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ENGINEERING AND THE BUILT ENVIRONMENT

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FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

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(this publication)

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- Chemical Engineering
- Electrical, Electronic and Computer Engineering
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GENERAL INFORMATION

The Afrikaans text of this publication is the official version and will be given precedence in the interpretation of the content.

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 courses closes on 30 September.

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

Statement of symbols
When registering at this University for the first time, a candidate must submit a record of symbols obtained for each subject in the Matriculation examination.

Medium of instruction
In conducting its business, the University uses two official languages, namely Afrikaans and English.

In formal education, the medium of instruction is either Afrikaans or English, 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 course and any further level of that course 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 Afrikaans or English.

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

Accommodation
Applications for accommodation in university residences for a particular year may be submitted as from April 1 of the preceding year. Applications will be considered as long as 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.

Parents' day and orientation
Details of the parents' day to which all parents are cordially invited, and the subsequent orientation week during which all new first-year students **must** be present, are obtainable from the Dean of Students, University of Pretoria 0002.

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 course fees without prior notification.

Take note:
In 2000, the University of Pretoria will phase in a new system of education, which corresponds with the required guidelines of SAQA (the South African Qualifications Authority) and the NQF (National Qualifications Framework). This system is an outcomes-based and market-orientated leering program.

From 2001 this system will be implemented in the Faculty of Engineering. The yearbooks of faculties other than Engineering must be consulted for courses presented by them.

As a result of the phasing in of the new system this yearbook may not reflect the latest changes. The Faculty Administration may be consulted in this regard.

Definition of terms

Familiarise yourself with the definition of the following terms. They are used generally in all faculties.

academic year: the duration of the academic year which is determined by the University Council and consists of two semesters
after-hours study: classes attended after hours by students who register for the curriculum of a first degree or diploma that is presented over a longer period than the minimum duration indicated in the regulations for the particular degree or diploma
course: a selected division of a subject deemed to be a unit and to which a course code is allocated
course code: consists of an equal number of letters and digits, which indicate the name of the course, the year of study, the period of study and the level of the course
credits: a number of credits are allocated to each course. These represent the quantity of work and the extent of the course
curriculum: a series of courses grouped together from different subjects over a specified period of time and in a certain sequence according to the regulations
examination mark: the mark a student obtains for an examination in a course, including practical and clinical examinations where applicable. If necessary, the examination mark is finalised after ancillary examinations have been completed
extended study programme: a study 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 obtained in a particular course according to a formula which is determined from time to time in the regulations for each course with the proviso that should no semester/year mark be required in a course, the examination mark serves as the final mark
GS: a combined mark (semester/year mark plus examination mark) of at least 40%
level of a course or level: the academic level of a course which is indicated in the course code
registration: the process a candidate is required to complete to be admitted as a student of the University or for admission to a course

admission regulation: a regulation compiled by the Dean of a Faculty concerning the admission of students to the Faculty, which includes a provision regarding the selection process
semester course: a course that extends over one semester
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 course as approved by regulation
subject: a demarcated field of study of which one course or more may be chosen for a degree
syllabus: the division of the study material for a specific course, according to the regulations
weighted average: the weighted average is composed of the marks of the various courses, weighted with the credits of each course as a fraction of the total number of credits for the semester or year
year course: a course that extends over one year (two semesters)

DEGREES AND DIPLOMA CONFERRED/AWARDED IN THE FACULTY

The following degrees and diplomas are awarded in the Faculty (minimum duration in brackets):

(a) Bachelors' degrees:
- (i) Bachelor of Engineering – BEng (4 years)

(b) Honours degrees: (1 year)
- (i) Bachelor of Engineering (Honours) – BEng(Hons)
- (ii) Baccalaureus Scientiae Honores – BSc(Hons)

(c) Masters' degrees: (1 year)
- (i) Master of Engineering – MEng
- (ii) Magister Scientiae – MSc

(d) Doctorates: (1 year)
- (i) Philosophiae Doctor – PhD
- (ii) Doctor of Engineering – DEng

(e) Diploma:
Postgraduate Diploma in Quality Assurance and Reliability (1 year)

General Regulations G.1 to G.15 are applicable to all bachelors degrees. Where the General Rules have vested authority in the Faculty to determine its own provisions, these provisions appear in this publication.

REGULATIONS AND CURRICULA

Eng. 1
Admission to study

1. **General**
To register for a first bachelor's degree at the University, a candidate must, in addition to the required matriculation exemption certificate, comply with the specific admission requirements for particular courses and fields of study as prescribed in the admission regulations and the faculty regulations of the departments.

It is expected of all new undergraduate students who wish to study at the University to do a language competency test. Based on this test, students will be placed on language development courses which must be passed before a degree can be conferred. The language competency test can, in special cases, be replaced by courses approved by the Dean.

