods 780	MEE 780	16
Advanced finite element methods 781	MEE 781	16
Mechatronics 780	MEG 780	16
Vibration-based condition monitoring 781	MEV 781	16
Advanced heat and mass transfer 780	MHM 780	16
Condition-based maintenance 780	MIC 780	16
Reliability-based maintenance 781	MII 781	16
Maintenance practice 780	MIP 780	16
Maintenance practice 781	MIP 781	16
Maintenance logistics 782	MIP 782	16
Maintenance operations 783	MIP 783	16
Reliability engineering 781	MIR 781	16
Tribology 780	MIT 780	16
Aerodynamics 780	MLD 780	16
Gas dynamics 780	MLG 780	16
Air-conditioning and refrigeration 780	MLR 780	16
Aeronautical structures 780	MLT 780	16

Flight mechanics 780	MLV 780	16
Aircraft design	MLW 780	16
Structural control 781	MOI 781	16
Optimum design 780	MOO 780	16
Design 780	MOX 780	16
Specialised design 781	MOX 781	16
Specialised design 782	MOX 782	16
Theory of elasticity 780	MSE 780	16
Fracture mechanics 780	MSF 780	16
Numerical thermoflow 780	MSM 780	16
Numerical thermoflow 781	MSM 781	16
Independent study 781	MSS 781	16
Independent study 782	MSS 782	16
Fatigue 780	MSV 780	16
Fluid mechanics 780	MSX 780	16
Advanced fluid mechanics 781	MSX 781	16
Specialised structural mechanics 781	MSY 781	16
Specialised structural mechanics 782	MSY 782	16
Experimental structural dynamics 783	MSY 783	16
Specialised thermoflow 780	MTV 780	16
Specialised thermoflow 781	MTV 781	16
Advanced thermodynamics and energy systems 781	MTX 781	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
Fossil fuel power stations 781	MUU 781	16
Vehicle dynamics 780	MVI 780	16
Numerical methods 780	MWN 780	16
Nano and micro heat transfer 781	MWX 781	16

MEng (Mechanical Engineering)(12250051)

Module	**Code**	**Credits**
Dissertation 890	MIR 890	128

(h) MINING ENGINEERING

A limited number of appropriate modules from other departments are allowed, i.e. 64 credits.

BEngHons (Mining Engineering)(12240071)

Module	**Code**	**Credits**
Financial mine evaluation 780	PFZ 780	16
Slope stability 781	PHS 781	16
Airflow and fans 711	PKB 711	16
Heat and refrigeration 712	PKB 712	16
Advanced design: mining 780	PMZ 780	16

Open pit mining 783	POY 783	16
Advanced explosives engineering 785	PRX 785	16
Guided special studies 700 Finalists only	PSS 700	32
Strata control – Hard rock mining 786	PSZ 786	16
Strata control – Collieries 788	PSZ 788	16

MEng (Mining Engineering)(12250071)

Module	**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

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

Eng. 20

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. 17 (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. 21

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. 18 (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. 22

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)

Module	Code	Credits
First year first semester		
Process control 410	CPB 410	16
Biotechnology 410	CBI 410	16
Second semester		
Chemical engineering 787	CIR 787	16
** Specialisation 420	CSS 420	16

*** Note: Only the Optimisation option may be taken.*

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

The modules CPB 410, CBI 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)

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

Specialisation in Process Technology – 128 credits

Specialisation in Process Technology 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:		
Biotechnology 410	CBI 410	16
Process control 410	CPB 410	16
Reactor design 410	CRO 410	16
Second semester		
Chemical engineering 787	CIR 787	16
** Specialisation 420	CSS 420	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:		
Process integration 732	CIP 732	32
Separation technology 732	CSK 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)

Module	**Code**	**Credits**
The following 128 credits are prescribed:		
Air quality control 787	CAM 787	32
Principles of environmental engineering 787	CEM 787	32
Waste management engineering 787	WAI 787	32
Water quality management 780	WQB 780	32

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

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

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

Module	**Code**	**Credits**
Dissertation 807	CVD 807	128

(b) CIVIL ENGINEERING

Students who have obtained a relevant three-year university degree or BTech degree may apply for admission to this post-graduate programme.
As for the other Honours degrees, a minimum 128 SAQA credits are required. The modules to select from are as follows:

BScHons (Applied Science)

Module	**Code**	**Credits**
Specialisation in **Water Resources (12243030)**		
Basic statistical methods 797	SHC 797	24
Basic hydraulics 788	SHW 788	24
and 24 credits from the following:		
Basic pavements and transportation 787	SGM 787	24
Basic structural design 793	SIC 793	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)**

Basic soil mechanics 785	SGM 785	24
Basic statistical methods 797	SHC 797	24

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

Specialisation in **Structures (12243031)**

Basic structural analysis 790	SIC 790	24
Basic structural design 793	SIC 793	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 pavements and transportation 787	SGM 787	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)

Module	**Code**	**Credits**
Dissertation 890	SST 890	128

(c) ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

MSc (Applied Science)(12253046)

Module	**Code**	**Credits**
Dissertation 891	EER 891	128

(d) ENGINEERING AND TECHNOLOGY MANAGEMENT

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

Core modules	**Code**	**Credits**
Technological entrepreneurship 780	IEE 780	16
Quality management 780	IKK 780	16
Engineering economics 780	IKN 780	16

Organisation and innovation 780	INV 780	16
Project management 780	IPK 780	16
Systems engineering 780	ISE 780	16
Operations management 781	IVV 781	16
and		
Electives		
(Ad hoc module for students from other departments)		
Asset management 780	IBB 780	16
Engineering logistics 780	IIX 780	16
Maintenance management 780	IMC 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)

Module	**Code**	**Credits**
Dissertation 895	ITB 895	128
or		

MSc (Technology Management)(Coursework)(12251076)

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

(e) INDUSTRIAL AND SYSTEMS ENGINEERING

An appropriate bouquet of 8 modules must be selected in consultation with the Head of Department to comply with the requirements for one of the following domains of specialisation:

- Resource Optimisation (RO)
- Supply Chain Engineering (SCE)
- Business Process Management (BPM)

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

Module	**Code**	**Credits**
Industrial analysis 780 (Compulsory)	BAN 780	16
Enterprise architecture 781	BBA 781	16
Quality management 780	BGH 780	16
Supply chain processes 781	BLK 781	16
Production management 781 (Compulsory)	BPZ 781	16
Simulation modelling 780	BUY 780	16
Research methodology 781(Compulsory)	INI 781	16
Basic statistical methods 797 (Compulsory)	SHC 797	24

A minimum of 3 approved modules may be selected from the BEngHons programme.

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

Module	**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)

Module	**Code**	**Credits**
32 credits from the following (compulsory):		
Basic physical metallurgy 701	NFM 701	32
Basic extractive metallurgy 701	NHM 701	32
Basic pyrometallurgy 701	NPM 701	32
and		
a maximum of 32 credits from the following: (optional)		
Research methodology 781	INI 781	16
Project management 780	IPK 780	16
Mathematical modelling of metallurgical processes and materials 780	NWM 780	32
Basic statistical methods 797	SHC 797	24
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:		
Fabrication engineering 700	NFE 700	32
Welding metallurgy 700	NSW 700	32
Welding processes 700	NWP 700	32
Design of welded structures 700	NWP 701	32

MSc (Applied Science) (Metallurgy)(12253022)

Module	**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)

Any one of the following three 32 credit module options:

Module	**Code**	**Credits**
Structural mechanics 732	MSY 732	32
Thermoflow 732	MTV 732	32
The combination of		
Maintenance practice 780	MIP 780	16
Reliability engineering 781	MIR 781	16

(If a student fails the selected 32 credit option or any one of the two 16 credit modules from the third option, 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 96 credits chosen from the modules as prescribed for the BEngHons programme, as approved by the head of department, and subject to concurrent registration prerequisite requirements published in the departmental postgraduate brochure.

MSc (Applied Science) (Mechanics)(12253021)

Module	**Code**	**Credits**
Dissertation 891	MIR 891	128

(h) MINING ENGINEERING

BScHons (Applied Science) (Mining)(12243044)

Module	**Code**	**Credits**
Basic mine environment engineering 701	PKB 701	16
Underground mining methods 701	PMY 701	32
Surface-mining 703	PMY 703	16
Explosives engineering 701	PRX 701	16
Guided special studies 700 Finalists only	PSS 700	32
Basic rock mechanics 703	PSZ 703	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)

Module	**Code**	**Credits**
Dissertation 891	PYI 891	128

DOCTORAL DEGREES

Doctor of Philosophy in Engineering [PhD (Engineering)]

Eng. 23
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 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. 24

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. 25

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
opw = other per week

BAN 313 Industrial analysis 313
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 2 lpw
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.

BAN 780 Industrial analysis 780
Academic organisation: Industrial and Systems Engineering
Prerequisite: Not for Industrial Engineering students
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
- Monte Carlo Simulation
- Continuous Simulation
- System Dynamics
- Multi-objective Decision-making
- Operations Research
- Decision Analysis
- Discrete Simulation

BAO 780 Advanced aspects of operations research 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

Module content:
Decision makers are frequently faced with complex problem environments. The module introduces two advanced topics in the field of Operations Research that can assist in the development of more relevant decision support models. The first topic deals with multi objectivity and introduces a variety of interventions to incorporate the competing objectives into mathematical programming models. Secondly, the topic of Data Envelopment Analysis (DEA) is introduced, a non-parametric method used to empirically measure the productive efficiency of decision-making units. This linear programming methodology allows the decision maker to measure the productivity in complex environments with multiple inputs and outputs; uncover often overlooked relationships between in- and outputs; and analyse and quantify the inefficiencies of every unit evaluated.

BAR 780 Solution algorithms in operations research 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
When developing decision-support models using optimisation, the computational burden is often so great that exact optimal solutions are not attainable, or not efficiently found, especially in combinatorial and discrete optimisation problems. Often approximate solutions are adequate and can provide superior solutions to the current state-of-practice decision approaches. The module introduces a selection of heuristics and metaheuristics applied to a variety of problems frequently faced by Industrial Engineers. The module also introduces a methodology to test and validate heuristics to ensure robust and reliable application.

BBA 781 Enterprise architecture 781
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Enterprise Engineering is a developing discipline that aims to comprehend enterprise complexity and thereby master it (Hoogervorst, 2009).Two important concepts support enterprise engineering: enterprise ontology and enterprise architecture. While enterprise ontology describes the essence of an enterprise, enterprise architecture provides normative guidance for design (Hoogervorst, 2009). The course provides different approaches to describe/represent the enterprise (its essence and implemented versions) and guide its evolution. The module covers:

- Background on Systems thinking, Systems Design and Systems Engineering
- Different perspectives on alignment: creating coherency and consistency between different systems
- Prominent approaches (and related mechanisms) to govern coherent and consistent enterprise design (e.g. Zachman, The Open Group, EA as Strategy, Hoogervorst/Dietz).
- Enterprise Modelling (notation standards, languages using different tools).
- Case studies
- Change Management

BCC 410 Computer control 410
Academic organisation: Industrial and Systems Engineering
Prerequisite: (BRV 320)
Contact time: 1 tpw 2 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Principles of digital control, digital mathematics, microcomputer control, programming of micro controllers, implementing ASSEMBLER programmes, stepmotor control, control through the parallel port, introduction to robotics and the kinematics of robots.

