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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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
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PART II
(separate publication)

SCHOOL FOR THE BUILT ENVIRONMENT
• Architecture and Landscape Architecture
• Construction Economics
• Town and Regional Planning

PART III
(separate publication)

SCHOOL OF INFORMATION TECHNOLOGY
• Informatics
• Information Science
• Computer Science
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FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

SCHOOL OF ENGINEERING

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GENERAL INFORMATION

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 business, the University uses two official languages, namely English and Afrikaans. In formal education the language of tuition is either English or Afrikaans, or both of these languages; provided that there is a demand and that it is academically and economically justifiable. However, it remains the student’s responsibility to ascertain on an annual basis in which language a module and any further level of that module is presented. In respect of administrative and other services, a student has the right to choose whether the University should communicate with him or her in English or Afrikaans. Where the University has the capacity, Sepedi is used as an additional language of communication.

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.

Degree with distinction
Weighted averages (GPA), together with other faculty-specific criteria if applicable, are used at UP to calculate averages for the determination of distinctions.

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 Faculty 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]

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**Regulations for the degree: Bachelor of Engineering [BEng]**

The rules for the degrees published in this Yearbook are subject to change and may be amended prior to the commencement of the academic year in 2015.

The General Regulations (G Regulations) apply to all faculties of the University of Pretoria. It is expected of each student to familiarise himself or herself well with these regulations. Ignorance concerning these regulations will not be accepted as an excuse for any transgression.

Please read all the Faculty Regulations in conjunction with the General Regulations.

**Eng. 1**

**Admission to degree study**

The 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 the General Regulations, G.1.3 and G.54, 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 Faculty Regulations Eng. 13.1 and Eng. 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.

<table>
<thead>
<tr>
<th>Rating code</th>
<th>Rating</th>
<th>Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Outstanding achievement</td>
<td>80-100%</td>
</tr>
<tr>
<td>6</td>
<td>Meritorious achievement</td>
<td>70-79%</td>
</tr>
<tr>
<td>5</td>
<td>Substantial achievement</td>
<td>60-69%</td>
</tr>
<tr>
<td>4</td>
<td>Adequate achievement</td>
<td>50-59%</td>
</tr>
<tr>
<td>3</td>
<td>Moderate achievement</td>
<td>40-49%</td>
</tr>
<tr>
<td>2</td>
<td>Elementary achievement</td>
<td>30-39%</td>
</tr>
<tr>
<td>1</td>
<td>Not achieved</td>
<td>0-29%</td>
</tr>
</tbody>
</table>

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

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

NB
Mining Engineering students are advised to also check if they are medically compliant
with the government requirements to work on a mine.

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 compiled 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 the General Regulations. G.12.3

(e) Supplementary examinations
Refer to General Regulation G.12.4.
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 the General Regulations. G.14

(i) Duration of examinations in undergraduate modules
The duration of an examination in an 8-credit module will not exceed 90 minutes and in a 16-credit module will not exceed 180 minutes, except where special approval is granted by the Dean to exceed these limits. The duration of a supplementary examination or a special examination in all undergraduate modules will not exceed 90 minutes, except where special approval is
Engi
neering
2015

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, 2015. 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 Faculty Regulations Eng. 13.1 and Eng. 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:

<table>
<thead>
<tr>
<th>Letter</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Industrial and Systems Engineering</td>
</tr>
<tr>
<td>C</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>E</td>
<td>Electrical, Electronic and Computer Engineering</td>
</tr>
<tr>
<td>M</td>
<td>Mechanical and Aeronautical Engineering</td>
</tr>
<tr>
<td>N</td>
<td>Materials Science and Metallurgical Engineering</td>
</tr>
<tr>
<td>P</td>
<td>Mining Engineering</td>
</tr>
<tr>
<td>S</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>I</td>
<td>Graduate School of Technology Management</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Code</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>()</td>
<td>Code in brackets: (XYZ 151)</td>
</tr>
<tr>
<td>GS</td>
<td>Code followed by GS: XYZ 151 GS</td>
</tr>
<tr>
<td>#</td>
<td>Code followed by #: XYZ 151#</td>
</tr>
</tbody>
</table>

Minimum requirement

- Examination admission
- Combined (final) mark of 40% - 49%
- 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 Faculty Regulations Eng. 14, Eng. 15 and Eng. 16.

<table>
<thead>
<tr>
<th>Module</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWK 122</td>
<td>Mechanics 122</td>
<td>16</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Module</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>JCP 203</td>
<td>8</td>
<td>Community-based project 203</td>
</tr>
</tbody>
</table>

Please note: 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 (12130021)

First year of study

First semester

<table>
<thead>
<tr>
<th>Module</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 171</td>
<td>16</td>
<td>General chemistry 171</td>
</tr>
<tr>
<td>CIR 113</td>
<td>8</td>
<td>Chemical engineering 113</td>
</tr>
<tr>
<td>FSk 116</td>
<td>16</td>
<td>Physics 116</td>
</tr>
<tr>
<td>HAS 110</td>
<td>8</td>
<td>Humanities and social sciences 110</td>
</tr>
<tr>
<td>MGC 110</td>
<td>16</td>
<td>Graphical communication 110</td>
</tr>
<tr>
<td>WTW 158</td>
<td>16</td>
<td>Calculus 158</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td></td>
</tr>
</tbody>
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Second semester

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Second year of study

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**Please note:** Students who have passed CBI 311, receive credit for CBI 410.
Second semester

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(b) Civil Engineering (12130081)

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Second year of study

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## Third year of study

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**Recess training**  
SPY 410 Practical training 410  16

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(c) Computer Engineering (12130101)

**First year of study**

**First semester**

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**Second year of study**

**First semester**

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Third year of study
First semester

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Fourth year of study
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(d) Electrical Engineering (12130031)

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First semester

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**Fourth year of study**

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### (e) Electronic Engineering (12130091)

### First year of study

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### Third year of study

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### (f) Industrial Engineering (12130011)

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# Third year of study

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## Second semester

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# Fourth year of study

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Engineering 2015

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### (g) Mechanical Engineering (12130051)

#### First year of study

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#### Second year of study

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### Third year of study

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### Fourth year of study

#### First semester

**Option – Mechanical and Aeronautical**

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

#### Second semester

**Option – Mechanical**

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One elective from the following:

- MAN 420 Porous flow 420 16
- MEG 421 Mechatronics 421 16
- MHM 420 Heat and mass transfer 420 16
- MIL 420 Maintenance engineering 420 16
- MKI 420 Nuclear engineering 420 16
- MLV 420 Aeronautics 420 16
- 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
- MSC 422 Research project 422 24 Finalists only, MSC 412
- MTV 420 Thermal and fluid machines 420 16

Elective module:

- MLV 420 Aeronautics 420 16

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 (12130061)

#### First year of study

##### First semester

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##### Recess training

- WWP 121 Workshop practice 121 6
### Second year of study

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### (i) Mining Engineering (12130071)

#### First year of study

#### First semester

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<td>SWK 122</td>
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<td>WTW 161</td>
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<td>WTW 263</td>
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<td>IPI 410 Engineering professionalism 410</td>
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<td>PEE 410 Mine ventilation engineering 410</td>
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<td>PMZ 422 Mine design 422</td>
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<td>PNB 400 Industrial excursions 400</td>
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<td>PSC 411 Project 411</td>
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**Eng. 13.2 Engineering Augmented Degree Programme (ENGAGE)**

The ENGAGE programme is presented in the following fields of study:

(a) Chemical Engineering (12136021)
(b) Civil Engineering (12136081)
(c) Computer Engineering (12136101)
(d) Electrical Engineering (12136031)
(e) Electronic Engineering (12136091)
(f) Industrial Engineering (12136011)
(g) Mechanical Engineering (12136051)
(h) Metallurgical Engineering (12136061)
(i) Mining Engineering (12136071)

**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 Faculty Regulations 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 Faculty Regulation 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

<table>
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<tbody>
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<td>Community-based project 203</td>
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Please note: 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 (ENGAGE)

## First year of study

### First semester

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<tbody>
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<td>Professional orientation 110</td>
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<td>JPO 111</td>
<td>8</td>
<td>Additional chemistry 1 111</td>
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### Second semester

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<td>JPO 122</td>
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<td>JPO 126</td>
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<td>WTW 161</td>
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<td>Linear algebra 161</td>
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## Second year of study

### First semester

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### Second semester

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**Third year of study**

### First semester

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<td>SWK 210 Strength of materials 210</td>
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### Second semester

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**(b) Civil Engineering (ENGAGE)**

### First year of study

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#### Second semester

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# Second year of study

## First semester

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## (c) Computer Engineering (ENGAGE)