1.1.1 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 matriculation certificate with university exemption.

(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.

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. Candidates are advised to contact the specific faculty administration in this regard.

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

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

2. **Requirements for specific courses**

To be admitted to any undergraduate field of study in the Faculty, a candidate must obtain at least 60% in Mathematics and Physical Science on Higher Grade in the final examination in Grade 12, as well as a minimum M score of 18. If, after publication of the final matriculation results, a candidate does not comply with the above admission requirements, but obtains one of the combinations mentioned below with a minimum M score of 12, he or she may be permitted to write an admissions test. Admission will then be considered on grounds of the results of the test. The combinations are as follows:

- A D symbol for Mathematics and Physical Science both on Higher Grade.
- An A, B or C symbol for Mathematics and a D symbol for Physical Science both on Higher Grade.
- An A, B or C symbol for Physical Science and a D symbol for Mathematics both on Higher Grade.

The M score is calculated as follows:

Symbols	**Higher Grade**	**Standard Grade**
A-symbol (80% and higher)	5	4
B-symbol (70% - 79%)	4	3
C-symbol (60% - 69%)	3	2
D-symbol (50% - 59%)	2	1
E-symbol (40% - 49%)	1	0

Eng. 2
Registration for a specific year
A student registers for all the courses he or she intends taking in that specific year (first and second semester courses and year courses) at the beginning of an academic year. Changes to a curriculum at the beginning of the second semester may be made only with the Dean's approval.

Eng. 3
Examinations

1. **Examinations and pass requirements**
   A student must obtain a minimum semester/year mark of 40% to gain examination admission to a course, with the exception of first semester courses at 100 level where 30% is required. A student must obtain a final mark of at least 50% to pass a course. Credit in a course will only be obtained through a successful examination in that course. It is a requirement for examination admission that practical classes must be attended and the prescribed tasks submitted.

   With the exception of courses where the Faculty Board has approved an alternative method, the final mark is calculated in the Faculty of Engineering and Building Sciences as follows:
   - A student's final mark is calculated in accordance with the stipulations of General Regulation G. 12(2.2).
   - Should a student complete a supplementary or ancillary examination and pass the examination, the final mark awarded is 50%.
   - Should a student complete a supplementary or ancillary examination and fail the examination, the final mark awarded is the mark obtained in the supplementary/ancillary examination.
   - Students may, in accordance with the stipulations of General Regulation G.10.3(a) and (b), be promoted in the course Engineering Drawing 112, should a semester mark of at least 60% be obtained.

2. **Subminima in examinations**
   Subminima required in examinations (if any), appear in the regulations of the relevant degree and in the syllabi of the courses.

3. **Examinations**
   The examinations for semester courses of the first semester, are held in May/June, while all other examinations (second semester courses and year courses) are held in October/November.

4. **Ancillary examinations**
   After conclusion of an examination, but before publication of the examination results, the examiners may summon a student for an ancillary examination on particular aspects of the course.

   Ancillary examinations will be granted to students who have obtained admission to an examination as follows:
   - a semester mark of 60% and higher; or
   - a semester mark of between 50% and 59% and a final mark of between 40% and 49%.

Exceptions to this rule will be considered by the Dean only in exceptional circumstances.

The pass mark for an ancillary examination is 50% and a higher mark will not be allocated.

5. **Re-marking of examination scripts** (also consult Reg. G.14)
After the examinations, the Departments must provide the students with information regarding the framework used by the examiners during the examinations. The Head of Department will determine the procedure which will be followed. Students may, within 14 days after the commencement of lectures in the following semester and after payment of the prescribed fee, apply for the remarking of an examination paper by an examiner who will be appointed by the Head of the Department. Application forms are available from the Faculty Administration offices.

6. **Supplementary examinations**
Supplementary examinations for first semester courses at 100 level are granted in terms of the provisions of General Regulation G.12.4.2. No other supplementary examinations are granted in the Faculty.

7. **Special examination**
In terms of the provisions of General Regulations G.12.6, the Dean may, on the recommendation of the Head of the Department concerned, grant a special examination to a student in the final year of study who has failed a limited number of courses and can therefore not comply with degree requirements, or who is not able to continue with his or her studies in the final semester in a meaningful way. A student must apply in writing to the Dean before being considered for a special examination(s).

In the Faculty of Engineering, students in the final year of study who have failed a maximum of two courses or who require a maximum of two courses to comply with degree requirements and have also obtained examination admission to the courses, qualify for special examinations. The Dean, on the recommendation of the Head of the Department concerned, decides when the special examinations will take place. The particular Head of the Department may, at his or her discretion, prescribe work which must be completed satisfactorily before a student may sit for this examination.