BCI 780 Supply chain information and decision technology 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Information technology is an important enabler of effective supply chain management, typically spanning the extended value chain from suppliers to customers. The timeliness and availability of relevant information are critical when applying supply chain strategies that increase service levels of and reduce cost and lead times. Value-added IT-based services are increasingly used to differentiate and develop relationships with customers. The objective of the course is to develop a sound understanding of components and priorities IT investment to enable supply chain integration and efficiency, the impact of business process change on IT implementation and selection of decision support systems.

- The Value of Information
- Leveraging Financial Information
- Advanced Supply Chain Planning and Execution
- Decision Support Systems
- IT Capabilities for Supply Chain Excellence
- Enterprise Resource Planning Systems
- Advanced Planning and Scheduling Systems
- Identification Technology
- Integrating Supply Chain IT

BCS 780 Novel industrial and systems engineering 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
The module affords an individual student the opportunity of studying a designated area of coherent advanced knowledge under the tutorship of a specialist staff member of the Department of Industrial and Systems Engineering.

BDE 780 Design and analysis of experiments 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

Module content:
The design of an experiment may be defined as 'the logical construction of an experiment in which the degree of uncertainty with which the inferences are drawn may be well defined'. The module deals with the following:

- Principles of experimental design (Randomisation, Replication and Blocking (local control)
- One-Factor-Two-level Factorial Designs
- One-Factor-Multi-level Factorial Designs
- Completely Randomised Design (CRD) and introduction to ANOVA
- Randomised Complete Block Design (RBD)
- Latin Square Design (LSD)
- Balanced Incomplete Block Design (BIBD)
- Factorial Experiments (2nd and 3rd factorial experiments)
- Blocking and Confounding in Factorial designs
- Overview of Factorial Designs

BEE 780 Inventory modelling 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:

- Theory of Inventory Systems:
  Inventory models and modelling including time and certainty complexities, linear and non-linear systems and feedback systems
- Review of inventory models:
  Types and representations (classic, shortage, capacity constraint, time value of money, deterioration, time varying, stochastic inputs, imperfect quality, integrated scheduling and lot sizing models, service systems and retrial queues)
- Review of important inventory papers, their approaches and their foci:
- Modelling and Solution techniques:
  Characterisation and assumptions
  Mathematical Modelling, Mathematical Programming, Heuristics, Simulation Models, Control Theory and other approaches
- State of the art of modelling:
  Current challenges and research trends
- Technological solutions of inventory modelling and management:
  Algorithms and software, integration to MRP, ERP and scheduling modules, integration to WMS modules, and demonstrations

BEN 420 Elective module 420
Academic organisation: Industrial and Systems Engineering
Prerequisite: Finalists only
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
An elective module chosen from an approved shortlist.

BES 220 Engineering statistics 220
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 2 lpw
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.

BES 780 Applied engineering statistics 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
This module presents an applied approach to solve real-world engineering problems. The premise of the course is that data analysis, and thus, applied statistics, is an inseparable part of conducting research and solving engineering problems. The module presents the elements of different types of statistical studies as they relate to different industrial settings. The aim of the module is to promote inductive reasoning through the gathering, analysing and interpreting of diverse types of observational data. The outcome of the module is an engineer equipped to select and apply statistical methods appropriate to an industrial setting.The course covers the following topics:

- Contextualisation: Different types of industrial processes and research settings, related types of statistical studies and a framework for understanding and applying statistics
- Principles of probabilistic and rational data gathering
- The use of common and specialised probability distributions (such as the Gamma, Exponential and Weibull distributions) in solving real-life problems, conducting scientific research and analysing stochastic and deterministic processes
- Data transformations: When and how to transform data
- Bridging the gap between technology and statistical analysis: The use of EXCEL in resolving basic and advanced statistical problems

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 course.

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.

BGH 780 Quality management 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Professionally, engineers are confronted with issues related to product quality and performance or organisational excellence. The intention of this course is to provide an overview of the domain of modern quality management and to equip the student with theory, methodologies and tools and techniques to improve and achieve product quality and performance excellence.
The course covers the following topics;
- Contextualisation: The History, Guru's, Principles, Industrial setting and the Domain of Quality Management
- Practices of improving and achieving product quality: Role in Industrial Engineering, On-line and Off-line Quality Control Practices
- Frameworks of improving organisational excellence: National Quality Awards, ISO 9000 and other frameworks
- Practices of improving performance excellence: Quality and Competitive advantage, Customer and Supplier relationships, People Empowerment and Motivation, Quality Leadership and Organisational change.

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
Module content:
The objective of the module is that students be exposed to probability theory, learn the ability to follow fairly involved theoretical reasoning, continue to learn how to reason mathematically, and solve problems of a more practical nature. It covers:
- Probability theory: Random variables and random vectors, Sequence of random variables, Transformation of Probability distributions
- Stochastic Processes: Examples of stochastic processes; various types of stochastic processes
- Poisson Processes: Homogeneous and non-homogeneous stochastic processes with examples

- Renewal Processes: Renewal functions; ordinary and delayed renewal processes; Regenerative stochastic processes
- Discrete-time Markov chains: continuous time Markov chains with focus on examples in Reliability, queuing and inventory models.

BID 320 Information systems design 320
Academic organisation: Industrial and Systems Engineering
Contact time: 1 tpw 2 ppw 3 lpw
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 normalization, object-oriented design and modelling, information system application building and testing.

BIE 420 Engineering economics 420
Academic organisation: Industrial and Systems Engineering
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Money-time relationships and equivalence (interest formulae, effective interest rate, bonds and loans). Bases for comparison of alternatives (present worth, annual worth, Internal rate of return, external rate of return, investment balance diagrams, Decision making among alternatives (useful lives equal to study period, useful lives different among alternatives, mutually exclusive alternatives in terms of combinations of proposals). The influence of inflation on engineering economic calculations. Decision making among alternatives on an after-tax basis. Replacement analysis (the economic life of an asset, retirement without replacement). Risk analysis of cash flows.

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

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

BIS 780 Information systems 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

Module content:
To introduce the student with a background in transactional application software development to a variety of aspects in the wider field of information technology. Emphasis is on the functional design of Business Intelligence systems from an Industrial Engineering perspective. The aim is to enable the student to appreciate the scope of management challenges in the integrated environment of business processes, transactional application software, data, IT infrastructure and telecommunications, data warehousing, and the necessary management information needed at various levels in an organisation. It covers:

- Technology trends
- Context diagram of application software portfolio
- Review of typical transactional information systems
- Role of Business Intelligence and data warehousing
- Business dimensional lifecycle
- Business requirement definition
- Basic elements of the data warehouse
- Extraction, Transformation and Loading processes
- Dimensional modelling (star schema)
- Metadata
- Information delivery

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

BJJ 210 Professional and technical communication 210
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw 2 opw
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: uses appropriate structure, use of modern or electronic communication methods; style and language for purpose and audience; uses effective graphical support; applies methods of providing information for use by others involved in engineering activity; meets the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Typed reports range from short (300-1 000 word plus tables 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.

BLC 780 Lean supply chain strategies and systems 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16

Module content:
Supply chain executives need to contribute and support long term strategic objectives by providing a competitive edge through an aligned supply chain strategy. The course addresses the impact of lean principles in supply chain management and practical approach to implementing lean thinking and demand driven supply chains. The course provides a framework for the strategic supply chain decisions, both in designing and managing an efficient extended supply chain. The latest innovations, trends and challenges in agile supply chain strategies and systems are reviewed. Team leadership skills are developed through practical applications, approaches and best practices of lean supply chain design and management. Supply chain leadership perspectives will be provided by executives and managers from industry and team-based simulation games.
Course outline:

- Fundamentals of lean management
- Lean Thinking and Supply Chain (SC) management
- Customer Value
- Network design strategies
- Supply Chain Integration and barriers to Integration
- SC performance measurement
- Extended Value Chain and Value Stream Mapping
- Eliminating Waste in the Supply Chain
- Applying Lean Principles to Supply Chain Operations
- Inventory positioning approaches
- Operational Executive Problems

A3 Performance Management

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

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

BLK 781 Supply chain processes 781
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

Module content:
A key objective of supply chain management is to develop competiveness and achieve a market advantage through the implementation of cross-functional processes as the mechanism to coordinate internal and external activities.The course aims to create an understanding of the importance of integrating key supply chain business processes and to develop the ability to analyse and implement such processes across functional and corporate silos. Standardised process definitions and practices, including strategic and operational sub-processes and key performance measurements, are considered.
Course outline:
- Customer Relationship Management Process
- Supplier Relationship Management Process
- Customer Service Management Process
- Demand Management Process
- Order fulfilment Process
- Manufacturing Flow Management (Planning and Control) Process
- Product Development and Commercialisation Process
- Returns Management Process
- Assessment of Supply Chain Management (SCM) Processes
- Implementing and Sustaining SCM Processes
- Supply Chain Mapping Approaches
- Supply Chain Performance Measurement

BMK 781 Process optimisation 781
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Process optimisation is an engineering discipline which focuses on the tools and techniques used specifically for business process analysis, design, and optimisation. As physics determines the physical behaviour of tangibles, process physics forms the foundation of business process behaviour. Traditionally, operations research techniques are used by Industrial Engineers to optimise business processes, process optimisation provides a more focused approach using techniques such as Social Network Analysis, System Dynamics, image profiling and process mining to uncover analytical models.The outcome of this course is to enable the student to create an integrated, analytical business process behaviour profile. This supports the analysis, design and optimisation of business processes in a Business Engineering lifecycle. The following topics are covered in the course:
- Standard Process Physics principles, facts and models.
- Process Intelligence
- Adaptive process control and SMART processes
- Robustness and complexity analysis
- Process mining
- Social Network Analysis

Process optimisation requires an understanding of operations research within the business engineer framework. This course requires a full understanding of undergraduate Industrial Engineering modules as well as a postgraduate understanding of resource optimisation and enterprise architecture.

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 and 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: 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Review of basic probability, Markov chain models, Markov decision models. Queuing 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 Operations 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.