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Engineering 2015

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BES 220 Engineering statistics 220 8
COS 222 Operating systems 222 16 COS 130/
EIR 222 Linear systems 222 16 EIR 211 GS/EIR 221
ERS 220 Digital systems 220 16 GS
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 (ENGAGE)

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
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### (e) Electronic Engineering (ENGAGE)

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# Engineering 2015

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#### Second semester

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### (g) Mechanical Engineering (ENGAGE)

#### First year of study

#### First semester

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#### Recess training

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### Second year of study

#### First semester

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#### Second semester

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<td>JPO 125</td>
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<td>Additional mechanics 125</td>
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<td>WTW 263</td>
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#### Third year of study

#### First semester

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#### Second semester

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<tr>
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(h) Metallurgical Engineering (ENGAGE)

#### First year of study

#### First semester

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<td>JPO 110</td>
<td>8</td>
<td>Professional orientation 110</td>
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<td>JPO 116</td>
<td>8</td>
<td>Additional mathematics 1 116</td>
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<td>Additional physics 152</td>
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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,
NJJ 210  Professional and technical communication 210  8  FSK 116/176, WTW
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
NMC 223  Materials science 223  16  161
NPT 220  Process thermodynamics 220  16  NMC 113/123
WTW 238  Mathematics 238  16  (CHM 171/172)
WTW 238  Mathematics 238  16  WTW 258 GS, 256
Total  72
# Mining Engineering (ENGAGE)

## First year of study
### First semester

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### Second semester

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### Recess training

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<td><strong>Practice</strong></td>
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## Second year of study
### First semester

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### Second semester

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Third year of study

First semester

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Second semester

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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 Faculty 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 the General Regulations, Reg. G.1.3 and G.54, 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.
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.

A student must obtain 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).

Credit for modules
Consult the General Regulations. 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.41.

(a) Subject to the stipulations of the General Regulations, Reg. G.1.3 and G.54, 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:
Engineering 2015

<table>
<thead>
<tr>
<th>Degree code</th>
<th>Dissertation</th>
<th>Degree code</th>
<th>Mini-dissertation</th>
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<td>12250161</td>
<td>WBK 890</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(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 Faculty regulations 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%.
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.

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.

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.

Please 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.
<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioprocessing 732</td>
<td>CBP 732</td>
<td>32</td>
</tr>
<tr>
<td>Fluoro-materials science and technology 732</td>
<td>CFT 732</td>
<td>32</td>
</tr>
<tr>
<td>Process integration 732</td>
<td>CIP 732</td>
<td>32</td>
</tr>
<tr>
<td>Chemical engineering 702</td>
<td>CIR 702</td>
<td>32</td>
</tr>
<tr>
<td>Carbon materials science and technology 732</td>
<td>CMS 732</td>
<td>32</td>
</tr>
<tr>
<td>Product design 732</td>
<td>CPO 732</td>
<td>32</td>
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<tr>
<td>Polymer processing 732</td>
<td>CPP 732</td>
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<tr>
<td>Polymer materials science 732</td>
<td>CPW 732</td>
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<tr>
<td>Bio-reaction engineering 732</td>
<td>CRH 732</td>
<td>32</td>
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<tr>
<td>Research Orientation 700</td>
<td>CRO 700</td>
<td>32</td>
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<tr>
<td>Separation technology 732</td>
<td>CSK 732</td>
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<tr>
<td>Additive technology 732</td>
<td>CYM 732</td>
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<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Multivariable control system design 700</td>
<td>CBO 700</td>
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<tr>
<td>Multivariable control system theory 700</td>
<td>CBT 700</td>
<td>32</td>
</tr>
<tr>
<td>Model-based control laboratory 732</td>
<td>CML 732</td>
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<tr>
<td>Process control system development 732</td>
<td>CSP 732</td>
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</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Air quality control 780</td>
<td>CAM 780</td>
<td>32</td>
</tr>
<tr>
<td>Principles of environmental engineering 780</td>
<td>CEM 780</td>
<td>32</td>
</tr>
<tr>
<td>Industrial waste engineering 780</td>
<td>WAI 780</td>
<td>32</td>
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<tr>
<td>Water quality management 780</td>
<td>WQB 780</td>
<td>32</td>
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</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological water treatment 780</td>
<td>WBW 780</td>
<td>32</td>
</tr>
<tr>
<td>Chemical water treatment 780</td>
<td>WCW 780</td>
<td>32</td>
</tr>
<tr>
<td>Water quality management 780</td>
<td>WQB 780</td>
<td>32</td>
</tr>
</tbody>
</table>

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      |

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 800</td>
<td>CVD 800</td>
<td>128</td>
</tr>
</tbody>
</table>

**(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:

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least 72 credits from the following:</td>
<td></td>
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<tr>
<td>Flood hydrology 792</td>
<td>SHC 792</td>
<td>24</td>
</tr>
<tr>
<td>Free surface flow 794</td>
<td>SHC 794</td>
<td>24</td>
</tr>
<tr>
<td>Pipe flow 795</td>
<td>SHC 795</td>
<td>24</td>
</tr>
<tr>
<td>Pump systems 785</td>
<td>SHW 785</td>
<td>24</td>
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<tr>
<td>and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the remainder of the credits from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete technology 794</td>
<td>SGC 794</td>
<td>24</td>
</tr>
<tr>
<td>Hydraulic design 793</td>
<td>SHC 793</td>
<td>24</td>
</tr>
<tr>
<td>Water resource analysis and management 796</td>
<td>SHC 796</td>
<td>24</td>
</tr>
<tr>
<td>Applied statistical methods and optimization 798</td>
<td>SHC 798</td>
<td>32</td>
</tr>
<tr>
<td>Numerical methods for Civil Engineers 780</td>
<td>SIK 780</td>
<td>24</td>
</tr>
<tr>
<td>Finite element applications in Civil Engineering 780</td>
<td>SIR 780</td>
<td>24</td>
</tr>
<tr>
<td>Infrastructure management 790</td>
<td>SSI 790</td>
<td>24</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the balance of the credits may also elected from the following electives presented by the Department of Chemical Engineering:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of environmental engineering 780</td>
<td>CEM 780</td>
<td>32</td>
</tr>
<tr>
<td>Industrial waste engineering 780</td>
<td>WAI 780</td>
<td>32</td>
</tr>
<tr>
<td>Biological water treatment 780</td>
<td>WBW 780</td>
<td>32</td>
</tr>
<tr>
<td>Chemical water treatment 780</td>
<td>WCW 780</td>
<td>32</td>
</tr>
<tr>
<td>Water quality management 780</td>
<td>WQB 780</td>
<td>32</td>
</tr>
</tbody>
</table>

**BEngHons (Geotechnical Engineering) (12240212)**

At least 128 credits from the following:

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Core modules:</td>
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<tr>
<td>Analytical soil mechanics 787</td>
<td>SGS 787</td>
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<tr>
<td>Theoretical soil mechanics 788</td>
<td>SGS 788</td>
<td>24</td>
</tr>
<tr>
<td>Specialised geotechnical testing 789</td>
<td>SGS 789</td>
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<tr>
<td>Electives:</td>
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<tr>
<td>Engineering geology 703</td>
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<tr>
<td>Engineering geology 704</td>
<td>IGL 704</td>
<td>16</td>
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<tr>
<td>Applied statistical methods and optimization 798</td>
<td>SHC 798</td>
<td>32</td>
</tr>
<tr>
<td>Numerical methods for Civil Engineers 780</td>
<td>SIK 780</td>
<td>24</td>
</tr>
<tr>
<td>Finite element applications in Civil Engineering 780</td>
<td>SIR 780</td>
<td>24</td>
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**BEngHons (Structural Engineering) (12240121)**

At least 128 credits from the following:

<table>
<thead>
<tr>
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<th>Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Module</td>
<td></td>
<td></td>
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<tr>
<td>Concrete technology 794</td>
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<tr>
<td>Steel design 776</td>
<td>SIN 776</td>
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<tr>
<td>Structural mechanics 777</td>
<td>SIN 777</td>
<td>24</td>
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<tr>
<td>Reinforced concrete design 778</td>
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<tr>
<td>Timber design 779</td>
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<tr>
<td>Structural analysis 790</td>
<td>SIN 790</td>
<td>24</td>
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<tr>
<td>Prestressed concrete design 791</td>
<td>SIN 791</td>
<td>24</td>
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<tr>
<td>and</td>
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<td></td>
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</table>
the remainder of the credits from the following:

- Applied statistical methods and optimization 798
- Numerical methods for Civil Engineers 780
- Finite element applications in Civil Engineering 780
- Infrastructure management 790

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:

<table>
<thead>
<tr>
<th>Core modules:</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied statistical methods and optimization 798</td>
<td>SHC 798</td>
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<table>
<thead>
<tr>
<th>Electives:</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement design 793</td>
<td>SGC 793</td>
<td>24</td>
</tr>
<tr>
<td>Concrete technology 794</td>
<td>SGC 794</td>
<td>24</td>
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<tr>
<td>Road rehabilitation technology 797</td>
<td>SGC 797</td>
<td>24</td>
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<tr>
<td>Numerical methods for Civil Engineers 780</td>
<td>SIK 780</td>
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<tr>
<td>Finite element applications in Civil Engineering 780</td>
<td>SIR 780</td>
<td>24</td>
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<tr>
<td>Infrastructure management 790</td>
<td>SSI 790</td>
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<tr>
<td>Transportation planning 789</td>
<td>SVC 789</td>
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<tr>
<td>Transportation studies 790</td>
<td>SVC 790</td>
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<tr>
<td>Transportation special 791</td>
<td>SVC 791</td>
<td>24</td>
</tr>
<tr>
<td>Traffic engineering 792</td>
<td>SVC 792</td>
<td>24</td>
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<tr>
<td>Multimodal transport 788</td>
<td>SVV 788</td>
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<tr>
<td>Geometric design and safety 791</td>
<td>SVV 791</td>
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**MEng (Water Resources Engineering) (12250161)**

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>WBK 890</td>
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</table>

**MEng (Geotechnical Engineering) (12250212)**

<table>
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<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>SGI 890</td>
<td>128</td>
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</table>

**MEng (Structural Engineering) (12250121)**

<table>
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<tr>
<th>Module</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>SIN 890</td>
<td>128</td>
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</table>

**MEng (Transportation Engineering) (12250111)**

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>SVI 890</td>
<td>128</td>
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</tbody>
</table>

(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

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Power electronics 780</td>
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<td>32</td>
</tr>
<tr>
<td>Energy management 732</td>
<td>EES 732</td>
<td>32</td>
</tr>
<tr>
<td>Power distribution engineering 732</td>
<td>EEV 732</td>
<td>32</td>
</tr>
<tr>
<td>Renewable energy 732</td>
<td>EGH 732</td>
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</tr>
<tr>
<td>Introduction to research 732</td>
<td>EIN 732</td>
<td>32</td>
</tr>
<tr>
<td>Solid-state lighting</td>
<td>ELV 732</td>
<td>32</td>
</tr>
<tr>
<td>Energy optimisation 732</td>
<td>ENO 732</td>
<td>32</td>
</tr>
<tr>
<td>Research project: Theory 732</td>
<td>EPT 732</td>
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<tr>
<td>Research project: Design and laboratory 732</td>
<td>EPT 733</td>
<td>32</td>
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<tr>
<td>Advanced topics in energy research 732</td>
<td>ERT 732</td>
<td>32</td>
</tr>
<tr>
<td>Electrical drives 780</td>
<td>ETE 780</td>
<td>32</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced classical optics 732</td>
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</tr>
<tr>
<td>Intelligent Systems 732</td>
<td>EAI 732</td>
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<tr>
<td>Advanced Topics in Intelligent Systems</td>
<td>EAI 733</td>
<td>32</td>
</tr>
<tr>
<td>Optimal control 780</td>
<td>EBO 780</td>
<td>32</td>
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<tr>
<td>Cellular wireless telephony 710</td>
<td>ECW 710</td>
<td>32</td>
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<tr>
<td>Electro optics 732</td>
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<tr>
<td>Interferometry 716</td>
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<tr>
<td>Renewable energy 732</td>
<td>EGH 732</td>
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<tr>
<td>Introduction to research 732</td>
<td>EIN 732</td>
<td>32</td>
</tr>
<tr>
<td>Electronic Defence – Electronic Counter Measures</td>
<td>ELB 780</td>
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<tr>
<td>Electronic Defence – Electronic Support</td>
<td>ELB 781</td>
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<tr>
<td>Solid-state lighting</td>
<td>ELV 732</td>
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<tr>
<td>Antenna theory 780</td>
<td>EMA 780</td>
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<tr>
<td>Multivariable control systems 732</td>
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<td>Microwave theory 780</td>
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<tr>
<td>Optical design 732</td>
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<tr>
<td>Detection and estimation 732</td>
<td>EOP 732</td>
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<tr>
<td>Research project: Theory 732</td>
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<tr>
<td>Research project: Design and laboratory 732</td>
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<td>Introductory radiometry and photometry 716</td>
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<td>Electro-optical systems design 732</td>
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<td>Adaptive systems 732</td>
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<tr>
<td>Digital communications 732</td>
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<tr>
<td>Coding theory 732</td>
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<tr>
<td>Topics in photonics 732</td>
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<td>Mobile communications 732</td>
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<td>Telecommunication systems engineering 732</td>
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**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.

<table>
<thead>
<tr>
<th>Module</th>
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<td>Intelligent Systems 732</td>
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<tr>
<td>Advanced Topics in Intelligent Systems</td>
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<tr>
<td>Renewable energy 732</td>
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<td>Introduction to research 732</td>
<td>EIN 732</td>
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<tr>
<td>Wireless sensor networks 732</td>
<td>EKS 732</td>
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<tr>
<td>Electronic Defence – Electronic Counter Measures</td>
<td>ELB 780</td>
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<tr>
<td>Electronic Defence – Electronic Support</td>
<td>ELB 781</td>
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<td>Nsw Solid-state lighting</td>
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<td>Detection and estimation 732</td>
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<td>EPT 732</td>
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<tr>
<td>Research project: Design and laboratory 732</td>
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<tr>
<td>New generation networks 732</td>
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<tr>
<td>Information security 780</td>
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</table>

**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.

<table>
<thead>
<tr>
<th>Module</th>
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<tr>
<td>Bioelectricity and electronics 732</td>
<td>EBE 732</td>
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<tr>
<td>Bioelectromagnetism and modelling 732</td>
<td>EBI 732</td>
<td>32</td>
</tr>
<tr>
<td>Introduction to research 732</td>
<td>EIN 732</td>
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<tr>
<td>Research project: Theory 732</td>
<td>EPT 732</td>
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<tr>
<td>Research project: Design and laboratory 732</td>
<td>EPT 733</td>
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**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.

<table>
<thead>
<tr>
<th>Module</th>
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<tr>
<td>Analogue electronic design 732</td>
<td>EME 732</td>
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<tr>
<td>Communication electronics 732</td>
<td>EMK 732</td>
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<tr>
<td>Research project: Theory 732</td>
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<tr>
<td>Research project: Design and laboratory 732</td>
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**MEng (Electrical Engineering)(12250031)**

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<th>Module</th>
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<td>EIR 890</td>
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**MEng (Electronic Engineering)(12250091)**

<table>
<thead>
<tr>
<th>Module</th>
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<tr>
<td>Dissertation 890</td>
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### MEng (Computer Engineering) (12250211)

<table>
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<tbody>
<tr>
<td>Dissertation 890</td>
<td>ERI 890</td>
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### MEng (Bioengineering) (12250201)

<table>
<thead>
<tr>
<th>Module</th>
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<td>Dissertation 890</td>
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### MEng (Microelectronic Engineering) (12250191)

<table>
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<tr>
<th>Module</th>
<th>Code</th>
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<tr>
<td>Dissertation 890</td>
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### MEng (Software Engineering) (12250202)

<table>
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<th>Module</th>
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<tbody>
<tr>
<td>Dissertation 890</td>
<td>EPR 890</td>
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</table>

### (d) ENGINEERING AND TECHNOLOGY MANAGEMENT

#### BEngHons (Technology Management) (12240251)

At least 128 credits from the following:

**Core modules:**
- Organisation and Innovation 780: INV 780, 16 credits
- Engineering economics 780: IKN 780, 16 credits
- Project management 780: IPK 780, 16 credits
- Systems engineering 780: ISE 780, 16 credits
- Operations management 781: IVV 781, 16 credits
- Technological entrepreneurship 780: IEE 780, 16 credits
- Maintenance management 780: IMC 780, 16 credits

and

**Electives/Ad hoc modules**
- Asset management: IIB 780, 16 credits
- Quality management 780: IKK 780, 16 credits
- Literature study 780: ILS 780, 16 credits
- Research methodology 781*: INI 781*, 16 credits

(Contact department for more information)

*Only on ad hoc basis for students from other departments.

#### MEng (Technology Management) (12250251)

This qualification follows upon the BEngHons (Technology Management).