The pass mark for a special examination is 50% and a higher mark will not be awarded.

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 of readmission. Students who forfeit the right of readmission, may apply in writing to the Admissions Committee for readmission to the Faculty. Specific provisions regarding promotion, including provisions for first year students, appear in the regulations of the relevant years of study.

Eng. 5
Five-year programme

(a) The five-year programme is followed by students whose school achievements have been influenced negatively by disadvantages in the school systems, but who have the potential to benefit from an extended study programme with academic support.
(b) Candidates who wish to follow the five-year programme are subject to the normal admission procedures of the Faculty.
(c) Applications for admission to the five-year programme are submitted during January of each year. Details are available from the Administration Offices of the Faculty of Engineering.
(d) Students who are admitted to the five-year programme, undergo a placement test on the basis of which 65 places in the course JPO 110 Professional Orientation 110 and JPO 120 Professional Orientation 120 are allocated to students with the biggest school handicap. The remainder of the students on the five-year programme register for Engineering Practice/Practical Orientation/Communication/Forum. All students on the five-year programme must attend the compulsory tutor sessions.
(e) The curricula for the five-year programme are not included in this publication, but are available in a separate publication from the Administration Offices of the Faculty of Engineering.
(f) A new first year student who is enrolled for the extended five-year programme, who passes only Professional Orientation and none of the other prescribed courses at the end of the first semester, will be excluded at the end of the first semester.
(g) The rules and regulations applicable to the four-year programme are applicable *mutatis mutandis* to the five-year programme except where otherwise indicated in the regulations of the five-year programme.

Eng. 6
Courses from other faculties

A student who follows a course presented by another faculty must familiarise himself or herself with the admission requirements of the specific course, the subminima in examination papers, time of supplementary examinations, etc.

Eng. 7
Change of study direction

Transfer from one field of study to another may only take place with the Dean's approval, after consultation with the relevant Head of Department.

Eng. 8
Minimum duration

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

Eng. 9
First aid certificate

Each student must, before the degree is awarded, obtain a First Aid Certificate which is to be submitted to the Faculty Administration.

Eng. 10
Exposure to the practice of engineering

Engineering students of the Faculty of Engineering are exposed in three ways to the practice of engineering during the course of their studies:

(a) Workshop Practice – an official course at the end of the first year of study during which students are trained in Workshop Practice. Students in Computer Engineering attend the Information Technology Practice course.
(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 courses regarding these aspects of training are explained in the sections of this publication which deal with the curricula and syllabi of the various departments.

Eng. 11
Registration for semester courses

(a) A student is not permitted to register for a semester course after fifteen days after the commencement of lectures in that particular semester.
(b) A student may not register for a course of a subsequent year if a timetable clash occurs with a course 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 latter course.
(c) Should a student register for courses 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 courses, the registration of such courses will be cancelled.

Eng. 12
Course information

(a) **Course credits, prerequisites and presentation**
The number of lectures, tutorials, practicals and total credits as well as the prerequisites for each semester and course are indicated in Regulations Eng.15, 17, 19 and 21 as follows:
L: number of lectures per week (50 min)
O: number of practicals, tutorials or seminar periods per week (50 min)
P: number of laboratory, drawing or design periods per week (45 min)
E: the total number of course credits are composed as follows:
$E = 2 \times L + O + P$
Before a student is admitted to a course, he or she must pass the prerequisite course(s), unless one of the following indications is used:

		Minimum requirement
Code in brackets:	(XYZ 123)	Admission to examination
Code followed by GS:	XYZ 123 GS	Average of 40%
Code followed by †:	XYZ 123†	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).

(b) **Course names**
Courses are indicated by:
(i) a course code as set out in **Definition of terms** on page 8 of this publication;

(ii) a name defining the course and three digits corresponding with those in the course code; and

(iii) the first letter of the course code, identifies the department in the Faculty of Engineering which presents the relevant course(s), as indicated in the table below:

Letter	Department
B	Industrial and Systems Engineering
C	Chemical Engineering
E	Electrical, Electronic and Computer Engineering
I	Engineering and Technology Management
L	Agricultural and Food Engineering
M	Mechanical and Aeronautical Engineering
N	Materials Science and Metallurgical Engineering
P	Mining Engineering
R	Computer Engineering courses
S	Civil Engineering

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

Eng. 13

(a) **Pass with distinction**

A student graduates with distinction if:

(i) no course of the third or fourth year of study was repeated and a weighted average of at least 75% was obtained in all the courses of the final year of study and in that year of study; and

(ii) the degree course was completed within the prescribed four years.

Exceptions will be considered by the Dean.