BOZ 780 Operations research 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Building on undergraduate modules in Operations Research, the module aims to extend the mathematical programming and optimisation capabilities by introducing uncertainty. Many decision makers are confronted with complex environments in which data is not

known with certainty, or in which the decision constraints are uncertain. For cases where one knows the shape, or can assume that the uncertainty follows a known probabilistic distribution, stochastic programming can be used. In the module both chance-constrained programming and fixed recourse are introduced. Fuzzy optimisation is introduced for cases where the shape and/or distribution of the uncertainty are not known.

BPJ 410 Project 410
Academic organisation: Industrial and Systems Engineering
Prerequisite: Finalists only
Contact time: 1 opw
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 opw
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 opw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Attendance module only
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 Faculty Administration 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 opw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Attendance module onlyDuring 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.

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

BPZ 782 Manufacturing planning and control systems 782
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
To introduce the student to the manufacturing environment, the nature and scope of the manufacturing task, the manufacturing planning and control systems.
It covers:

- Production Management History, context and modelling complexity
- Understanding system variability and attendant buffering principles and techniques
- Batching principles and techniques (from EOQ to RoP)
- Production planning and control principles and activities
- Demand anticipation and management
- Sales and Operations planning, MPS and MRP
- Capacity planning, scheduling and production flow management
- Tactical and consequential inventory management principles
- Pull production philosophies and techniques
- Principles, the variability impact and effects on system slacks
- Theory of constraints, CONWIP and Lean/JIT
- Current PM challenges and research opportunities

BSI 780 Business engineering 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Organisations are complex systems which consist of people, processes, customers, resources and regulatory environments. Business Engineering (BE) is a discipline which uses an engineering approach towards introducing planned business change into the organisation. This includes formal analysis, design, implementation and maintenance of the holistic business system; requiring a deep understanding and knowledge of the interaction and balance of complex business system elements.
The outcome of the course is to enable the student to understand the art and science of engineering complex business systems. The following topics are covered in the course:
- BE principles for design, implementation and optimisation of complex business systems
- BE programme process which governs the implementation of holistic business changes
- BE programme and project structures
- BE Tools and techniques used throughout the BE lifecycle for engineering modelling and optimisation.
- Business
- Models and innovation approaches
- Integrated Business planning
- Business Process reference models for strategic, tactical, core and support processes.

Business engineering is the ultimate pinnacle of industrial engineering competency – being able to construct business systems serving complicated organisational value propositions. The course requires a full understanding of undergraduate Industrial Engineering modules as well as a postgraduate understanding of resource optimisation, enterprise architecture, and supply chain engineering.

BSS 310 Engineering management 310
Academic organisation: Industrial and Systems Engineering
Contact time: 1 opw 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 2
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.

BTH 780 Reliability engineering 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
To make students conversant with the concepts, tools and techniques of reliability engineering.
Capita selecta from:
- Introduction to Reliability Engineering
- Reliability Mathematics
- Probability Plotting
- Reliability Prediction for Design
- Reliability Testing
- Reliability Growth
- Maintainability
- Reliability Management

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.

BUY 780 Simulation modelling 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 1

Language of tuition: English **Credits:** 16
Module content:
- Stochastic Modelling
- Stochastic Simulation Modelling
- System Dynamics
- Agent Based Simulation
- Input/Output Analysis
- Simulation and Optimization
- Simulation Project Management
- Simulation Modelling Software

BVK 780 Supply chain design 780
Academic organisation: Industrial and Systems Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Strategic design of supply chain networks, inventory management and supply chain integration. Framework for strategic alliances and third party logistics. Analysis and application of alternative supply chain reference models as the basis for modelling, analysis and improvement.
Course outline:
- Supply Chain Network Design
- Strategic Management of Inventory
- Supply Chain Integration
- Strategic Alliances
- Coordinated Product and Supply Chain Design
- Supply Chain Modelling (SCOR, VRM)

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.

CBI 410 Biotechnology 410
Academic organisation: Chemical Engineering
Prerequisite: (CKN 321), (CMO 320/310), (CPA 310)
Contact time: 3 tpw 4 lpw
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.

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
Module content:
Design of multivariable controllers using various design techniques. Application of criteria for achieving satisfactory performance, reduction of interaction, maintaining stability and obtaining robust controllers. Design techniques: Sequential loop closure, use of interaction analysis and the RGA; Frequency domain techniques: Inverse Nyquist Array (INA)-, Characteristic Loci (C.L) – and LACEY-techniques; Model-based approaches: Model-Predictive Control (MPC), Internal Model Control (IMC) and Dynamic Matrix Control (DMC); Optimal Controller Design Techniques: LQG, µ-synthesis and H Neural networks and Fuzzy Logic Controllers.

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, pharmaceutical, veterinary, brewing and food industries. Principles including implications of bio-prospecting, bio-safety, inoculum production, aseptic growth, quality control and product formulation as applicable to bio-processes. Fermentation with various microbial groups, bio-leaching, gene transfer, solid-substrate fermentation, enzymatic catalysis and immunology. Bioreactors, batch and continuous processing. Bio-remediation.

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
Module content:
Overview of single loop feedback principles; Matrices and matrix operations; Singular values; State-space description of systems; Extension to multivariable systems; Properties of multivariable systems: Interaction, Stability, Performance, Robustness, Uncertainty. Norms and relationships between single and multiple loop criteria. Criteria for control system specification.

CCT 990 Thesis: Chemical technology 990
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 360

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. Focus on design aspects.

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

CIO 320 Chemical engineering design 320
Academic organisation: Chemical Engineering
Prerequisite: (CTD 223), (COP 311)
Contact time: 3 tpw 4 lpw
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.

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
Module content:
Heat integration: targeting for minimum use of utilities, selection and optimal placing of utilities, role of minimum temperature difference, design for maximum energy recovery, placement of heat engines and heat pumps, capital-energy trade-offs, heat integration of reactors, heat integration of distillation columns, total site analysis; Mass integration: modelling of mass exchange units, synthesis of mass exchanger networks, mathematical optimization techniques for mass integration, wastewater minimization using the WaterPinch; Batch process integration: types and operational philosophies of batch processes, heat integration using time average models, wastewater minimisation in batch processes, scheduling techniques of batch processes, design and synthesis of batch processes.

CIR 113 Chemical engineering 113
Academic organisation: Chemical Engineering
Contact time: 2 lpw 2 tpw
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 171 GS
Contact time: 2 lpw 2 tpw
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 lpw 2 tpw
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: 3 tpw 4 lpw
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. Generalized correlations for physical and thermodynamic properties. Phase equilibrium in multiphase reacting and non-reacting systems with due allowance for non-ideal mixture behaviour.

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

CIR 890 Dissertation: Chemical engineering 890
Academic organisation: Chemical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

CJJ 210 Professional and technical communication 210
Academic organisation: Chemical Engineering
Prerequisite: CIR 123
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Typed reports range from short (300-1 000 word plus tables 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: 3 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: CJJ 210, CHM 226, CPN 321#, CKN 321#, (CMO 320/310), CIO 310/320#
Contact time: 2 lpw 8 ppw
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.

CML 732 Model-based control laboratory 732
Academic organisation: Chemical Engineering
Contact time: 12 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Development of models for complex processes using conservation laws, equilibrium relationships and transport equations. Numerical modelling. Use of commercial software packages. Process identification techniques.
Implementation of advanced, model-based, controller designs on experimental test rigs taking into account the practical role of controllers, computing equipment, software, measuring instruments, final control elements, noise, etc. in the successful operation of a control system.

CMO 310 Mass transfer 310
Academic organisation: Chemical Engineering
Prerequisite: (CTD 223), COP 311#
Contact time: 3 tpw 4 lpw
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.

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
Module content:
Materials science of carbon and graphite materials: Pitch, mesophase, cokes, synthetic carbons, bulk carbon and graphite, carbon fibres and matrices, sintered carbon, carbon/carbon composites and nuclear graphite. Carbon nanotechnology. Characterization of carbon materials: crystallography (powder X-ray diffraction), thermogravimetric and differential scanning calorimetry, thermo-mechanical analysis, infrared and Raman spectroscopy. Processing of carbon materials.

COP 311 Transfer processes 311
Academic organisation: Chemical Engineering
Prerequisite: WTW 238, (WTW 263)
Contact time: 3 tpw 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.

CPA 310 Particle technology 310
Academic organisation: Chemical Engineering
Prerequisite: (CIR 211), COP 311#
Contact time: 3 tpw 4 lpw
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. Hydrocyclones, flotation, filtration. Centrifuges. Fluidised bed technology. Mixing. Comminution. Pneumatic transport.

CPB 410 Process control 410
Academic organisation: Chemical Engineering
Prerequisite: CPN 321 GS
Contact time: 3 tpw 4 lpw
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. Applied process control. Choice of control instrumentation. Plantwide control strategy. Development of P and IDs.

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:** 24
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 310/320#, CKN 321#
Contact time: 3 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.

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
Module content:
The methodology to develop chemical products involves assessing needs, generating ideas, sorting and screening ideas, development of good ideas, and assessment of manufacturing methods. Engineering principles must be used to estimate whether the performance of the product will meet requirements, and involves the application of eg. thermodynamics of mixing, phase equilibrium, solutions, surface chemistry, diffusion and transport properties. Students will choose a need for suitable chemical product, and implement the product design process and techniques to arrive at a unique product that meets the need. Students will present their projects both orally and as a written report.

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
Module content:
Unit processes in polymer processing. Analysis of complex processes: Description in terms of elementary processing steps. Transport phenomena: Transport equations, rheology and mixing processes. Elementary process steps: Particle technology, melting, pumping, pressure elevation, mixing, modelling of processes. Forming: Extrusion,

calendering, injection moulding, and film blowing. Reactive processing: Thermo set materials, reaction kinetics.

CPR 420 Chemical engineering practice 420
Academic organisation: Chemical Engineering
Prerequisite: CLB 321
Contact time: 1 tpw 2 lpw
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. Control applications, choice of instrumentation and development of a plantwide control strategy. Development of PandID'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 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.

CPS 410 Process synthesis 410
Academic organisation: Chemical Engineering
Prerequisite: CLB 321, CIR 310 GS
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. Applications using computer packages.

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.

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

Module content:
Fundamentals of polymer chain behaviour: Inter and intra molecular forces and chain statistics, rubber elasticity and visco elasticity. The solid-state properties of polymer materials and their applications: plastics, rubbers, adhesives, resins, binders and coatings, etc. Polymer phases: Liquid, glass and crystalline states. Phase transitions: Glass transition, crystallization and spinodal decomposition. Multi component systems: Morphology and thermodynamics of polymer blends and alloys; compatibilization with block copolymers. Mechanical properties and failure of polymers. Physical characterization of polymers. Resins and binders.

CPY 311 Practical training 311
Academic organisation: Chemical Engineering
Prerequisite: (CJJ 210) and (CIR 211)
Contact time: 1 opw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Attendance module only
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 Faculty Administration 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 320/310), CPY 311
Contact time: 1 opw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Attendance module only
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.