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>ITB 890</td>
<td>128</td>
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</tbody>
</table>

or

#### MEng (Technology Management) (12250252)

**Core modules**
- Mini-dissertation: IGB 898, 64 credits
- Literature study 801: ILS 801, 16 credits
- Research methodology 800: INI 800, 16 credits
- Strategic technology management 802: ITB 802, 16 credits
Electives
Technology commercialisation 881
or
Module from the MEM/MPM programme (subject to the approval of the head of department)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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<tr>
<td>Mini-dissertation 898 (MEng)</td>
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<td>Mini-dissertation 898 (MSc)</td>
<td>ISC 898</td>
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<tr>
<td>Financial management 830</td>
<td>FBS 830</td>
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<tr>
<td>Maintenance management 801</td>
<td>IIB 801</td>
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<tr>
<td>Research methodology 800</td>
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<tr>
<td>Project management 803</td>
<td>IPK 803</td>
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<tr>
<td>Production and operations management 801</td>
<td>IPP 801</td>
<td>16</td>
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<tr>
<td>Systems engineering and management 801</td>
<td>ISE 801</td>
<td>16</td>
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<tr>
<td>Technology management 801</td>
<td>ITB 801</td>
<td>16</td>
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<tr>
<td>People management 883</td>
<td>PEM 883</td>
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<tr>
<td>and</td>
<td></td>
<td></td>
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<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Domain: General
Decision analysis and risk management 801  
Strategic management 801

Electives
Engineering service management 801  
Marketing management 801
Engineering logistics 801
Quality management 801
Information management 884
Legal aspects of project management 803
Life cycle management of SHE 802
New ventures and entrepreneurship 801

or

Domain: Asset and Maintenance Management
Electives
Engineering asset management 801
Reliability engineering 801
Engineering logistics 801
Legal aspects of project management 803
Life cycle management of SHE 802
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

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-dissertation 898 (MEng)</td>
<td>IGB 898</td>
<td>64</td>
</tr>
<tr>
<td>Mini-dissertation 898 (MSc)</td>
<td>ISC 898</td>
<td>64</td>
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</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Advanced aspects of operations research 780</td>
<td>BAO 780</td>
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<tr>
<td>Solution algorithms in operations research 780</td>
<td>BAR 780</td>
<td>16</td>
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<tr>
<td>Enterprise architecture 781</td>
<td>BBA 781</td>
<td>16</td>
</tr>
<tr>
<td>Supply chain information and decision technology 780</td>
<td>BCI 780</td>
<td>16</td>
</tr>
<tr>
<td>Novel industrial and systems engineering 780</td>
<td>BCS 780</td>
<td>16</td>
</tr>
<tr>
<td>Design and analysis of experiments 780 (Compulsory)</td>
<td>BDE 780</td>
<td>16</td>
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<tr>
<td>Inventory modelling 780</td>
<td>BEE 780</td>
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<tr>
<td>Applied engineering statistics 780</td>
<td>BES 780</td>
<td>16</td>
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<tr>
<td>Quality management 780</td>
<td>BGH 780</td>
<td>16</td>
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<tr>
<td>Probability models 780</td>
<td>BHM 780</td>
<td>16</td>
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</table>
Information systems 780  BIS 780  16
Lean supply chain strategies and systems 780  BLC 780  16
Supply chain processes 781 (Compulsory)  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

Industrial Engineers are not allowed more than 2 appropriate modules from other departments.
Non-Industrial Engineers are not allowed more than 1 appropriate module from other departments.

**Non-Industrial Engineers**
The following curriculum must be followed:

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Enterprise architecture 781</td>
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<tr>
<td>Novel Industrial and systems engineering 780</td>
<td>BCS 780</td>
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<tr>
<td>Design and analysis of experiments 780</td>
<td>BDE 780</td>
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<tr>
<td>Inventory modelling 780</td>
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<tr>
<td>Applied engineering statistics 780</td>
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<tr>
<td>Quality management 780</td>
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<tr>
<td>Probability models 780</td>
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<tr>
<td>Information systems 780</td>
<td>BIS 780</td>
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<tr>
<td>Supply chain processes 781 (Compulsory)</td>
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<td>Manufacturing planning and control systems 782</td>
<td>BPZ 782</td>
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<tr>
<td>Reliability engineering 780</td>
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<tr>
<td>Simulation modelling 780</td>
<td>BUY 780</td>
<td>16</td>
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<tr>
<td>Supply chain design 780</td>
<td>BVK 780</td>
<td>16</td>
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<tr>
<td>Research methodology 781 (Compulsory)</td>
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</table>

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

**MEng(Industrial Engineering)(12250011)**

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Dissertation 890</td>
<td>BIR 890</td>
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</tbody>
</table>
(f) MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

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

**BEngHons (Metallurgical Engineering)** (12240061)

<table>
<thead>
<tr>
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<th>Code</th>
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<tr>
<td>Fabrication engineering 700</td>
<td>NFE 700</td>
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<tr>
<td>Physical metallurgy 700</td>
<td>NFM 700</td>
<td>32</td>
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<tr>
<td>Heat treatment 700</td>
<td>NHB 700</td>
<td>32</td>
</tr>
<tr>
<td>Hydrometallurgy 700</td>
<td>NHM 700</td>
<td>32</td>
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<tr>
<td>Corrosion 700</td>
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<td>Literature survey 700</td>
<td>NLO 700</td>
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<tr>
<td>Mechanical metallurgy 700</td>
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<tr>
<td>Minerals processing 700</td>
<td>NMP 700</td>
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<tr>
<td>Applied theory of sampling for minerals processing 700</td>
<td>NMP 701</td>
<td>32</td>
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<tr>
<td>Nuclear reactor materials 700</td>
<td>NNR 700</td>
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<tr>
<td>Metallurgical analysis 700</td>
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<td>Pyrometallurgy 700</td>
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<td>Froth flotation 700</td>
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<td>Welding metallurgy 700</td>
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<td>Refractory materials 700</td>
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<td>Mathematical modelling of metallurgical processes and materials 700</td>
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<td>Welding processes 700</td>
<td>NWP 700</td>
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</tr>
<tr>
<td>Design of welded structures 700</td>
<td>NWP 701</td>
<td>32</td>
</tr>
</tbody>
</table>

**Option: Welding Engineering (12240062)**

The following 128 credits are prescribed:

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabrication engineering 700</td>
<td>NFE 700</td>
<td>32</td>
</tr>
<tr>
<td>Welding metallurgy 700</td>
<td>NSW 700</td>
<td>32</td>
</tr>
<tr>
<td>Welding processes 700</td>
<td>NWP 700</td>
<td>32</td>
</tr>
<tr>
<td>Design of welded structures 700</td>
<td>NWP 701</td>
<td>32</td>
</tr>
</tbody>
</table>

**MEng (Metallurgical Engineering)** (12250061)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>NIN 890</td>
<td>128</td>
</tr>
</tbody>
</table>