(b) ***First class pass**

A student obtains a first class pass if no courses of the fourth year were repeated and a weighted average of at least 60% was obtained in all the courses of the fourth year.

(c) ***Second class pass**

A student obtains a second class pass if no courses of the fourth year were repeated.

(d) ***Third class pass**

A student obtains a third class pass if some courses of the fourth year of study had to be repeated.

(e) **Exceptions**

Exceptions cases to any of these classifications will be considered by the Dean.

* Instituted in order to comply with standards set by various international accreditation bodies. Pass with distinction and Pass with a first class are

indicated on the degree certificate. Degree classifications are also indicated on the candidate's academic record at request.

I. BACHELOR'S DEGREES (BEng)

Eng. 14
The degree of Bachelor of Engineering may be obtained in the following fields of study:

(a) Agricultural Engineering (12130041)
(b) Chemical Engineering (12130021)
(c) Civil Engineering (12130081)
(d) Computer Engineering (12130101)
(e) Electrical Engineering (12130031)
(f) Electronic Engineering (12130091)
(g) Industrial Engineering (12130011)
(h) Mechanical Engineering (12130051)
(i) Metallurgical Engineering (12130061)
(j) Mining Engineering* (12130071)

* A medical certificate must be obtained from the Medical Bureau for Industrial Diseases before admission to Mining Engineering.

Eng. 14

FIRST YEAR OF STUDY FOR BEng

Eng. 15

(a) Industrial Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CHM 116	Chemistry 116	3	1	2	9	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	SWK 110	Statics 110	3	1	1	8	
(5)	WTW 114	Calculus 114	4	2	0	10	
(6)	BSQ 110	Communication 110	0	1	0	1	
		Total	15	6	8	44	

Second semester

(1)	MOW 121	Machine Design 121	2	0	6	10	MIT 112 GS
(2)	NMC 120	Materials Science 120	3	1	2	9	
(3)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(4)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	MRV 122	Computer Literacy 122	0	2	0	2	
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	15	7	11	48	

(b) Chemical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CMY 131	First Course in Chemistry 131	4	0	3	11	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	SWK 110	Statics 110	3	1	1	8	
(5)	WTW 114	Calculus 114	4	2	0	10	
		Total	16	4	9	45	

Second semester

(1)	CIR 121	Chemical Engineering 121	3	1	0	7	
(2)	CRV 120	Computer Literacy 120	0	3	0	3	CIR 121†
(3)	CMY 141	General Chemistry 141	4	0	3	11	CMY 131 GS
(4)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(5)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(6)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(7)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	17	8	6	48	

(c) Electrical Engineering
(d) Electronic Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CHM 116	Chemistry 116	3	1	2	9	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	EIT 110	Information Technology 110	3	0	2	8	
(5)	EXI 110	Technological Innovation 110	1	0	2	4	
(6)	WTW 114	Calculus 114	4	2	0	10	
(7)	EXF 100	Forum 100	0	1	0	1	
		Total	16	5	11	48	

Second semester

(1)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(2)	NMC 120	Materials Science 120	3	1	2	9	
(3)	SWK 121	Introductory Mechanics 121	3	1	1	8	
(4)	EBN 120	Circuits 120	3	1	1	8	
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	EXF 100	Forum 100	0	1	0	1	
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	16	7	6	45	

(e) Agriculture Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CHM 116	Chemistry 116	3	1	2	9	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	SWK 110	Statics 110	3	1	1	8	
(5)	WTW 114	Calculus 114	4	2	0	10	
(6)	LXF 110	Forum 110	0	1	0	1	
		Total	5	6	8	44	

Second semester

(1)	NMC 120	Materials Science 120	3	1	2	9	
(2)	MOW 121	Machine Design 121	2	0	6	10	MIT 112 GS
(3)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(4)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	MRV 122	Computer Literacy 122	0	2	0	2	
(8)	LXF 120	Forum 120	0	1	0	1	
(9)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	15	8	11	49	

(f) Mechanical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CHM 116	Chemistry 116	3	1	2	9	
(3)	SWK 110	Statics 110	3	1	1	8	
(4)	FSK 116	Physics 116	3	1	2	9	
(5)	WTW 114	Calculus 114	4	2	0	10	
(6)	MSQ 112	Communication 112	0	1	0	1	
		Total	15	6	8	44	

Second semester

(1)	MOW 121	Machine Design 121	2	0	6	10	MIT 112 GS
(2)	NMC 120	Materials Science 120	3	1	2	9	
(3)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(4)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	MRV 122	Computer Literacy 122	0	2	0	2	
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	15	7	11	48	