CRH 732 Bio-reaction engineering 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:
In depth understanding of the important metabolic pathways in microorganisms, black box models for describing stoichiometry of bioreactions, metabolic flux analysis as the basis for metabolic (genetic) engineering, kinetics of microbial conversions and basic bioreactor design.

CRO 410 Reactor design 410
Academic organisation: Chemical Engineering
Prerequisite: CKN 321 GS
Contact time: 3 tpw 4 lpw
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.

CRO 700 Research orientation 700
Academic organisation: Chemical Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 2
Language of tuition: English **Credits:** 32
Module content:
Design, construction and testing of experimental setup. Initial test experiments, calibrations and modifications. Preliminary results. Experimental plan and schedule for the research dissertation. Detailed predictions on anticipated measurements. Directly relevant literature (core essentials taken from CIR 702).

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. Oral presentation and poster.

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
Module content:
Characterisation and classification of particulate solids, bulk and single particle properties (flowability, rheology, density, etc.), preparation of particles and powders, separation of particles from liquid, gas and solid- solid separation, unit operations involving solids (fluidisation, ion exchange, pneumatic transport, hopper design, etc.) behaviour of multi-component and multiphase systems.

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
Module content:
Process control computers, interfaces and data-transfer. Control of: distillation columns, heat exchangers, boilers, reactors, biological systems & batch processes; pH-control. Identification of opportunities for advanced control. Cost benefits analysis (CBA). Development and implementation of advanced control systems. Plantwide control vs control of individual processing units. Control philosophy. Development of a control strategy. Base layer control: Inventory control, maintaining a mass and energy balance. Control of production quality and production rate. Control system performance. Design diagrams. Design documentation. Hazard control. Role of the control engineer as member of the design team. Control loop performance & Control system performance measures.

CSS 420 Specialisation 420
Academic organisation: Chemical Engineering
Prerequisite: CPJ 421#
Contact time: 4 lpw
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, Water Utilisation Engineering and Optimisation techniques.

CTD 223 Thermodynamics 223
Academic organisation: Chemical Engineering
Prerequisite: CIR 211, MPR 212/213, (WTW 258)
Contact time: 3 tpw 4 lpw
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.

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

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
Module content:
Property modification through reactive processing and additive compounding. Colorants and optical modifiers (pigments, dyes, absorbers and opacifiers), fillers and reinforcements; Stabilisers (anti oxidants, light stabilisers, flame retardants); Surfactants (antistatic, antifog and antiblock); Functional additives (gas absorbers, biocides, foaming agents, barrier additives and cross-linkers); Viscosity modifiers. Optimisation of formulations using statistical methods: Taguchi experimental designs and triangular formulation designs.

EAD 410 Electrical drives 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELX 311 GS and EDF 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:
Single and three-phase DC-AC invertors, PWM, 4-quadrant conversion, DC and AC variable speed drives and high frequency transformer design.

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.

EAI 320 Intelligent systems 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: WTW 258
Contact time: 1 ppw 1 tpw 1 wbppw 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, optimization and problemsolving using intelligent systems techniques.

EAI 732 Intelligent systems 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 provides the theoretical background necessary to understand, research and develop real-world software and hardware systems that incorporate and exhibit intelligent behaviour. The module incorporates advanced theory from fields such as Artificial Intelligence, Computational Intelligence, Machine Learning, Pattern Recognition and Signal Processing. Core topics of the module include: Bayesian Theory, Neural Networks, Kernel Methods, Graphic Models, and Numerical Bayesian Methods.

EAI 733 Advanced topics in intelligent systems 733
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EAI 732
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32
Module content:
The aim of the module is to augment the general background provided by the EAI 732 module with the specific theoretical background required for MEng. The module will, depending on the intended research field of the student, incorporate advanced theory from fields such as: Digital Image Processing, Computer and Robotic Vision, Probabilistic Robotics, Data Fusion, Hardware and Software Parallel Processing, Real-Time and Reactive Systems.

EAS 410 Computer engineering: Architecture and systems 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMK 310 GS
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
This module aims to provide a strong foundation for allowing students to understand modern computer architectures and systems. Microarchitectures and instruction set architectures (ISAs) will be studied in detail, as well as computer memory types and their organisation. The study will also cover performance acceleration techniques such as caching and pipelining.
Topics relating to parallel processing will be studied, including instruction level parallel processing (SIMD), multi-threading and multi-core processors as well as their synchronisation. Specialised architectures and techniques used in embedded processors (such as those found in smartphones) will be explored. The module also provides an overview of advanced computer communication buses, memory and storage systems prevalent in enterprise class computing (data centres), including topics such as: network-attached storage NAS, virtualisation, clusters, grid computing and cloud computing. Practicals will demonstrate various elements of computer architectures using VHDL.

EBB 320 Control systems 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELI 220 GS
Contact time: 1 ppw 1 tpw 3 lpw
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 (eg. PID) and feedback controllers.

EBB 732 Biosignals and systems 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Bio-engineering: 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 course 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 course.

EBN 111 Electricity and electronics 111
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:
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: 1 ppw 1 tpw 3 lpw
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.

EBN 780 Non-linear control 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

EBO 780 Optimal control 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Introductory control course such as EBB 320
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.

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.

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:
Semester: Year course through CE@UP.
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.

EDC 310 Digital communication 310
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ELI 220 GS
Contact time: 1 ppw 1 tpw 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 equalizers. 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: 1 ppw 1 tpw 3 lpw
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.

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 ETK 320 and Microwaves and antennas EMZ 320 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).

EER 891 Dissertation 891
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

EES 424 Specialisation 424
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ERS 220
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Semiconductor physics: materials, doping, carrier drift and diffusion. Device physics. Integrated circuit (IC) fabrication technology. IC layout design. Digital IC design: MOS inverters; static, transfer and dynamic logic gates; sequential gates; design topics: high speed, low power, clock and power distribution. Computer-aided design of integrated circuits. VHDL Hierarchy Revisited. Specialist topics are included for specific niche areas.

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.

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

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 course 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:
Credits: 16 (must be combined with Introduction to the science of measurement to form a 32 credit module)
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.

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.

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

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 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.

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

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 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, three-phase circuits, transients. 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: 1 ppw 1 tpw 3 lpw
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, three-phase circuits, transients. 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 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

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

EIW 121 Information technology practice 121
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 36 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*Attendance module only
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 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*Attendance module only
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 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*Attendance module only
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 opw
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: uses appropriate structure, use of modern or electronic communication methods; style and language for purpose and audience; uses effective graphical support; applies methods of providing information for use by others involved in engineering activity; meets the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse.

Typed reports range from short (300-1 000 word plus tables 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 ppw 1 tpw 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 ppw 1 tpw 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, invese-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.

EKS 732 Wireless sensor networks 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Computer networks ERN 780
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 course 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: 10 lpw
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 non coherent 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 mono pulse. 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.

ELI 220 Linear systems 220
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211 GS/221 GS
Contact time: 1 ppw 1 tpw 3 lpw
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: 1 tpw 2 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Electronic transducers. Circuit board layout: power circuit techniques, low noise techniques, high frequency techniques. Intellectual property law in South Africa. Design and implement a group project: technical specifications and interface specifications, systems engineering, industry standards, architecture and engineering judgement, material procurement, documentation and configuration management, man/machine interfaces, packaging technology, ergonomics and aesthetics, complete design and construction of a system (including electromagnetic compatibility), design for

manufacturing and maintainability, integration, production facilities and techniques, logistics.

ELV 732 Solid-state lighting 732
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
Photometry (quantities, units and definitions), light and vision (photopic, scotopic and mesopic), solid-state light sources, LED and OLED sources (luminous efficacy, rated life, thermal dependence, etc.), drive and control electronics for SSL (linear and on-linear dimming, thermal and light feed-back control, luminaire fundamentals and design, lighting design (CAD), specific lighting applications (task and ambient, indoor and outdoor, safety and security, automotive), SSL measurements (photometric, colorimetric, electrical and thermal). Cost-effective energy efficiency: principles and life cycle cost calculations. International standards and testing.

ELX 311 Electrical machines 311
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211/221
Contact time: 1 ppw 1 tpw 3 lpw
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, 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.

EMA 780 Antenna theory 780
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Microwaves and antennas EMZ 320 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 course such as EBB 320
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 310 Electromagnetic compatibility 310
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:
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.

EME 732 Analogue electronic design 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Analogue electronic design EME 732 (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 specialized for electronic circuits. The course 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 310 Microprocessors 310
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ERS 220 GS, EIR 211/221 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:
Hardware based introduction to system designing microprocessors. General microprocessor 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.

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 EMZ 320 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.

EMR 101 Introduction to laboratory measurements and computer simulations 101
Academic organisation: Electrical, Electronic and Computer Engineering
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 during the recess period and lasts for one week. This module serves as an introduction to measurement techniques and basic principles of a laboratory for electrical, electronic and computer engineering students. It also provides basic training in a computer simulation environment (Matlab, including Simulink) in the computer laboratories. The importance and complementary nature of simulations and accurate experimental measurements is emphasized in the module.

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 238 GS, WTW 263 GS, EIR 211/221 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:
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, trans-formations, 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 ppw 1 tpw 3 lpw
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, polarization, lossy media, good conductor, power density; Wave reflection and Transmission - Normal incidence, snell, fibre optics, oblique incidence, reflection 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: ELI 220 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:
Amplifier concepts: gain, input impedance, output impedance, bandwidth, cascaded stages. Amplifier power dissipation and power efficiency. Operational amplifiers: non-ideal, limitations, low power, programmable. Diode operational circuits: Logarithmic amplifiers, peak detector, clamp, absolute value, voltage regulators. Feedback and stability in amplifiers. Operational circuits: Instrumentation amplifiers, multipliers, oscillators, filters, translinear circuits, and sampling electronics.

ENE 410 Advanced electronics 410
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: ENE 310 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:
Bipolar and Field Effect Transistor (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 distortion. Large signal power amplifiers. Communication electronics: RF component modelling, two-port models for RF networks, matching networks, small signal narrowband RF amplifiers, RF oscillators.

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 modelling 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.

ENR 420 Energy systems 420
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 ppw 1 tpw 3 lpw
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 tariffs, energy efficiency and the energy audit. The third part, 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 covered can be energy management for any one or more of the commercial, industrial, residential or transport energy systems.

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 ETB 732
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.

EPE 321 Software engineering 321
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: COS 212
Contact time: 1 ppw 1 tpw 3 lpw
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: EWE 320/ELO 320, Finalists only
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 a 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: ERD 320 Finalists only
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 a 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 890 Dissertation 890
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

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 MEng 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.

EPW 200 Practical wiring 200
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 36 opw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 4
Module content:
*Attendance module only
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:** 16
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.