(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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid-structure interaction 780</td>
<td>MAH 780</td>
<td>16</td>
</tr>
<tr>
<td>Porous flow 780</td>
<td>MAN 780</td>
<td>16</td>
</tr>
<tr>
<td>Aircraft turbomachinery 780</td>
<td>MAY 780</td>
<td>16</td>
</tr>
<tr>
<td>Solar energy 780</td>
<td>MBA 780</td>
<td>16</td>
</tr>
<tr>
<td>Control systems 780</td>
<td>MBB 780</td>
<td>16</td>
</tr>
<tr>
<td>Topology and shape optimisation 780</td>
<td>MBT 780</td>
<td>16</td>
</tr>
<tr>
<td>Course Title</td>
<td>Code</td>
<td>Year</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>Composite materials 780</td>
<td>MCM 780</td>
<td>16</td>
</tr>
<tr>
<td>Non-destructive testing 780</td>
<td>MCT 780</td>
<td>16</td>
</tr>
<tr>
<td>Finite element methods 780</td>
<td>MEE 780</td>
<td>16</td>
</tr>
<tr>
<td>Advanced finite element methods 781</td>
<td>MEE 781</td>
<td>16</td>
</tr>
<tr>
<td>Mechatronics 780</td>
<td>MEG 780</td>
<td>16</td>
</tr>
<tr>
<td>Vibration-based condition monitoring 781</td>
<td>MEV 781</td>
<td>16</td>
</tr>
<tr>
<td>Advanced heat and mass transfer 780</td>
<td>MHM 780</td>
<td>16</td>
</tr>
<tr>
<td>Condition-based maintenance 780</td>
<td>MIC 780</td>
<td>16</td>
</tr>
<tr>
<td>Reliability-based maintenance 781</td>
<td>MII 781</td>
<td>16</td>
</tr>
<tr>
<td>Maintenance practice 780</td>
<td>MIP 780</td>
<td>16</td>
</tr>
<tr>
<td>Maintenance practice 781</td>
<td>MIP 781</td>
<td>16</td>
</tr>
<tr>
<td>Maintenance logistics 782</td>
<td>MIP 782</td>
<td>16</td>
</tr>
<tr>
<td>Maintenance operations 783</td>
<td>MIP 783</td>
<td>16</td>
</tr>
<tr>
<td>Reliability engineering 781</td>
<td>MIR 781</td>
<td>16</td>
</tr>
<tr>
<td>Tribology 780</td>
<td>MIT 780</td>
<td>16</td>
</tr>
<tr>
<td>Aerodynamics 780</td>
<td>MLD 780</td>
<td>16</td>
</tr>
<tr>
<td>Gas dynamics 780</td>
<td>MLG 780</td>
<td>16</td>
</tr>
<tr>
<td>Air-conditioning and refrigeration 780</td>
<td>MLR 780</td>
<td>16</td>
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<tr>
<td>Aeronautical structures 780</td>
<td>MLT 780</td>
<td>16</td>
</tr>
<tr>
<td>Flight mechanics 780</td>
<td>MLV 780</td>
<td>16</td>
</tr>
<tr>
<td>Aircraft design</td>
<td>MLW 780</td>
<td>16</td>
</tr>
<tr>
<td>Structural control 781</td>
<td>MOI 781</td>
<td>16</td>
</tr>
<tr>
<td>Optimum design 780</td>
<td>MOO 780</td>
<td>16</td>
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<tr>
<td>Design 780</td>
<td>MOX 780</td>
<td>16</td>
</tr>
<tr>
<td>Specialised design 781</td>
<td>MOX 781</td>
<td>16</td>
</tr>
<tr>
<td>Specialised design 782</td>
<td>MOX 782</td>
<td>16</td>
</tr>
<tr>
<td>Theory of elasticity 780</td>
<td>MSE 780</td>
<td>16</td>
</tr>
<tr>
<td>Fracture mechanics 780</td>
<td>MSF 780</td>
<td>16</td>
</tr>
<tr>
<td>Numerical thermoflow 780</td>
<td>MSM 780</td>
<td>16</td>
</tr>
<tr>
<td>Numerical thermoflow 781</td>
<td>MSM 781</td>
<td>16</td>
</tr>
<tr>
<td>Independent study 781</td>
<td>MSS 781</td>
<td>16</td>
</tr>
<tr>
<td>Independent study 782</td>
<td>MSS 782</td>
<td>16</td>
</tr>
<tr>
<td>Fatigue 780</td>
<td>MSV 780</td>
<td>16</td>
</tr>
<tr>
<td>Fluid mechanics 780</td>
<td>MSX 780</td>
<td>16</td>
</tr>
<tr>
<td>Advanced fluid mechanics 781</td>
<td>MSX 781</td>
<td>16</td>
</tr>
<tr>
<td>Specialised structural mechanics 781</td>
<td>MSY 781</td>
<td>16</td>
</tr>
<tr>
<td>Specialised structural mechanics 782</td>
<td>MSY 782</td>
<td>16</td>
</tr>
<tr>
<td>Experimental structural dynamics 783</td>
<td>MSY 783</td>
<td>16</td>
</tr>
<tr>
<td>Specialised thermoflow 780</td>
<td>MTV 780</td>
<td>16</td>
</tr>
<tr>
<td>Specialised thermoflow 781</td>
<td>MTV 781</td>
<td>16</td>
</tr>
<tr>
<td>Advanced thermodynamics and energy systems 781</td>
<td>MTX 781</td>
<td>16</td>
</tr>
<tr>
<td>Reactor coolant flow and heat transfer 782</td>
<td>MUA 782</td>
<td>16</td>
</tr>
<tr>
<td>Reactor engineering science 783</td>
<td>MUA 783</td>
<td>16</td>
</tr>
<tr>
<td>Reactor physics 784</td>
<td>MUA 784</td>
<td>16</td>
</tr>
<tr>
<td>Reactor materials engineering 785</td>
<td>MUA 785</td>
<td>16</td>
</tr>
<tr>
<td>Reactor materials engineering 786</td>
<td>MUA 786</td>
<td>16</td>
</tr>
<tr>
<td>Reactor stress analysis 787</td>
<td>MUA 787</td>
<td>16</td>
</tr>
<tr>
<td>Fossil fuel power stations 781</td>
<td>MUA 788</td>
<td>16</td>
</tr>
<tr>
<td>Vehicle dynamics 780</td>
<td>MVI 780</td>
<td>16</td>
</tr>
<tr>
<td>Numerical methods 780</td>
<td>MWN 780</td>
<td>16</td>
</tr>
<tr>
<td>Nano and micro heat transfer 781</td>
<td>MWX 781</td>
<td>16</td>
</tr>
</tbody>
</table>
(h) MINING ENGINEERING

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

BEngHons (Mining Engineering)(12240071)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial mine evaluation 780</td>
<td>PFZ 780</td>
<td>16</td>
</tr>
<tr>
<td>Slope stability 781</td>
<td>PHS 781</td>
<td>16</td>
</tr>
<tr>
<td>Airflow and fans 711</td>
<td>PKB 711</td>
<td>16</td>
</tr>
<tr>
<td>Heat and refrigeration 712</td>
<td>PKB 712</td>
<td>16</td>
</tr>
<tr>
<td>Advanced design: mining 780</td>
<td>PMZ 780</td>
<td>16</td>
</tr>
<tr>
<td>Open pit mining 783</td>
<td>POY 783</td>
<td>16</td>
</tr>
<tr>
<td>Advanced explosives engineering 785</td>
<td>PRX 785</td>
<td>16</td>
</tr>
<tr>
<td>Guided special studies 700 Finalists only</td>
<td>PSS 700</td>
<td>32</td>
</tr>
<tr>
<td>Strata control – Hard rock mining 786</td>
<td>PSZ 708</td>
<td>16</td>
</tr>
<tr>
<td>Strata control – Collieries 788</td>
<td>PSZ 788</td>
<td>16</td>
</tr>
</tbody>
</table>

MEng (Mining Engineering)(12250071)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>MIR 890</td>
<td>128</td>
</tr>
</tbody>
</table>

(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
  - WTW 762

(Prerequisite: WTW 732)

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 Faculty Regulation Eng. 17 (e) to (g) apply *mutatis mutandis*.

<table>
<thead>
<tr>
<th>Master of Science in Applied Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>[MSc (Applied Science)]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Master of Science in Technology Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>[MSc (Technology Management)]</td>
</tr>
</tbody>
</table>

Eng. 21
Also consult the General Regulations G.30 to G.41.
(a) Subject to the stipulations of the General Regulations, G.54, 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 Faculty 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).

<table>
<thead>
<tr>
<th>BSChons (Applied Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSChons (Technology Management)</td>
</tr>
<tr>
<td>MSc (Applied Science)</td>
</tr>
<tr>
<td>MSc (Technology Management)</td>
</tr>
</tbody>
</table>

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.

**Please 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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First year first semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process control 410</td>
<td>CPB 410</td>
<td>16</td>
</tr>
<tr>
<td>Biotechnology 410</td>
<td>CBI 410</td>
<td>16</td>
</tr>
<tr>
<td><strong>Second semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical engineering 787</td>
<td>CIR 787</td>
<td>16</td>
</tr>
<tr>
<td><strong>Specialisation 420</strong></td>
<td>CSS 420</td>
<td>16</td>
</tr>
<tr>
<td><strong>Note: Only the Optimisation option may be taken.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process control system development 732</td>
<td>CSP 732</td>
<td>32</td>
</tr>
<tr>
<td>Process integration 732</td>
<td>CIP 732</td>
<td>32</td>
</tr>
<tr>
<td>Separation technology 732</td>
<td>CSK 732</td>
<td>32</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specialisation in Carbon, Fluoro-materials and Polymer Materials Science - 128 credits from the following:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bioprocessing 732</td>
<td>CBP 732</td>
<td>32</td>
</tr>
<tr>
<td>Fluoro-materials science and technology 732</td>
<td>CFT 732</td>
<td>32</td>
</tr>
<tr>
<td>Chemical engineering 707</td>
<td>CIR 707</td>
<td>32</td>
</tr>
<tr>
<td>Carbon materials science and technology 732</td>
<td>CMS 732</td>
<td>32</td>
</tr>
<tr>
<td>Product design 732</td>
<td>CPO 732</td>
<td>32</td>
</tr>
<tr>
<td>Polymer processing 732</td>
<td>CPP 732</td>
<td>32</td>
</tr>
<tr>
<td>Polymer materials science 732</td>
<td>CPW 732</td>
<td>32</td>
</tr>
<tr>
<td>Separation technology 732</td>
<td>CSK 732</td>
<td>32</td>
</tr>
<tr>
<td>Additive technology 732</td>
<td>CYM 732</td>
<td>32</td>
</tr>
<tr>
<td><strong>Specialisation in Process Technology – 128 credits</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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  
** Specialisation 420  
** Note: Any of the options may be taken excluding the Product Design option