(g) Metallurgical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	

(2)	CMY 131	First Course in Chemistry 131	4	0	3	11	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	SWK 110	Statics 110	3	1	1	8	
(5)	WTW 114	Calculus 114	4	2	0	10	
(6)	NIP 111	Engineering Practice 111	(Attendance)				
		Total	16	4	9	45	

Second semester

(1)	NMC 120	Materials Science 120	3	1	2	9	
(2)	CMY 141	General Chemistry 141	4	0	3	11	CMY 131 GS
(3)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(4)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	NIP 121	Engineering Practice 121	0	1	0	1	
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	17	6	8	48	

(h) Mining Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CHM 116	Chemistry 116	3	1	2	9	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	SWK 110	Statics 110	3	1	1	8	
(5)	WTW 114	Calculus 114	4	2	0	10	
(6)	PMI 110	Introduction to Mining 110	0	1	0	1	
		Total	15	6	8	44	

Second semester

(1)	MOW 121	Machine Design 121	2	0	6	10	MIT 112 GS
(2)	NMC 120	Materials Science 120	3	1	2	9	
(3)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(4)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	PMI 120	Introduction to Mining 120	0	1	0	1	PMI 110
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
(9)	PYL 120	Practical Training 120	(Attendance)				
		Total	15	6	11	47	

(i) Computer Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	WTW 114	Calculus 114	4	2	0	10	
(2)	FSK 116	Physics 116	3	1	2	9	
(3)	EIT 110	Information Technology 110	3	0	2	8	
(4)	EPE 110	Introduction to Program-ming 110	4	0	3	11	
(5)	EXI 110	Technological Innovation 110	1	0	2	4	

(6)	EXF 100	Forum 100	0	1	0	1	
		Total	15	4	9	43	

Second semester

(1)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(2)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(3	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(4)	EBN 120	Circuits 120	3	1	1	8	
(5)	EPE 120	Software Engineering 120	3	0	2	8	EPE 110 GS, EIT 110 GS
(6)	MEG 120	Mechanics 120	3	1	1	8	
(7)	EXF 100	Forum 100	0	1	0	1	
(8)	EIW 120	Information Technology Practice 120	(Attendance)				
		Total	16	6	6	44	

(j) Civil Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	MIT 112	Engineering Drawing 112	2	0	3	7	
(2)	CHM 116	Chemistry 116	3	1	2	9	
(3)	FSK 116	Physics 116	3	1	2	9	
(4)	SWK 110	Statics 110	3	1	1	8	
(5)	WTW 114	Calculus 114	4	2	0	10	
(6)	SPZ 110	Practical Orientation 110	1	1	0	3	
		Total	16	6	8	46	

Second semester

(1)	SIK 120	Civil Engineering Practice 120	2	2	4	10	
(2)	SGM 121	Soil Mechanics 120	2	2	2	8	
(3)	FSK 126	Physics 126	3	1	2	9	FSK 116 GS
(4)	SWK 120	Statics 120	3	1	1	8	SWK 110 GS
(5)	WTW 128	Calculus 128	2	1	0	5	WTW 114 GS
(6)	WTW 126	Linear Algebra 126	2	1	0	5	WTW 114 GS
(7)	SPZ 120	Practical Orientation 120	0	1	0	1	(SPZ 110)
(8)	WWP 120	Workshop Practice MW 120	(Attendance)				
		Total	14	9	9	46	

Notes:

(i) A report about the workshop practice/practical training is submitted at the beginning of the second year of study (consult the relevant syllabi).

(ii) A subminimum of 40% is required in each examination paper in MOW 121 and SIK 120.

(iii) Chemistry 116 is recognised only by the Faculty of Engineering and does not grant admission to Chemistry at 200-level, nor is it recognised for the BSc degree.

(iv) Students may be promoted in the courses Engineering Drawing 112 should a semester mark of at least 60% be obtained (refer Regulation Eng. 6).

SECOND YEAR OF STUDY FOR THE BEng

Eng. 16
Admission to the second year of study:

(a) A new first year student who is registered for the four-year programme and who does not pass at least one of EIT 110, EPE 110, WTW 114, CMY 131/CHM 116, MIT 112, FSK 116 or SWK 110, is excluded from the Faculty at the end of the first semester.

(b) A student who complies with all the requirements of the first year of study, is promoted to the second year of study. A student who does not comply with all the requirements, but who is able to register for all outstanding courses up to the end of the second year of study, may at registration be promoted to the second year of study.

(c) A student who is registered on the four year programme and has not passed at least 70% of the course credits of the first year of study after the November examinations, is not promoted to the second year of study. These students must reapply for admission should they intend proceeding with their studies. Application on the prescribed form must be submitted to the Faculty Administration not later than 15 January. Late applications will be accepted only in exceptional circumstances after approval by the Dean. Should first year students be readmitted, admission conditions will be determined by the Admissions Committee.