ERC 732 New generation networks 732
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: Computer Networks ERN780 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 course is to prepare students for advanced research in next generation communications networks.

ERD 320 Computer engineering design 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMK 310 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:
Electronic transducers. Circuit board layout: power circuit techniques, low noise techniques, high frequency techniques. Intellectual property law in South Africa. Design and implement a group project: technical specifications and interface specifications, systems engineering, Industry standards, architecture and engineering judgement, material procurement, documentation and configuration management, man/machine interfaces, packaging technology, ergonomics and aesthetics, complete design and construction of a system (including electromagnetic compatibility), design for manufacturing and maintainability, integration, production facilities and techniques, logistics.

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.

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

ERI 990 Thesis: Computer engineering 990
Academic organisation: Electrical, Electronic and Computer Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 360

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 420 Specialisation 420
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 1 ppw 1 tpw 3 lpw
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: Electrical, Electronic and Computer Engineering
Contact time: 1 ppw 1 tpw 3 lpw
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.

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 optimization algorithms for an optimization problem arising from an energy management mathematical model; (v) ability to write research reports.

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.

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.

ESP 300 DSP programming 300
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EPW 200
Contact time: 36 opw
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 320GS or EDC 310GS
Contact time: 1 ppw 1 tpw 3 lpw

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.

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 ETD 732
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 course. Adaptive systems ETA 732 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.

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 2
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, congruencies, 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 ETD 732
Contact time: 32 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 32
Module content:
The course ETK 780 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 course 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 course is to create the opportunity for experts to give lectures on specialised topics in the field 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 2
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, telecommunication 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), specialized 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).

EWE 320 Electrical engineering design 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EIR 211/221 GS
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to system level design; the system design process; design for operational feasibility; power transformer design; power cable design; power capacitor design; protection system design; introduction to electrical design software; design project.

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.

IAM 801 Engineering 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

IBB 780 Asset Management 780
Academic organisation: Engineering and Technology Management
Contact time: 20 contact hours
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
"Asset Management" may be defined as a life cycle process for creating, establishing, maintaining, operating, rehabilitating and divesting an asset in an optimal or balanced manner to satisfy the constraints imposed by economy, ergonomics, technical integrity and business performance. Within this definition, physical assets include equipment, infrastructure, and people. The 'holistic' view implied here recognises the wider range of disciplines required for strategic decisions and tactical management of physical assets.

Strategy and tactics depend on the asset, whereas people processes underpin the effective management of an asset.
The overall objective for the physical Asset Management module is to provide an integrated understanding of the complimentary disciplines applicable to the management of engineered assets. The module will emphasise the synergy between specialist and cross-disciplinary skills and their respective roles with respect to the management of physical assets. The overall outcome for the learner will be awareness of the collaboration required and application off cross-disciplinary skills in technical, engineering, finance logistics, human communication, and other functions to achieve effective management of physical assets.

IBD 780 Decision analysis and risk management 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

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

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

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 engineering 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

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

IGL 703 Engineering geology 703
Academic organization: Geology
Contact time: 20 contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 16
Module content:
Introduction to geology, SA stratigraphy and engineering geology, introduction to rock engineering, engineering geology in urban and regional development, dams, slopes and tunnels.

IGL 704 Engineering geology 704
Academic organization: Geology
Contact time: 10 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16

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

IIM 801 Marketing management 801
Academic organisation: Engineering and Technology Management
Contact time: 12 discussion classes
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **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

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 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

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

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

ILB 884 Information management 884
Academic organisation: Informatics
Contact time: 14 lpw 2 wbppw 22 opw 6 dpw
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 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

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

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

IMP 801 Project management practice 801
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

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

INI 800 Research 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

INV 780 Organisation and innovation 780
Academic organisation: Engineering and Technology Management
Contact time: 16 lpw 22 opw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

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 or Semester 2
Language of tuition: English **Credits:** 16

IPF 802 Project financial and cost management 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

IPI 410 Engineering professionalism 410
Academic organisation: Engineering and Technology Management
Contact time: 1 opw 2 lpw
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.

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 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

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

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

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 Decision analysis and 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 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

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 804 Strategic project management 804
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

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 802 Technology management 802
Academic organisation: Engineering and Technology Management
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **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

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

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

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: 4 ppw 6 tpw 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 Additional 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 Afrikaans and English **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and chemical reasoning skills required by CHM 171/172.

JPO 112 Additional 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 Additional graphical communication 113
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, conceptual understanding, drawing skills and reasoning skills required by MGC 110.

JPO 114 Additional 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 116 Additional mathematics 1 116
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 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 Additional Chemistry 2 121
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 chemical reasoning skills required by CHM 181

JPO 122 Additional 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 physic reasoning skills required by FSK 116/176.

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

JPO 124 Additional 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 Additional mechanics 125
Academic organisation: EBIT Dean's Office
Contact time: 1 lpw 3 tpw Foundation Course
Period of presentation: Semester 2
Language of tuition: **Credits:** 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by SWK 122.

JPO 126 Additional mathematics 2 126
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 mathematical reasoning skills required by WTW 161 and WTW 168.

JPO 127 Additional computers 127
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 222

JPO 152 Additional Physics 152
Academic organisation: School of Engineering
Contact time: 1 lpw 3 tpw
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 Additional Chemistry 1 161
Academic organisation: School of Engineering
Contact time: 1 lpw 3 tpw
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.

KBS 803 Construction management 803
Academic organisation: Engineering and Technology management
Contact time: 10 lpw
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

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 power-line bundles, bridge piers, risers, pipe lines under sea, stays, masts, chemical-reaction towers, offshore platforms and aircraft components.

MAN 420 Porous flow 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 lpw
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.

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 turbomachinery 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:
History of the gas turbine, cycles and engine design, gas turbine cycles types, military and civil engines, advanced cycles, review 2D design, 3D design of turbomachines, wind turbine design, secondary flows, loss mechanisms, loss mitigation methods, cooling/heat transfer, cascades, rotating machines, intrusive and un-intrusive techniques, full scale testing, standards.

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 410 Control systems 410
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MVR 320 GS
Contact time: 2 ppw 3 lpw
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.

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 1
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 421 Mechatronics 421
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 lpw
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.

MEG 780 Mechatronics 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 13 lpw
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.

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: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Convectiocorrelations; 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.

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.

MIA 320 Impact of engineering activity and group work 320
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 opw 2 lpw
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.

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 420 Maintenance engineering 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 lpw
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. Optimizing 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.

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.

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

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.

MIP 782 Maintenance logistics 782
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Introduction to Logistics, RAM (Reliability, Maintainability, and Availability), Measures of Logistics, Inventory Systems, Systems Engineering and Supportability Analysis: Systems Engineering Process, Supportability Analysis, Aspects of Logistical Design: Logistics in the Design and Development Phase, Just-in-Time Systems, Facility Layout, Job Design and Work Measurement, Logistics from the Development to the Retirement Phase: Logistics in the Production/Construction Phase, Logistics in the Utilisation and Support Phase, Planning and Scheduling: Forecasting, Planning, Maintenance Scheduling, Project Management, Theory of Constraints, Logistics Management: Quality Management, Supply Chain Management, Logistics Management.

MIP 783 Maintenance operations 783
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Understanding the Maintenance Function: Maintenance Models, Maintenance Profit Impact, Maintenance Reliability Centredness, Strategic Fundamentals, Building a Business Case for Maintenance, Maintenance Management Systems: Philosophies, System Structure, Database Structure, Maintenance Administration, Work/Cost/Materials Control, Maintenance Cost Management: Maintenance Cost Strategies, Maintenance Budgeting, Maintenance Cost Analysis, Total Productive Maintenance: History, Benefits, Structure, Implementation, Strategic Thinking in Maintenance: Principles, The role of a Maintenance Policy, Measurement, Quality in Maintenance: Quality Principles, Total Quality Management, Maintenance Application, Maintenance Risk: Risk Calculation, Macro Risk Management, Micro Risk Management, World Class Maintenance: Definitions, Methods to achieve WCM.

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.

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

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

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.

MJJ 210 Professional and technical communication 210
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 2 lpw 2 opw
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: uses appropriate structure, use of modern or electronic communication methods; style and language for purpose and audience; uses effective graphical support; applies methods of providing information for use by others involved in engineering activity; meets the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Typed reports range from short (300-1 000 word plus tables 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. Plagiarism policies and their implications.

MKI 420 Nuclear engineering 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 dpw 1 ppw 3 lpw
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 321 Continuum and computational structural mechanics 321
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (MSY 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. Kinematics of deformation and the strain tensor. Lagrangian and Eulerian descriptions. The stress tensor and equilibrium equations. Hooke's law for isotropic media. Boundary Value Problem formulation. Application of continuum mechanics to linear elasticity. Weak form of the Boundary Value Problem. Finite element method in structural mechanics. Applicability and limitations of the finite element method. Critical interpretation of results from commercial software.

MKM 411 Computational fluid dynamics 411
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:
Introduction to continuum mechanics, continuity equation, momentum equation, Navier-Stokes equation, energy equation, boundary conditions in thermal fluid systems, finite difference method, introduction to finite volume method (FVM), FVM for diffusion problems, FVM for convection-diffusion problems, introduction to pressure-velocity coupling in FVM. SIMPLE algorithm, selecting and assessing the applicability and limitations of the method, properly applying the method with commercial software, critically testing and assessing the end-results.

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.

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.

MLV 780 Flight mechanics 780
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:
Drag: friction, pressure, induced, interference, cooling, trim, drag estimation and reduction, piston engines, propellers, gas turbines, turbojet, turboprop and turbofan engines, propfan engines, aircraft performance, take off, climb, level flight, range, flight and manoeuvre envelopes, landing, energy methods, static stability and control: stick fixed, stick free, lateral stability and control, dihedral effect, coupling, dynamic longitudinal stability, short period oscillations, phugoid oscillations, dynamic damping, flight characteristics.

MLW 780 Aircraft design 780
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Conceptual aircraft design, the design process, sizing, airfoil and geometry considerations, thrust and wing loading, configuration layout and loft, crew and passenger considerations, propulsion, landing gear, aerodynamics, structures, weights, stability and control, performance, cost analysis, trade off studies, design proposals.

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 420 Optimum design 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 lpw
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.

MOO 780 Optimum design 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:
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.

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. Hookes 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: 3 lpw 4 tpw
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 lpw 3 tpw
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: 3 lpw 5 tpw
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 project 410
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 312 GS and MOW 323 GS
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.

MOX 780 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:
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 specialized 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 specialized 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 specialized 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 specialized and advanced nature, at the level of the other postgraduate modules offered by the Department.

MPR 213 Programming and information technology 213
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 4 lpw 4 ppw
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 opw
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 Faculty Administration within one week of registration. Attend two (2) industry visits in the first semester and two (2) industry visits in the second semester. Attend at least six (6) guest lectures through the year.