**Second year**
Product design 732
and one of the following modules:
Process integration 732
Separation technology 732
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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following 128 credits are prescribed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air quality control 787</td>
<td>CAM 787</td>
<td>32</td>
</tr>
<tr>
<td>Principles of environmental engineering 787</td>
<td>CEM 787</td>
<td>32</td>
</tr>
<tr>
<td>Waste management engineering 787</td>
<td>WAI 787</td>
<td>32</td>
</tr>
<tr>
<td>Water quality management 780</td>
<td>WQB 780</td>
<td>32</td>
</tr>
</tbody>
</table>

### BSChons (Applied Science) (Water Utilisation) (12243029)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following 128 credits are prescribed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial waste engineering 787</td>
<td>WAI 787</td>
<td>32</td>
</tr>
<tr>
<td>Biological water treatment 787</td>
<td>WBW 787</td>
<td>32</td>
</tr>
<tr>
<td>Chemical water treatment 787</td>
<td>WCW 787</td>
<td>32</td>
</tr>
<tr>
<td>Water quality management 780</td>
<td>WQB 780</td>
<td>32</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 807</td>
<td>CVD 807</td>
<td>128</td>
</tr>
</tbody>
</table>

(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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialisation in <strong>Water Resources</strong> (12243030)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic statistical methods 797</td>
<td>SHC 797</td>
<td>24</td>
</tr>
<tr>
<td>Basic hydraulics 788</td>
<td>SHW 788</td>
<td>24</td>
</tr>
<tr>
<td>and 24 credits from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic pavements and transportation 787</td>
<td>SGM 787</td>
<td>24</td>
</tr>
<tr>
<td>Basic structural design 793</td>
<td>SIC 793</td>
<td>24</td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 890</td>
<td>SST 890</td>
<td>128</td>
</tr>
</tbody>
</table>

### MSc (Applied Science) (Structures) (12253036)

### MSc (Applied Science) (Transportation Planning) (12253028)

### MSc (Applied Science) (Water Resources) (12253031)

### (c) ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

### MSc (Applied Science)(12253046)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 891</td>
<td>EER 891</td>
<td>128</td>
</tr>
</tbody>
</table>
### (d) ENGINEERING AND TECHNOLOGY MANAGEMENT

#### BScHons (Technology Management)(12241072)

128 credits from the following:

<table>
<thead>
<tr>
<th>Core modules</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological entrepreneurship 780</td>
<td>IEE 780</td>
<td>16</td>
</tr>
<tr>
<td>Engineering economics 780</td>
<td>IKN 780</td>
<td>16</td>
</tr>
<tr>
<td>Organisation and innovation 780</td>
<td>INV 780</td>
<td>16</td>
</tr>
<tr>
<td>Project management 780</td>
<td>IPK 780</td>
<td>16</td>
</tr>
<tr>
<td>Systems engineering 780</td>
<td>ISE 780</td>
<td>16</td>
</tr>
<tr>
<td>Operations management 781</td>
<td>IVV 781</td>
<td>16</td>
</tr>
<tr>
<td>Maintenance management 780</td>
<td>IMC 780</td>
<td>16</td>
</tr>
</tbody>
</table>

and

<table>
<thead>
<tr>
<th>Electives</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature study 780</td>
<td>ILS 780</td>
<td>16</td>
</tr>
<tr>
<td>Quality management 780</td>
<td>IKK 780</td>
<td>16</td>
</tr>
<tr>
<td>Research methodology 781*</td>
<td>INI 781</td>
<td>16</td>
</tr>
<tr>
<td>Asset management 780</td>
<td>IBB 780</td>
<td>16</td>
</tr>
</tbody>
</table>

*Only on ad hoc basis for students from other departments.

#### MSc (Technology Management)(12251072)

This qualification follows upon the BScHons (Technology Management)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 895</td>
<td>ITB 895</td>
<td>128</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### MSc (Technology Management)(Coursework)(12251076)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-dissertation 898</td>
<td>ISC 898</td>
<td>64</td>
</tr>
<tr>
<td>Strategic technology management 802</td>
<td>ITB 802</td>
<td>16</td>
</tr>
<tr>
<td>Literature study 801</td>
<td>ILS 801</td>
<td>16</td>
</tr>
<tr>
<td>Research methodology 800</td>
<td>INI 800</td>
<td>16</td>
</tr>
</tbody>
</table>

**Elective module**

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology commercialisation 881</td>
<td>IKG 881</td>
<td>16</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module from the MEM/MPM programme</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

(subject to the approval of the head of department)

---

### (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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial analysis 780</td>
<td>BAN 780</td>
<td>16</td>
</tr>
<tr>
<td>Enterprise architecture 781</td>
<td>BBA 781</td>
<td>16</td>
</tr>
<tr>
<td>Design and analysis of experiments 780</td>
<td>BDE 780</td>
<td>16</td>
</tr>
</tbody>
</table>
Engineering 2015

Quality management 780 BGH 780 16
Supply chain processes 781 BLK 781 16
Manufacturing planning and control systems 782 BPZ 782 16
Simulation modelling 780 BUY 780 16
Research methodology 781 INI 781 16

<table>
<thead>
<tr>
<th>MSc (Applied Science) (Industrial Systems)(12253011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
</tr>
<tr>
<td>Code</td>
</tr>
<tr>
<td>dissertation 891</td>
</tr>
</tbody>
</table>

(f) MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

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

<table>
<thead>
<tr>
<th>BScHons (Applied Science) (Metallurgy)(12243022)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
</tr>
<tr>
<td>Code</td>
</tr>
<tr>
<td>32 credits from the following (compulsory):</td>
</tr>
<tr>
<td>Basic physical metallurgy 701</td>
</tr>
<tr>
<td>Basic extractive metallurgy 701</td>
</tr>
<tr>
<td>Basic pyrometallurgy 701</td>
</tr>
<tr>
<td>and</td>
</tr>
<tr>
<td>a maximum of 32 credits from the following: (optional)</td>
</tr>
<tr>
<td>Research methodology 781</td>
</tr>
<tr>
<td>Project management 780</td>
</tr>
<tr>
<td>Mathematical modelling of metallurgical processes and materials 780</td>
</tr>
<tr>
<td>Basic statistical methods 797</td>
</tr>
<tr>
<td>and</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

Option: Welding Technology(12243062)

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 |

<table>
<thead>
<tr>
<th>MSc (Applied Science) (Metallurgy)(12253022)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
</tr>
<tr>
<td>Code</td>
</tr>
<tr>
<td>dissertation 891</td>
</tr>
</tbody>
</table>

(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:

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural mechanics 732</td>
<td>MSY 732</td>
<td>32</td>
</tr>
<tr>
<td>Thermoflow 732</td>
<td>MTV 732</td>
<td>32</td>
</tr>
<tr>
<td><strong>The combination of</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance practice 780</td>
<td>MIP 780</td>
<td>16</td>
</tr>
<tr>
<td>Reliability engineering 781</td>
<td>MIR 781</td>
<td>16</td>
</tr>
</tbody>
</table>

(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 the General Regulations. 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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 891</td>
<td>MIR 891</td>
<td>128</td>
</tr>
</tbody>
</table>

### (h) MINING ENGINEERING

### BScHons (Applied Science) (Mining)(12243044)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic mine environment engineering 701</td>
<td>PKB 701</td>
<td>16</td>
</tr>
<tr>
<td>Underground mining methods 701</td>
<td>PMY 701</td>
<td>32</td>
</tr>
<tr>
<td>Surface-mining 703</td>
<td>PMY 703</td>
<td>16</td>
</tr>
<tr>
<td>Explosives engineering 701</td>
<td>PRX 701</td>
<td>16</td>
</tr>
<tr>
<td>Guided special studies 700 Finalists only</td>
<td>PSS 700</td>
<td>32</td>
</tr>
<tr>
<td>Basic rock mechanics 703</td>
<td>PSZ 703</td>
<td>16</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissertation 891</td>
<td>PYI 891</td>
<td>128</td>
</tr>
</tbody>
</table>

### DOCTORAL DEGREES

**Doctor of Philosophy in Engineering [PhD (Engineering)]**

Eng. 23

Also consult the General Regulations. G.42 to G.53

(a) Subject to the stipulations of the General Regulations, G.42 and G.54, 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.42 to G.53.