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

(e) A student who has passed between 50% and 70% of the course credits of the first year of study and has obtained readmission, may, on recommendation of the relevant Head of Department and with the approval of the Dean, be permitted to enroll for courses of the second year of study in addition to the first year courses which he or she failed, providing that he or she complies with the prerequisites for the second year courses and no timetable clashes occur. The total number of courses for which a student registers may not exceed the number of course credits prescribed for the second year of study. The number of courses registered for in each semester may not exceed the prescribed number of courses by more than one course.

(f) In exceptional cases, the Dean may, on recommendation of the relevant Head of Department, permit a student to register for more than the prescribed number of course credits.

(g) Students in Electrical and Electronic Engineering, who fail a first year course for the second time, forfeit the privilege of registering for any courses of an advanced year of study.

N.B.:

(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 on p 85 (WWP 120), WORKSHOP PRACTICE MW 120: (PI), and on p73, (PPY 217, 218) PRACTICAL TRAINING 217, 218: (P2).

Eng. 17

(a) Industrial Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	BBZ 210	Basic Industrial Engineering 210	3	1	0	7	
(2)	EIR 210	Electrical Engineering 210	3	1	2	9	WTW126GS, 128GS
(3)	MOW 215	Machine Design 215	3	0	4	10	MOW 121, SWK 120
(4)	MSD 210	Dynamics 210	3	1	2	9	SWK 120, FSK 116
(5)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(6)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(7)	EKN 151 **and** EKN 152	Economics 151 **and** Economics 152				4	
(8)	BPY 210	Practical Training 210	(Report)				
		Total	16	5	8	49	

Second semester

(1)	BBZ 220	Basic Industrial Engineering 220	4	1	1	10	
(2)	BAN 221	Industrial Analysis 221	3	0	0	6	
(3)	BVS 221	Manufacturing Systems 221	3	1	1	8	
(4)	EPE 220	Software Engineering 220	3	0	2	8	
(5)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(6)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(7)	BSQ 220	Communication 220	0	1	0	1	
		Total	17	5	4	43	

(b) Chemical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	CIR 212	Chemical Engineering 212	2	3	0	7	CIR 121
(2)	CHM 214	Chemistry 214	2	0	3	7	CMY 131,141
(3)	CHM 216	Chemistry 216	2	0	3	7	CMY 131,141
(4)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 120
(5)	EIR 210	Electrical Engineering 210	3	1	2	9	WTW 128GS, 126GS
(6)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(7)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(8)	CPY 211	Practical Training 211	(Report)				
		Total	16	7	10	49	

Second semester

(1)	CBI 220	Biochemical Engineering 220	2	0	2	6	CMY 141 GS
(2)	CIR 222	Chemical Engineering 222	2	2	0	6	CIR 212
(3)	CTD 222	Thermodynamics 222	2	2	0	6	CIR 212
(4)	IGB 220	Engineering Management 220	2	2	0	6	
(5)	MSZ 220	Strength of Materials 220	3	1	1	8	SWK 120; WTW 128†
(6)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(7)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(8)	CSQ 221	Communication 221	0	2	0	2	
(9)	CRV 220	Computer Literacy 220	0	4	0	4	CRV 120; CTD 222†; WTW 263†
		Total	15	15	3	48	

(c) Electrical Engineering and (d) Electronic Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	ESK 210	Engineering Statistics 210	3	0	0	6	
(2)	EBN 210	Circuits 210	3	0	0	6	EBN 120,WTW 126
(3)	ERP 210	Software Engineering 210	3	1	1	8	EIT 110
(4)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 121
(5)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(6)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(7)	EGP 210	Laboratory 210	1	0	4	6	ESK 210† or GS, EBN 210† or GS
(8)	EXF 200	Forum 200	0	1	0	1	
		Total	17	5	7	46	

Second semester

(1)	ESL 220	Systems Analysis 220	4	1	0	9	EBN 210
(2)	ERS 220	Digital Systems 220	3	0	0	6	
(3)	ELK 220	Electronic Components 220	3	0	0	6	EBN 120 GS
(4)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(5)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(6)	EGP 220	Laboratory 220	1	0	4	6	ELK 220† or GS, ESL 220† or GS, ERS 220† or GS
(7)	EXF 200	Forum 200	0	1	0	1	
		Total	15	4	4	38	

(e) Agricultural Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	EIR 210	Electrical Engineering 210	3	1	2	9	WTW 126GS, 128GS
(2)	MRV 210	Computer Methods 210	1	1	0	3	MRV 122
(3)	MOW 212	Machine Design 212	1	0	4	6	MOW 121, MSZ 210†
(4)	MOV 212	Manufacturing Techniques 212	2	0	0	4	
(5)	MSZ 210	Strength of Materials 210	3	1	1	8	SWK 120, WTW 128†
(6)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 120
(7)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(8)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(9)	LPY 214	Practical Training 214	(	Report		)	
		Total	17	6	9	49	