MPY 415 Practical training 415
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 opw
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 health and 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. Students must also attend two (2) industry visits in the first semester and two (2) industry visits in the second semester as well as attend at least six (6) guest lectures through the year.

MSA 780 Smart materials 780
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 10 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

MSC 412 Research project 412
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: Finalists only
Contact time: 8 opw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
The module involves the management of the execution of a project that produces knowledge and understanding of a phenomenon, conclusions and a recommended course of action. The project is undertaken under the supervision of a staff member with the student ultimately taking responsibility for the management of and execution of the project. The student should be able to demonstrate competence in designing and conducting investigations and experiments and adherence to well defined time-lines and work breakdown structures. 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 as well as communicating progress on a regular basis.

MSC 422 Research project 422
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: Finalists only, MSC 412
Contact time: 12 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 24
Module content:
Module content: The module involves the management of the execution of a project that produces knowledge and understanding of a phenomenon, conclusions and a recommended course of action. The project is undertaken under the supervision of a staff member with the student ultimately taking responsibility for the management of and execution of 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 and adherence to well defined time-lines and work breakdown structures. An acceptable process consists of but is not restricted to: (a) understanding of the stated problem, (b) developing a work breakdown structure, (c) performing the necessary analyses; (d) selecting and using appropriate equipment or software; (e) construction and instrumentation of an experimental set-up; (f) taking measurements; (g) analysing, interpreting and deriving information from data; (h) drawing conclusions based on evidence; (i) 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: 2 tpw 3 lpw
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.

MSE 780 Theory of elasticity 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:
Mechanics of elastic deformable bodies, based on the fundamental concepts of modern continuum mechanics: kinematics, balance laws, constitutive equations; classical small-deformation theory; formulation of boundary-value problems of linear elastostatics; plane problem of elastostatics; variational formulations, minimum principles.

MSF 780 Fracture mechanics 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:
Historical development; Linear Elastic Fracture Mechanics (LEFM): Stress concentrations and singularities, stress intensity factor, stability of crack propagation; Elasto-plastic fracture mechanics: crack tip plasticity, small scale yielding, measurement of Kic, J-integral; Fatigue crack growth: Paris Law; life prediction; combined mode fracture, strain energy density methods.

MSM 780 Numerical thermoflow 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 and 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 310 Structural mechanics 310
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 217, WTW 256
Contact time: 1 ppw 3 lpw
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.

MSY 732 Structural mechanics 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

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 specialized 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 specialized 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 specialized 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 specialized 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 310 Thermofluids 310
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 lpw
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 Thermofluids 410
Academic organisation: Mechanical and Aeronautical Engineering
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.
(i) Classification: kinetic and positive displacement pumps and compressors. Incompressible and compressible flow. Pump, compressor and fan theory.
(ii) Equipment: functioning, properties, characteristics and use of well-known pumps and compressors.
(iii) Applications: specific speed, cavitation, water hammer. Pump connections: pipe system connections. Pumping of solids. Air-pressure systems.

(iv) Turbo machines: turbo machine theory. Impulse and reaction turbines. Analytical analysis. Characteristics: applications; integration of hydroturbines with power systems.

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 specialized 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 specialized 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 specialized 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 specialized and advanced nature, at the level of the other postgraduate modules offered by the Department.

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

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 multi-velocity 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 420 Fossil fuel power stations 420
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 ppw 3 lpw
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.

MUU 781 Fossil fuel power stations 781
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 13 lpw
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, feed water and circulating water systems, coal handling, 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: 1 ppw 3 lpw
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.

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.

MVM 780 Fluid machines 780
Academic organisation: Mechanical and Aeronautical Engineering
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8

MVR 320 Vibration and noise 320
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (MSD 210)
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Introduction to vibration: basic concepts, classification, modelling 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 lpw 3 tpw
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: 1 ppw 3 lpw
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.

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.

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

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.

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 electrocrystallization processes and present practices used for the electrowinning of metals such as copper, nickel, cobalt, zinc, manganese and gold.

NEX 320 Excursions 320
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMP 310)
Contact time: 1 lpw 6 ppw
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.

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 re-crystallisation; grain growth and the use of grain boundary engineering; the

martensite, bainite and pearlite transformations; thermomechanical processing and some elements of quantitative metallography. The course is practice orientated; the current best fundamental understanding of these transformation processes covered, and its role in engineering application demonstrated. The course 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 post graduate 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 course is partly available on CD-ROM with up-to-date references to the latest literature.

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.

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 course 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.

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

NJJ 210 Professional and technical communication 210
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 2 lpw
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: uses appropriate structure, use of modern or electronic communication methods; style and language for purpose and audience; uses effective graphical support; applies methods of providing information for use by others involved in engineering activity; meets the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Typed reports range from short (300-1 000 word plus tables 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.

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 course 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.

NMC 113 Materials science 113
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 1 ppw 1 tpw 4 lpw
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: 1 ppw 1 tpw 4 lpw
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: 2 ppw 4 lpw
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 Materials science 313
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMC 223)
Contact time: 3 lpw 3 ppw
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 microscopy). 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: 3 lpw 4 ppw
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.

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 course is largely available on CD-ROM with references to the latest literature.

NMP 310 Minerals processing 310
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 3 lpw 4 ppw
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 2 ppw 3 lpw
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.

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: 10 lpw
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.

NOP 421 Process design 421
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NMP 411)
Contact time: 1 lpw 1 tpw
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.

NPA 700 Metallurgical analysis 700
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
The aim is to solve metallurgical problems with the aid of hi-tech analytical techniques. These different analytical techniques are given in modular form and the respective metallurgical area of specialisation will dictate the combination of three techniques to suit the requirements of the research student. Specialisation areas like Physical Metallurgy, Welding Metallurgy, Hydro Metallurgy, Pyro Metallurgy and Minerals Processing are covered and any other combination can be requested by the study leaders after consultation with the course leader. The techniques included are TEM, SEM, Auger Spectroscopy (AES), X-ray Photo-electron Spectroscopy (XPS), Glow Discharge Optical emission Spectroscopy (GDOES), X-ray Diffraction (XRD), X-ray fluorescence (XRF), Gleeble hot working simulations and Dilatometry. Lectures cover the theory of these techniques in depth and the theory is illustrated with industrial case studies.

NPB 412 Process metallurgy and control 412
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NPM 321)
Contact time: 1 tpw 2 lpw
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: 2 tpw 3 lpw
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).

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.

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: 2 ppw 3 lpw
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 opw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
*Attendance module only
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 Faculty Administration 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 opw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
*Attendance module only
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.

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 321 Refractory materials 321
Academic organisation: Materials Science and Metallurgical Engineering
Prerequisite: (NPT 220) and NPM 321 #
Contact time: 1 tpw 2 lpw
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.

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.

NWM 780 Mathematical modelling of metallurgical processes and materials 780
Academic organisation: Materials Science and Metallurgical Engineering
Contact time: 48 Contact hours
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 32
Module content:
This module covers both the theory and practice of mathematical modelling applied to metallurgical processes and materials. The module applies the theory mastered in prior learning such as mathematics, physics, thermodynamics, fluid mechnanics, heat transfer, etc. to create mathematical representations of processes and materials. A range of modelling techniques is addressed in the module, such as solution models of solid and liquid mixtures, mass and energy balances, steady state process models, dynamic process models, heat transfer models, computational fluid dynamics models, multiphysics models and technical-economic models. The created models are then applied to solve problems encountered in research and industry.

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.

PEE 410 Mine environmental control engineering 410
Academic organisation: Mining Engineering
Prerequisite: MTV 310, Finalists only
Contact time: 1 tpw 2 ppw 3 lpw
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.

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

PHS 781 Slope stability 781
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PJJ 210 Professional and technical communication 210
Academic organisation: Mining Engineering
Contact time: 2 lpw 2 opw
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: uses appropriate structure, use of modern or electronic communication methods; style and language for purpose and audience; uses effective graphical support; applies methods of providing information for use by others involved in engineering activity; meets the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Typed reports range from short (300-1 000 word plus tables 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.

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

PME 320 Mineral economics 320
Academic organisation: Mining Engineering
Contact time: 1 tpw 4 lpw
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: 2 tpw 3 lpw
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: 2 tpw 3 lpw
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 320, Finalists only
Contact time: 1 tpw 2 ppw 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: Finalists only
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 1
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.

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 422 Mine design 422
Academic organisation: Mining Engineering
Prerequisite: PMY 410, PSZ 410, PEE 410. PNB 400, Finalists only
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 – 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.

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

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, Finalists only
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.

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

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, in English only.

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 opw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
*Attendance module only
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:
Explosive engineering: 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 realized 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.

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 785 Advanced explosive engineering 785
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
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.

PSC 321 Introduction to project 321
Academic organisation: Mining Engineering
Contact time: 1 tpw 2 lpw
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, Finalists only
Contact time: 1 tpw
Period of presentation: Semester 2
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.

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 410 Strata control 410
Academic organisation: Mining Engineering
Prerequisite: SWK 210, PMY 320, Finalists only
Contact time: 1 tpw 2 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Three dimensional stress and strain tensors and linear elasticity. The state of stress in the earth's crust. Rock material and rock mass failure criteria. The response of the rock mass to underground excavations, energy release rate and excess shear stress. Mining induced seismicity, rock bursts and measures to minimise mining induced seismicity so as to improve SHE. Elementary mine layout design, pillar design and underground excavation support and their effects on SHE. Stress analysis of mining layouts and mine layout optimisation.

PSZ 703 Basic rock mechanics 703
Academic organisation: Mining Engineering
Contact time: Self study
Period of presentation: Semester 1
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 2
Language of tuition: English **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

PWP 121 Workshop practice 121
Academic organisation: Mining Engineering
Contact time: 1 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*Attendance modules only
The modules are presented during the first year of study and, subject to departmental arrangements, can be attended either during July or December holiday periods. The

duration will be a minimum of two weeks, during which time the student will receive training in a mine as well as a mine workshop. Training will include the following maintenance aspects: rotary and percussion drills, transport equipment, hoists and hoist ropes, electrical motors, conveyor belts and pumps. A satisfactory report must be submitted within two weeks after the commencement of lectures of the following semester.

PYI 890 Dissertation: Mining engineering 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

SBM 321 Civil building materials 321
Academic organisation: Civil 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:
The behaviour, properties and application of cement and concrete products, structural steel, fibre reinforcing, polimers, masonry work and bituminuous materials.

SBZ 221 Civil engineering measurement techniques 221
Academic organisation: Civil Engineering
Contact time: 1 ppw 2 lpw 3 tpw
Period of presentation: Semester 2
Language of tuition: English **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 sensors, displacement transducers, stress cells and inclinometers. Adjustment and use of plane table, level, compass and theodite. Elementary site survey and levelling. Definition of survey. Coordinate systems and bearing. Method of determining levels. Tachometry.