(a) Subject to the stipulations of the General Regulations, G.42 and G.54 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.
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 or Semester 2
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: 24 contact hours per semester
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: 24 contact hours per semester
Period of presentation: Semester 1 or 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: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
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
BCI 780 Supply chain information and decision technology 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English Credits: 16
Module content:
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: 24 contact hours per semester
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: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
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)
Engineering 2015

- 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: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
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

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: 24 contact hours per semester
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: 24 contact hours per semester
Period of presentation: Semester 1 or 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.

BHM 780 Probability models 780

Academic organisation: Industrial and Systems Engineering

Contact time: 24 contact hours per semester

Period of presentation: Semester 1 or Semester 2

Language of tuition: English Credits: 16

Module content:
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:** 24 contact hours per semester  
**Period of presentation:** Semester 1 or Semester 2  
**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:** 24 contact hours per semester
**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:

BLK 781 Supply chain processes 781
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English       Credits: 16
Module content:
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: 24 contact hours per semester
Period of presentation: Semester 1 or 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:

- 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:**

**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: 24 contact hours per semester
Period of presentation: Semester 1 or 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 or Semester 2
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 only*  
During or at the end of the third year of study, students in industrial engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

**BPZ 220 Productivity 220**  
**Academic organisation:** Industrial and Systems Engineering  
**Contact time:** 1 tpw 2 ppw 3 lpw  
**Period of presentation:** Semester 2  
**Language of tuition:** Both Afr and Eng  
**Credits:** 16  
**Module content:**  

**BPZ 421 Business engineering 421**  
**Academic organisation:** Industrial and Systems Engineering  
**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 782 Manufacturing planning and control systems 782**  
**Academic organisation:** Industrial and Systems Engineering  
**Prerequisite:** BOB 310  
**Contact time:** 24 Contact hours per Semester  
**Period of presentation:** Semester 1 or Semester 2  
**Language of tuition:** English  
**Credits:** 16  
**Module content**  
- Random variables review  
- Forecasting models: Time Series models (Review); Regression models (Review); Auto regression and noise models; Integrated models (Causal and time series); Model selection techniques
• Aggregate planning models: Spread sheet models; MP models of Aggregate Planning (LP, DP, QP, GP, SP applications); Constrained systems models (Lagrangian)
• Lot sizing and disaggregation models: System characterisation and notations; Single item models (EOQ, EPQ, back ordering, discount, deteriorating, etc.); Dynamic Economic Lot models (DP and heuristics); Joint item lot sizing models; Multi echelon models; Safety stock modelling; Joint item disaggregation models with opening/target inventories
• Scheduling models: System characterisation and notations; Single and two machine/s sequencing models; Flow scheduling models; Job shop scheduling models; Constraint scheduling models; Line balancing techniques
• Overview of some pull based techniques

BSI 780 Business engineering 780
Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or Semester 2
Language of tuition: English  
Credits: 16
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: 24 contact hours per semester
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:** 24 contact hours per semester  
**Period of presentation:** Semester 1 or Semester 2  
**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 1 or Semester 2  
**Language of tuition:** English  
**Credits:** 32

**Module content:**  
CAM 787 Air quality control 787  
**Academic organisation:** Chemical Engineering  
**Contact time:** 32 contact hours per semester  
**Period of presentation:** Semester 1 or Semester 2  
**Language of tuition:** English  
**Credits:** 32  
**Module content:**  

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:**  

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:**  
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 or Semester 2  
**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

CIM 210 Chemical engineering materials 210  
**Academic organisation:** Chemical Engineering  
**Prerequisite:** CHM 171/172, CIR 310#  
**Contact time:** 2 lpw 2 tpw  
**Period of Presentation:** Semester 1  
**Language of tuition:** Both Afr and Eng  
**Credits:** 8
Module content:
Introduction to the synthesis, processing, structure, physical properties, and technical performance of important engineering materials: metals, ceramics, polymers and composites. Structural, mechanical, thermodynamic, and design related issues important to chemical engineering applications. Materials specification with emphasis on the corrosion of metals and life time estimation for polymer components.

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:

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:
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, Nm³. Material balances where gases are involved. Fuels and combustion: coal analysis, combustion calculations.

CIR 211 Chemical engineering 211  
Academic organisation: Chemical Engineering  
Prerequisites: CIR 123  
Contact time: 3 lpw 3 tpw  
Period of Presentation: Both Afr and Eng  
Language of tuition: Semester 1  
Credits: 12  
Module content:  

CIR 310 Chemical engineering 310  
Academic organisation: Chemical Engineering  
Prerequisite: (CTD 223), SWK 210, CHM 215, CIM 210#  
Contact time: 2 lpw 2 tpw  
Period of Presentation: Semester 1  
Language: Both Afr and Eng  
Credits: 8  
Module content:  

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

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

CJJ 310 Professional and technical communication 310  
**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 communication with engineering and technical audiences, as well as with the community at large, is taught. The emphasis is on written documentation. Formal communication is characterised by: the use of appropriate language and style; effective structuring of information; the use of modern electronic communication technologies, with emphasis on word processing, spreadsheets, appropriate email protocols, effective use of graphic information, effective and correct presentation of numerical data, correct referencing methods, seamless inclusion of mathematics expressions, tables, diagrams and appendices in written work; appropriate methods for levelling communication to the requirements of the target audience.

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/CJJ 310, 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:

CML 732 Model-based control laboratory 732
Academic organisation: Chemical Engineering
Contact time: 12 contact hours per semester
Period of presentation: Semester 1 or 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:

CMS 732 Carbon materials science and technology 732
Academic organisation: Chemical Engineering
Contact time: 10 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English
Credits: 32
Module content:
COP 311 Transfer processes 311
Academic organisation: Chemical Engineering
Prerequisite: WTW 238, (WTW 263)
Contact time: 3 t pw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng
Credits: 16
Module content:

CPA 310 Particle technology 310
Academic organisation: Chemical Engineering
Prerequisite: (CIR 211), COP 311#
Contact time: 3 t pw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng
Credits: 16
Module content:

CPB 410 Process control 410
Academic organisation: Chemical Engineering
Prerequisite: CPN 321 GS
Contact time: 3 t pw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng
Credits: 16
Module content:

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 t pw
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:

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 e.g. 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:

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:**  

**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:**  

**CPY 311 Practical training 311**

**Academic organisation:** Chemical Engineering  
**Prerequisite:** (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:

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:
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: 4 lpw 3 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng
Credits: 16
Module content:

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 GS
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 problem solving 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 (e.g. 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.

**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:**
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:**  

EDF 320 Power electronics 320  
**Academic organisation:** Electrical, Electronic and Computer Engineering  
**Prerequisite:** ELX 311 GS, 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:**  
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 1 or 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 or Semester 2
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

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.

EGH 732 Renewable energy 732
Academic organisation: Electrical, Electronic and Computer Engineering  
Contact time: 32 contact hours per semester
Period of presentation: Semester 1 or semester 2
Language of tuition: English  
Credits: 32

Module content:
This course will cover various renewable energy technologies including Wind, Solar Photovoltaic systems, Distributed generation and Hybrid power system.
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 GS, EIR 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:**  

EKK 410 Power system analysis 410  
**Academic organisation:** Electrical, Electronic and Computer Engineering  
**Prerequisite:** EKK 320 GS  
**Contact time:** 1 ppw 1 tpw 4 lpw  
**Period of presentation:** Semester 1  
**Language of tuition:** Both Afr and Eng  
**Credits:** 16
Module content:

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 or Semester 2
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 fulfill 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 and QoS, and advanced application support (e.g. security).

ELB 780 Electronic Defence – Electronic Countermeasures 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:
Radar including aspects such as: radar frequency bands and their characteristics, radar types (e.g. tracking vs search radar), the radar range equation, radar cross-section (RCS), target characteristics such as scintillation and glint, pulse compression, coherent and non-coherent integration (e.g. Doppler processing), range and Doppler ambiguities, target tracking including simple tracking filters and angle-tracking techniques (e.g. monopulse), high range-resolution (HRR) techniques, and environmental effects such as atmospheric attenuation and multipath. Electronic attack (EA) – also referred to as jamming or electronic countermeasures (ECM) – including vulnerabilities of radar and communications systems, EA system architectures (e.g. digital radio-frequency memory (DRFM) systems), non-coherent and coherent jamming techniques. Electronic Protection (EP) – also referred to as electronic counter-countermeasures (ECCM) – including the relationship between good system design and EP, and basic EP techniques to counter the EA techniques listed above.

ELB 781 Electronic Defence – Electronic Support 781
Academic organisation: Electrical, Electronic and Computer Engineering
Contact time: 32 contact hours per semester
Period of presentation: Semester 1 or semester 2
Language of tuition: English Credits: 32
Module content:
The role of electronic support (ES) receivers from tactical and strategic perspectives. ES system architectures including analogue and digital receivers. The following topics will be considered: signal detection, parameter estimation including direction finding (DF)/angle of arrival (AoA) estimation and pulse repetition interval (PRI) tracking, emitter classification, and low probability of detection (LPD) and low probability of intercept (LPI) techniques to counter ES receivers.