Second semester

(1)	IGB 220	Engineering Management 220	2	2	0	6	
(2)	LKW 222	Agricultural Power Machinery 222	3	1	1	8	
(3)	MSK 222	Theory of Machines 222	2	0	0	4	
(4)	MTX 220	Thermodynamics 220	3	1	1	8	FSK 116
(5)	SIN 222	Structural Engineering 222	2	2	2	8	WTW 126,128, SWK 120, MSZ 210 GS
(6)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(7)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(8)	MSS 220	Statistics for Engineers 220	1	1	0	3	
		Total	17	9	4	47	

(f) Mechanical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MOW 212	Machine Design 212	1	0	4	6	MOW 121, MSZ 210†
(2)	MOV 212	Manufacturing Techniques 212	2	0	0	4	
(3)	NMC 210	Materials Science 210	3	0	0	6	(NMC 120)
(4)	MSZ 210	Strength of Materials 210	3	1	1	8	SWK 120, WTW 128†
(5)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 120
(6)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(7)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(8)	MRV 210	Computer Methods 210	1	1	0	3	MRV 122
(9)	MPY 215	Practical Training 215	(	Report		)	
		Total	17	5	7	46	

Second semester

(1)	MOW 222	Machine Design 222	1	0	4	6	MOW 212, MOV 212, MSK 222†
(2)	MSK 222	Theory of Machines 222	2	0	0	4	FSK 116
(3)	EBN 120	Circuits 120	3	1	1	8	
(4)	MTX 220	Thermodynamics 220	3	1	1	8	FSK 116
(5)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(6)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(7)	IGB 220	Engineering Management 220	2	2	0	6	
(8)	MSS 220	Statistics for Engineers 220	1	1	0	3	
		Total	16	7	6	45	

(g) Metallurgical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	NMX 210	Metallurgical Thermodynamics 210	3	1	0	7	
(2)	EIR 210	Electrical Engineering 210	3	1	2	9	WTW 126GS, 128GS
(3)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 120
(4)	GMI 210	Mineralogy 210	3	0	4	10	
(5)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(6)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(7)	NSQ 200	Communication 200	0	1	0	1	
(8)	NPY 216	Practical Training 216	(Report)				
		Total	16	8	8	48	

Second semester

(1)	NMC 221	Materials Science 221	3	0	4	10	NMC 120
(2)	NPI 220	Process Engineering 220	3	2	0	8	
(3)	MSZ 220	Strength of Materials 220	3	1	1	8	SWK 120, WTW 128†
(4)	IGB 220	Engineering Management 220	2	2	0	6	
(5)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(6)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(7)	NSQ 200	Communication 200	0	1	0	1	
(8)	MRV 122	Computer Literacy 122	0	2	0	2	
		Total	15	8	5	43	

(h) Mining Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 120
(2)	EIR 210	Electrical Engineering 210	3	1	2	9	WTW 126GS, 128GS

(3)	MOW 215	Machine Design 215	3	0	4	10	MOW121, SWK120
(4)	PMM 211	Mining Methods 211	3	1	1	8	PMI 110, PMI 120
(5)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(6)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(7)	PPY 217	Practical Training 217	(Report)				
(8)	PPY 218	Practical Training 218	(Report)				
		Total	16	5	9	46	

Second semester

(1)	BBZ 220	Basic Industrial Engineering 220	4	1	1	10	
(2)	MSZ 220	Strength of Materials 220	3	1	1	8	SWK 120, WTW 128†
(3)	MTX 220	Thermodynamics 220	3	1	1	8	FSK 116
(4)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(5)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(6)	BAN 221	Industrial Analysis 221	3	0	0	6	
(7)	MRV 122	Computer Literacy 122	0	2	0	2	
(8)	PSQ 221	Communication 221	0	1	0	1	
		Total	17	8	3	45	

(i) Computer Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(2)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, 126,128
(3)	ECG 210	Interactive Computer Graphics 210	3	0	4	10	
(4)	ESK 210	Engineering Statistics 210	3	0	0	6	
(5)	EBN 210	Circuits 210	3	0	0	6	EBN 120, WTW 126
(6)	COS 212	Data Structures and Algorithms 212				7	COS 110 or EPE 120
(7)	EGP 211	Laboratory 211	1	0	4	6	ESK 210† or GS, EBN 210† or GS, COS 212† or GS
(8)	EXF 200	Forum 200	0	1	0	1	
		Total				46	