SBZ 420 Civil engineering construction management 420
Academic organisation: Civil Engineering
Prerequisite: (SVC 412)
Contact time: 1 ppw 1 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: English **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.

SCA 420 Computer applications in civil engineering 420
Academic organisation: Civil Engineering
Prerequisites: (SHC 410) (SIN 411) (SIN 413) (SGM 323) (SVC 412)
Contact time: 2 ppw 2 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
In this module commercially available computer packages will be used to develop models based on Finite Elements, Finite Differences and other approaches. Limitations and simple checks to ensure consistency of commonly used design software packages will be illustrated. Basic principles and techniques will be discussed and the effect of aspects such as meshing, element choice, boundary conditions and material properties will be investigated. Applications within the various fields of Civil Engineering will be considered. Results obtained from models will be compared to actual experimental results. This module will contain groupwork and multi-disciplinary problems will be solved.

SDO 420 Detailed design 420
Academic organisation: Civil Engineering
Prerequisite: (SHC 410), (SIN 411), (SIN 413), (SGM 323), (SVC 412)
Contact time: 1 ppw 1 tpw 5 lpw
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 1 tpw 4 lpw
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 characterization 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.

SGC 793 Pavement design 793
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year

Language of tuition: English **Credits:** 24
Module content:
Design philosophy in First and Third World environments; characterising and use of pavement materials; drainage; systems approach to layout, geometric and pavement design; stresses and strains in pavements; mechanistic design methods and elasto-plastic behaviour; economic analysis; designing pavements for streets, gravel and paved roads, runways, and industrial areas. Report writing.

SGC 794 Concrete technology 794
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Properties of concrete and concrete mixes. Characteristics of Portland cement and supplementary cementitious materials. Aggregates, admixtures and practical design of mixes. Manufacture, curing and testing, including non-destructive methods. Statistical approach to quality control. Time-dependent behaviour and durability of concrete. The principles for appropriate selection of materials and techniques for repair, maintenance and strengthening of civil engineering structures. Investigation and diagnosis. Corrosion of reinforcement. Alkali-aggregate reaction, sulphate attack. Physical degradation. Repair materials. Protective systems. Systems for repair.

SGC 797 Road rehabilitation technology 797
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Development of road management systems and application to existing street and road networks. Evaluation of, and measurements on existing facilities. Maintenance management. Recycling of materials. Design methods for upgrading, re-construction and strengthening of the existing road infrastructure. Prerequisite: Pavement Design SGC 793.

SGI 890 Dissertation 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

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 Afrikaans and English **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: 1 tpw 2 ppw 3 lpw
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 2 dpw 3 lpw
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.

SGM 785 Basic soil mechanics 785
Academic organisation: Civil Engineering
Contact time: 20 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Introduction to soil mechanics, classification of soil characteristics, seepage and permeability, stress and strain in saturated and partially saturated soils, Mohr's circle applications.

SGM 787 Basic pavements and transportation 787
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24

Module content:
Pavements: The geological cycle and origin of road building materials, soil testing and classification systems, compaction, stabilization, bitumen, introduction to pavements, principles of pavement design and management.
Transportation: Introduction to traffic analysis techniques, capacity and level of service concepts, traffic signal design, road geometric design, transport demand models and road safety engineering.

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 787 Analytical soil mechanics 787
Academic organisation: Civil Engineering
Contact time: 20 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Solution of confined and unconfined seepage problems using the methods of fragments, finite differences and finite elements. Numerical solutions of consolidation problems and secondary compression. Slope stability analysis methods. The point estimate method. Monte Carlo simulation.

SGS 788 Theoretical soil mechanics 788
Academic organisation: Civil Engineering
Contact time: 20 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Introduction to critical state soil mechanics. Stress and strain invariants. Stress paths. State boundary surfaces including Roscoe and Hvorslev surfaces. Cam clay model. Application of geotechnical constitutive models in finite element analysis.

SGS 789 Specialised geotechnical testing 789
Academic organisation: Civil Engineering
Contact time: 32 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Test procedures and interpretation of; Standard Penetration Test (SPT), Cone Penetration Test (CPT), Piezocone (CPTU) and seismic methods. Theory, application and interpretation of advanced geotechnical laboratory tests. Laboratory Instrumentation and calibration. Stress and strain conditions for laboratory tests. Triaxial stress space, stress paths. Triaxial tests, direct shear tests, oedometer test and Rowe cell test.

SHC 310 Hydraulics 310
Academic organisation: Civil Engineering
Prerequisite: (SWK 210)
Contact time: 1 dpw 1 ppw 4 lpw

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 ppw 1 tpw 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), SHC 321GS
Contact time: 1 ppw 1 tpw 4 lpw
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.

SHC 792 Flood hydrology 792
Academic organisation: Civil Engineering
Contact time: 32 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This course entails the calculation of design flows for different return periods, using the statistical, deterministic – and empirical methods. Dambreak analysis is included in this course as well as channel and level pool routing.

SHC 793 Hydraulic design 793
Academic organisation: Civil Engineering
Contact time: 32 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This course covers the hydraulic aspects associated with the design of hydraulic structures for dams, road drainage, and other conveyance systems. The hydraulic considerations for the selection and design of energy dissipation structures are assessed in this course.

SHC 794 Free surface flow 794
Academic organisation: Civil Engineering
Contact time: 32 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This course entails the calculation of design flows for different return periods, using the statistical, deterministic – and empirical methods. Dambreak analysis is included in this course as well as channel and level pool routing.

SHC 795 Pipe flow 795
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
The focus in this course will be on the practical aspects of pipeline design. The theoretical background to pipeline hydraulics will be covered and practical examples will be assessed. The following specific aspects such as pipeline hydraulics included dynamic pressures, pipeline component selection and design, pipeline installation and the testing and operation of pipelines will be covered in this course.

SHC 796 Water resource analysis and management 796
Academic organisation: Civil Engineering
Contact time: 32 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
In this course students will be familiarized with the background and procedures used in the creation of flow records and the use of the WRSM2005 model. Surface water systems will be analysed and gross yields will be determined. In the second part of the course the theory and procedures required for the yield determination of surface water resources will be discussed.

SHC 797 Basic statistical methods 797
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Basic mathematical methods. Algebra. Matrices and matrix algebra. Series expansions. Differentiation and integration. Probability theory. Graphic analysis. Discrete and continuous probability distributions. Moments and expectation. Statistical sampling and experimental design. Parameter estimation. Confidence intervals. Hypothesis testing. Regression analysis.

SHC 798 Applied statistical methods and optimisation 798
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24

Module content:
The course will apply some of the basics theories and methodologies in statistics and operations research to solve common civil engineering problems. The course seeks to demonstrate the use and application in the civil engineering field. Each of the applications seeks to determine how best to design and operate a system, usually under conditions requiring the allocation of scarce resources. Emphasis will be on the applications of these methods in common civil engineering practice. Some of the applications will include; optimum network design, maximum flow problem, project scheduling, queuing theory, Markov chain applications, etc.

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

SHW 785 Pump systems 785
Academic organisation: Civil Engineering
Contact time: 32 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24

SHW 788 Basic hydraulics 788
Academic organisation: Civil Engineering
Contact time: 28 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This course covers the basic hydraulic principles and their application. Themes covered include: fluid characteristics, fluid kinematics, pipe flow, pipe networks, introduction to pumps and pump stations, free surface flow, flow measurement, hydraulic assessment of hydraulic structures, storm water drainage and culvert systems and flood hydrology.

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.

SIC 790 Basic structural analysis 790
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Virtual work and influence lines, analysis of statically indeterminate structures (two and three-dimensional), slope-deflection, superposition, stiffness and flexibility methods, matrix and computer methods, plastic analysis of portal frames.

SIC 793 Basic structural design 793
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This course comprises two sections: reinforced concrete design and structural steel design.
Reinforced concrete design covers the design of beams; behaviour and design of slabs; design of slender columns and columns subjected to bi-axial bending; design of simple and combined footings; staircase design; and an introduction to prestressed concrete. Structural steel design covers the characteristics of steel; design of structural steel members including elements in bending, and bending combined with tension and compression; design of portal frames; composite construction and the bending resistance of composite sections; and plastic design.

SIE 310 Civil engineering economics 310
Academic organisation: Civil Engineering
Contact time: 2 lpw 2 opw
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.

SIK 780 Numerical methods for Civil Engineers 780
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
In this course, numerical procedures for solving complex engineering systems with the aid of linear equations, eigenvalue procedures, numerical integration, finite differences analyses, finite elements review, Fourier transformation and optimization will be reviewed and discussed.
Some underlying theory for these numerical algorithms will be demonstrated and applicable and relevant problems associated with the use of these algorithms in the field of Civil Engineering will be covered.

SIN 223 Structural analysis 223
Academic organisation: Civil Engineering
Prerequisite: WTW 161, WTW 168 and SWK 210
Contact time: 1 tpw 2 ppw 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 1 tpw 2 lpw
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: 1 ppw 1 tpw 2 lpw
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: 1 ppw 1 tpw 2 lpw
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: 1 ppw 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Analysis 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 ppw 1 tpw 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.

SIN 776 Steel design 776
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Introduction to structural reliability, tension elements, buckling of plates in compression elements, compression elements, beams and plate girders, plastic analysis and design of structures and structural elements, connections, composite design and steel-framed structures.

SIN 777 Structural mechanics 777
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Continuum mechanics. Classical and numerical (finite difference and finite element) solutions for plane and plate structures. Plasticity and failure criteria. Elastic stability. Non-linear analysis.

SIN 778 Reinforced concrete design 778
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Material properties. Behaviour and analysis of reinforced concrete members for flexure, axial loads, flexure plus axial load and shear. Cracking and deflection (short- and long-term) of flexural members. Plasticity in flexural members. Braced and unbraced slender columns.

SIN 779 Timber design 779
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Timber properties, grading, treatment, structural form, element design and bracing of structures. Analysis of I-beams, composite beams, frames and connections. Research project.

SIN 790 Structural analysis 790
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Stiffness and flexibility methods for plane, grid and three-dimensional structures.In-plane stability of beam-columns and frames; effective lengths and lateral torsional instability of beams. Dynamics: free and forced, undamped and damped framed systems and mass matrices and natural frequencies.

SIN 791 Pre-stressed concrete design 791
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Material properties; prestressing systems; flexural design; losses; effects of continuity; shear; deflections; anchorage; cracking; prestressed concrete slabs and detailing.

SIN 890 Dissertation: Structural engineering 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

SIR 780 Finite element applications in Civil Engineering 780
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This course covers general finite element theory; discretization aspects related to geometry, nodes and numbering, element type and shape; interpolation functions; formulation of element characteristic matrices and vectors for elasticity problems; assembly and solution of the finite element equations; modelling procedures and results processing. More advanced applications of finite elements such as non-linear static elasticity, buckling, dynamics and transient thermal problems will be covered. In terms of the application of the Finite Element method, the student will choose a specific field (e.g. structures, geotechnical, transportation or water/hydrology) to apply the theory that was covered in the course to solve typical Civil Engineering problems.