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:

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:

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 1 or 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:

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; Electromagnetic 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:** English  
**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 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:

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:
Transmission line equations, wave propagation, input impedance, power flow, transients; Electrostatics, charge and current, laws of Coulomb and Gauss, scalar potential, properties of materials, boundary conditions, capacitance, Magnetostatics, laws of Biot-Savart and Ampère, magnetic properties of materials, boundary conditions, inductance; Faraday’s law, time harmonic fields, displacement current, boundary conditions; Plane wave propagation, polarization, power density; Wave reflection and transmission, normal and oblique incidence.

EMZ 320 Microwaves and antennas 320
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: EMZ 310 GS, ENE 310 GS
Contact time: 1 ppw 1 tpw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng
Module content:
Smith Chart; Waveguides, stripline, microstripline; Network analysis, S-parameters, signal flow diagrams, matching networks; Power divider; Filter implementation, Richard’s transformation, Kuroda’s identities; Antenna fundamentals, port and radiation characteristics, Friis transmission equation, halfwave dipole, aperture antennas, linear arrays, microstrip patch antenna and arrays; Antenna applications, satellite, base stations, adaptive beams; Radar range equation.

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
Module content:

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
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:**  
EPE 321 Software engineering 321
Academic organisation: Electrical, Electronic and Computer Engineering
Prerequisite: COS 212
Contact time: 1 ppw 1 lpw 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 MEng 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:
Introduction to laboratory equipment, solar cell, imaging radiometry, spectral radiometry, atmospheric transmittance, wavelength calibration of a monochromator, photometric measurements, measurement of colour.
Credits: 16 (must be combined with Introduction to the Science of measurement to form a 32 credit module)

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 1 or 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 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:

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

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

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 or Semester 2
Language of tuition: English

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 1 or Semester 2  
**Language of tuition:** English  
**Credits:** 32  
**Module content:**  
Adaptive systems ETA 732 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 Electrica drives 780**  
**Academic organisation:** Electrical, Electronic and Computer Engineering  
**Prerequisite:** Undergraduate level Power electronics and Electric machines.  
**Contact time:** 32 contact hours per semester  
**Period of presentation:** Semester 1 or 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:**  

**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 or Semester 2  
*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 or Semester 2  
*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 1 or 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 or Semester 2
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 hour
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 of 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: Both Afr and Eng 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

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

ILS 780 Literature Study 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

ILS 801 Literature Study 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
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 or Semester 2
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 1 or 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 or Semester 2  
**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 Afr and Eng Credits: 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and chemical reasoning skills required by CHM 171/172.

JPO 112 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 physical 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 2
Language of tuition: English
Credits: 8
Module content:
Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by NMC 113/123

JPO 124 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:** English  
**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 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:** Construction Economics  
**Contact time:** 10 lpw  
**Period of presentation:** Semester 1  
**Language of tuition:** English  
**Credits:** 16

KBS 804 Construction management 804  
**Academic organisation:** Construction Economics  
**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:** Construction Economics  
**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:**

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 layouts 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.

MCT 780 Non-destructive testing 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:

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:

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:
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:**  

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:**  

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:*  

**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:*  

**MIA 320 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:**  

**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 1 or 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:**

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:**

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:**
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:

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, buildingreliability models and optimisation of system reliability; Fault Tree Analysis; FailureModes, 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:

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:
MKM 321 Solid mechanics 321
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 227
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English
Credits: 16
Module content:

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 inviscid 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:

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:

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, feedback 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:**  

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:**  

MOW 217 Manufacturing and design 217  
**Academic organisation:** Mechanical and Aeronautical Engineering  
**Prerequisite:** MGC 110  
**Contact time:** 3 lpw 4 tpw  
**Period of presentation:** Semester 1  
**Language of tuition:** Both Afr and Eng  
**Credits:** 16
Module content:
Detailed exposure to manufacturing processes including heat treatment. Detailed exposure to machine elements. Conceptual framework for design process including life cycle, ergonomics, material selection, manufacturing and safety factor considerations.

MOW 227 Structural design 227
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: SWK 122
Contact time: 3 lpw 4 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng Credits: 16
Module content:
Analyse statically determinate structures to obtain section forces and moments and stress distributions. Thin-walled pressure vessels. Stress and strain transformations. Introduction of stress tensor. Derivation of stress transformation equations. Eigenvalue/vector analysis for principle stresses and strains. Mohr’s circle. Failure criteria. Fatigue strength design. All analysis techniques above are applied to the open-ended design of components like beams and shafts.

MOW 312 Machine design 312
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: MOW 217, (MOW 227)
Contact time: 3 lpw 3 tpw
Period of presentation: Semester 1
Language of tuition: English Credits: 16
Module content:
Open-ended subsystem design using the following elements: Beams, shafts, bolts, bearings, rivets, welds, springs, couplings, clutches, brakes, gears and gear systems. Static and fatigue design fundamentals. Code design: Pressure vessels, structural steel design, hoisting systems and ropes, welding SANS code.

MOW 323 Simulation-based design 323
Academic organisation: Mechanical and Aeronautical Engineering
Prerequisite: (MSD 210), MOW 227
Contact time: 3 lpw 5 tpw
Period of presentation: Semester 2
Language of tuition: English Credits: 16
Module content:
Computational dynamics analysis of mechanisms, linkages and cams. Structural computational analysis using finite element software. Systems engineering and functional analysis. Open-ended multidisciplinary design and design improvement of products and systems.

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:
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 conduction: 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:
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 or Semester 2  
**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:**  
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:**

**MSY 310 Structural mechanics 310**
*Academic organisation:* Mechanical and Aeronautical Engineering  
*Prerequisite:* MOW 227, WTW 256  
*Contact time:* 1 ppw 3 lpw  
*Period of presentation:* Semester 1  
*Language of tuition:* English  
**Credits:** 16

**Module content:**

**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.

MTG 990 Thesis: Metallurgy 990
Academic organisation: Materials Science and Metallurgical Engineering
Period of presentation: Year
Language of tuition: Both Afr and Eng Credits: 360

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:

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:

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 1 or 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.
(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.

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 lpw 3 lpw  
**Period of presentation:** Semester 2  
**Language of tuition:** Double Medium  
**Credits:** 16  
**Module content:**  

**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:**  
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: EnglishCredits: 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: EnglishCredits: 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: EnglishCredits: 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 or Semester 2
Language of tuition: EnglishCredits: 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: EnglishCredits: 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:

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:

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:

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:

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:

MWN 780 Numerical methods 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:

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, tunnelling, 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 lwp  
**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:
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.  

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:

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:

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:

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 or Semester 2
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 sulphhydryl 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 ventilation 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 1 or 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:

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:

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. Tunnelling: 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
**Prerequisite:** PNB 300
**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  
**Prerequisite:** SGM 221  
**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, polymers, masonry work and bituminous 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:**  

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:**  

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:**

**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:

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:

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

SGM 221 Pavement materials and design 221
Academic organisation: Civil Engineering
Prerequisite: SGM 210 GS
Contact time: 1 tpw 2 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng
Credits: 16
Module content:
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:

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 Coulomb’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 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:

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:

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:

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:
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:**

**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:** 32

**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, probabilistic analysis, Markov chain applications, etc.

**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:**  
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  

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:

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:**

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.

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:**  
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 1 or Semester 2
Language of tuition: Both Afr and Eng Credits: 16
Module content:
SWK 210 Strength of materials 210
Academic organisation: Civil Engineering
Prerequisite: SWK 122, WTW 168
Contact time: 2 t pw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng  Credits: 16
Module content:

SWK 211 Statics 211
Academic organisation: Civil Engineering
Prerequisite: SWK 122
Contact time: 1 ppw 2 lpw 3 t pw
Period of presentation: Semester 1
Language of tuition: English  Credits: 16
Module content:

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 or Semester 2
Language of tuition: English  Credits: 32
Module content:

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:

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

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**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.

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**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
Contact time: 3 lpw 1 ppw
Language of tuition: Double Medium
Credits: 12
Module content:
Organic chemistry. Chemical properties of organic (including aromatic) compounds. Functional group transformation and synthesis.

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:
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:

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 lw 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 lw 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.

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 lw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng
Credits: 16

SUR 220 Surveying 220
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium
Credits: 16
Module content:
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 $\mathbb{R}^n$, 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.

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:

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:

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:

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:
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:**  

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.*  
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

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**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.

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