SIR 990 Thesis: Civil engineering 990
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

SJJ 210 Professional and technical communication 210
Academic organisation: Civil Engineering
Contact time: 2 lpw 2 opw
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: uses appropriate structure, use of modern or electronic communication methods; style and language for purpose and audience; uses effective graphical support; applies methods of providing information for use by others involved in engineering activity; meets the requirements of the target audience. Effective oral communication as evidenced by appropriate structure, style and language; appropriate visual materials; delivers fluently; meets the requirements of the intended audience. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Typed reports range from short (300-1 000 word plus tables 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.

SPY 410 Practical training 410
Academic organisation: Civil Engineering
Contact time: 1 opw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Attendance module only
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) (SVC 323)
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.

SSI 790 Infrastructure management 790
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
This module will cover the following topics: Asset Management principles, Maintenance Management principles, Maintenance strategies and philosophies, Condition based Maintenance, Reliability Centred Maintenance (RCM), Resource Management, Maintenance Management Systems, Total Productive Maintenance (TPM) and Risk Management. Maintenance management of the following disciplines will be studied in detail: Road infrastructure, Railway infrastructure, Airport infrastructure, Buildings and other structures, Water resources and water supply.

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

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: Civil Engineering
Prerequisite: SIE 310/BIE 310
Contact time: 2 ppw 4 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.

SVC 789 Transportation planning 789
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Introduction to transport planning processes and institutions in S.A. Introduction to contemporary issues in land use/transport planning (including in urban transport; rural transport; air transport; energy and environment). Social, economic, and political impacts and dependencies of transport. Project evaluation, discounting, inflation, engineering economic studies. Benefit - cost analysis. Risk and sensitivity analysis. Social accounting for transport projects.

SVC 790 Transportation studies 790
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Basic transportation relationships, land use, data collection and surveys. Four step transportation model, trip generation, trip distribution, modal split, trip assignment, advanced modelling approaches. Introduction to discrete choice models, econometrics, and stated preference analysis. Role of transport modelling in developmental context.

SVC 791 Transportation special 791
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Basic transportation relationships, land use, data collection and surveys. Four step transportation model, trip generation, trip distribution, modal split, trip assignment, advanced modelling approaches. Introduction to discrete choice models, econometrics, and stated preference analysis. Role of transport modelling in developmental context.

SVC 792 Traffic engineering 792
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Part 1: Traffic flow theory: Traffic and vehicle characteristics. Traffic flow studies. Traffic interactions. Traffic flow analysis and queuing theory. Traffic flow models. Traffic control theory. Part 2: Traffic studies and facility design: Transportation and land use. Traffic impact studies. Site planning and design. Determination of demand. Traffic control investigations. Intersection design. Internal circulation. Parking areas.

SVI 890 Dissertation 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: English **Credits:** 128

SVV 788 Multimodal transport 788
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
The role of public transport in cities; theory and principles of public transport network design, scheduling and operations; terminals; public transport modes; costs, fares and subsidies; contemporary issues and approaches to public transport restructuring and formalisation in South Africa, including Bus Rapid Transit (BRT). Planning and designing for non-motorised transport, including pedestrians, bicyclists, and animal-drawn transport.

SVV 791 Geometric design and safety 791
Academic organisation: Civil Engineering
Contact time: 40 Contact hours
Period of presentation: Year
Language of tuition: English **Credits:** 24
Module content:
Rural/Peri-urban road networks: transportation policy, standards and safety, environmental quality, capacity, design, interchanges. Urban street networks: functional classes, town planning considerations, capacities, environment, safety, standards design, evaluation of road networks.
Traffic safety in global and national content, Road Safety Engineering and the assessment and interpretation of accident information, reactive and proactive identification of remedial measures, traffic safety strategies: 3E model and Haddon matrix.

SWK 122 Mechanics 122
Academic organisation: Civil Engineering
Prerequisite: WTW 158
Contact time: 2 tpw 4 lpw
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
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.

SWK 211 Statics 211
Academic organisation: Civil Engineering
Prerequisite: SWK 122
Contact time: 1 ppw 2 lpw 3 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
Centroids: centroids of lines, surfaces and volumes. Constraints and statical determinancy. Space trusses. Bending moments and cables: distributed loads, parabolic and uniform cables. Liquid statics: buoyancy. Elasticity: stress-strain, stiffness, elastic moduli relations, torsion. Deflection of beams: deriviation of differential equations, bending stresses. Friction: friction surfaces, wedges, screws, belt, bearings and rolling resistance. Work and energy, virtual work. Vibration.

SWP 121 Workshop practice 121
Academic organisation: Civil Engineering
Contact time: 1 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 6
Module content:
*Attendance module only
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.

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. Focus on design aspects

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. Focus on the science and not the design aspects

WBK 890 Dissertation: Water resource engineering 890
Academic organisation: Civil Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 128

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
Module content:
Composition and characterisation of sewage; Basic design principles of: Simple sewage treatment systems – night soil, pit latrines, septic tanks; Small scale sewage works – oxidation dams, biological filters and reed beds; Anaerobic digestion; Suspended – and Attached growth processes; Sludge handling and treatment. The module includes training and practice for simulation software for wastewater treatment processes. Focus on design aspects.

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
Module content:
Composition and characterisation of sewage; Basic design principles of: Simple sewage treatment systems – night soil, pit latrines, septic tanks; Small scale sewage works – oxidation dams, biological filters and reed beds; Anaerobic digestion; Suspended – and Attached growth processes; Sludge handling and treatment. The module includes training and practice for simulation software for wastewater treatment processes.

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
Module content:
Water quality standards: drinking water quality standards (chemical), performance evaluation for drinking water treatment systems Basic water chemistry: Acid-base and solubility equilibrium chemistry; Chemistry of the carbonate system Conventional drinking water treatment: coagulation-flocculation; sedimentation, flotation; sand filtration; chlorination; chemical stabilisation. Advanced drinking water treatment: activated carbon adsorption; ozone and ultra-violet disinfection; enhanced coagulation; membrane processes; softening; iron and manganese removal. Industrial water treatment: chemical precipitation; neutralisation; oxidation-reduction; desalination processes; ion exchange. Focus on design aspects.

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
Module content:
Water quality standards: drinking water quality standards (chemical), performance evaluation for drinking water treatment systems. Basic water chemistry: Acid-base and solubility equilibrium chemistry; Chemistry of the carbonate system. Conventional drinking water treatment: coagulation-flocculation; sedimentation, flotation; sand filtration; chlorination; chemical stabilisation. Advanced drinking water treatment: activated carbon adsorption; ozone and ultra-violet disinfection; enhanced coagulation; membrane processes; softening; iron and manganese removal. Industrial water treatment: chemical precipitation; neutralisation; oxidation-reduction; desalination processes; ion exchange.

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
Module content:
Water quality parameters: physical, chemical, biological, microbiological; Units of expression; Evaluation of parameters; Methods of analysis and practical laboratory analyses; Water quality interpretation, evaluation and assessment, water quality guidelines and requirements for domestic, industrial, agricultural, ecological, recreational requirements; Limnology and water quality in rivers and lakes; Surface water modelling; Ground water quality and assessment; Regulatory aspects including all relevant legislation; Integrated environmental management, integrated pollution control; Procedures to assess effluent discharge impacts; and Water quality management, policies and procedures, role of catchment management agencies, and catchment management plans.

WWP 121 Workshop practice 121
Academic organisation: Mechanical and Aeronautical Engineering
Contact time: 1 opw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 6
Module content:
*Attendance module only
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.

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

List of modules presented by other faculties

Faculty of Humanities

HAS 110 Humanities and social sciences 110
Academic organisation: Anthropology and Archaeology
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: Afrikaans
Contact time: 2 lpw
Period of presentation: Semester 2
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.

Faculty of Natural and Agricultural Sciences

CHM 171 General chemistry 171
Academic organisation: Chemistry
Contact time: 1 dpw 4 lpw 1 ppw 1 wbppw
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 4 lpw 1 ppw 1 wbppw
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 4 lpw 1 ppw 1 wbppw
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 3 lpw 1 ppw 1 wbppw
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
Contact time: 1 dpw 4 lpw 1 ppw
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 4 lpw 1 ppw
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
Contact time: 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Eng **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: Par 1.2
Contact time: 4 lpw 1 ppw
Period of presentation: Quarter 4
Language of tuition: Eng **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: CMY 117, GLY 155 and 1 of GLY 161, GLY 162 and WTW 114 or WTW 158 or PHY 114
Contact time: 4 lpw 1 ppw
Period of presentation: Quarter 1
Language of tuition: Eng **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
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 2
Language of tuition: Eng **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 220 Surveying 220
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 1 ppw
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: 4 lpw 1 tpw
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: 2 lpw 1 tpw
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: 2 lpw 1 tpw
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: 4 lpw 2 tpw
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.

Faculty of Law

BER 310 Business law 310
Academic organisation: Mercantile Law
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introduction to law. General principles of the law of contract. Specific contracts: purchase contracts; letting and hiring of work; employment contracts. Agency. General aspects of entrepreneurial law. Dispute resolution – mediation and arbitration.

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.

BSR 410 Management Accounting 410
Academic organisation: Financial Management
Prerequisite: FBS 110
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
The work of management and the need for managerial accounting information. The changing business environment. Cost terms, concepts, and classification. Job order costing. Process costing. Activity-based costing and quality management. Cost-volume-profit relations. Variable and fixed costing. Budgeting and control. Standard costs and flexible budgets. Segment reporting and decentralisation. Relevant costs for decision-making. Allocations of service departments cost to operating departments.

FBS 110 Financial management 110
Academic organisation: Financial Management
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10

Module content:
*Only for BSc (Mathematical Statistics. Construction Management, Real Estate and Quantity Surveying) and BEng (Industrial Engineering) students.
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.

FBS 830 Financial management 830
Academic organisation: Financial Management
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

FBS 831 Financial management 831
Academic organisation: Financial Management
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

PEM 883 People management 883
Academic organisation: Human Resource Management
Contact time: 3 dpw 16 lpw 2 wbppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16

PEM 884 People management 884
Academic organisation: Human Resource Management
Contact time: 3 dpw 16 lpw 2 wbppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16

School of Information Technology

COS 110 Program design: Introduction 110
Academic organisation: Computer Science
Prerequisite: COS 153 or COS 131 or COS 132 and Maths level 5 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: 1 ppw 4 lpw
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 222 Operating systems 222
Academic organisation: Computer Science
Prerequisite: COS 153 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**.**

E&OE