Second semester

(1)	ELK 220	Electronic Components 220	3	0	0	6	EBN 120 GS
(2)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(3)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(4)	ESL 220	Systems Analysis 220	4	1	0	9	EBN 210

(5)	ERS 220	Digital Systems 220	3	0	0	6	
(6)	COS 222	Operating Systems 222				7	COS 110 or EPE 120
(7)	EGP 221	Laboratory 221	1	0	4	6	ELK 220† or GS, ESL 220† or GS ERS 220† or GS, COS 222† or GS
(8)	EXF 200	Forum 200	0	1	0	1	
		Total				45	

(j) Civil Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	SBZ 210	Calculation Techniques 210	2	2	1	7	SIK 120
(2)	SIN 212	Structural Engineering 212	4	0	2	10	WTW 114, WTW 126GS, 128GS, SWK 120GS
(3)	MSD 210	Dynamics 210	3	1	2	9	FSK 116, SWK 120
(4)	SIK 213	Civil Engineering Practice 213	2	0	2	6	SIK 120 GS
(5)	WTW 218	Calculus 218	2	1	0	5	WTW 114,128
(6)	WTW 286	Differential Equations 286	2	1	0	5	WTW 114, WTW 126,128
(7)	SSQ 211	Communication 211	0	3	0	3	First year practical training
		Total	15	8	7	45	

Second semester

(1)	SUR 220	Surveying 220	3	0	4	10	
(2)	SGM 220	Soil Mechanics 220	2	1	2	7	SGM 120 GS
(3)	SIK 223	Civil Engineering Practice 223	2	1	0	5	SIK 213
(4)	SIN 222	Structural Engineering 222	2	2	2	8	WTW 126,128; SWK 120, SIN 212 GS
(5)	WTW 228	Calculus 228	2	1	0	5	WTW 114,128
(6)	WTW 263	Numerical Methods 263	2	1	0	5	WTW 126,128
(7)	SSQ 221	Communication 221	0	3	0	3	SSQ 211
		Total	13	9	8	43	

Note:
A subminimum of 40% is required in each examination paper in SIN 212, 222.

THIRD YEAR OF STUDY FOR THE BEng

Eng. 18
Admission to the third year of study:

(a) A student who complies with all the requirements of the second year of study, is promoted to the third year of study. A student who does not comply with all the requirements but who is able to register for all outstanding courses up to the end of the third year of study, may at registration be promoted to the third year of study.

(b) A student must pass all the prescribed courses of his first year of study before he or she is admitted to any courses of the third year of study.

(c) A student who has not passed all the prescribed courses of the second year of study must register for the outstanding courses. A student may on the recommendation of the relevant Head of Department and with approval from the Dean, be permitted to register for courses of the third year of study in addition to the outstanding second year courses, provided that he or she complies with the prerequisites of the third year courses and no timetable clashes occur. The total number of course credits for which a student registers may not exceed the number of course credits prescribed for the third year of study. The number of courses registered for in each semester may not exceed the prescribed number of courses by more than one course.

(d) In exceptional cases, the Dean may, on recommendation of the Head of Department concerned, permit a student to register for more than the prescribed number of course credits.

(e) Students in Electrical and Electronic Engineering who fail a second year course for the second time, forfeit the privilege of registering for any courses of the third year of study.

(f) Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out on p85, (WWP 120) WORKSHOP PRACTICE MW 120 (PI) and p74 (PPY 317) PRACTICAL TRAINING 317: (P3).

Eng. 19
(a) Industrial Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	BBZ 310	Basic Industrial Engineering 310	4	1	0	9	
(2)	BVS 310	Manufacturing Systems 310	3	3	1	10	(BVS 220)
(3)	BPZ 310	Production 310	3	1	0	7	
(4)	BOZ 310	Operations Research 310	3	1	0	7	(BAN 221)
(5)	BAN 312	Industrial Analysis 312	3	1	0	7	(BAN 221)
(6)	*FRK 151	Financial Accounting 151 **and**				6	
	*FRK 152	Financial Accounting 152 **and**					
	*FRK 181	Financial Accounting 181					
(7)	BSQ 310	Communication 310	0	1	0	1	
(8)	BPY 310	Practical Training 310	(Attendance and Report)				
		Total	18	10	1	47	

Second semester

(1)	BBZ 320	Basic Industrial Engineering 320	4	2	0	10	

(2)	BVS 320	Manufacturing Systems 320	4	1	1	10	(BVS 310)
(3)	BPZ 320	Production 320	3	1	0	7	(BPZ 310)
(4)	BOZ 320	Operations Research 320	3	1	0	7	(BOZ 310)
(5)	BUY 320	Simulation Modelling 320	3	1	0	7	(BAN 312)
(6)	*FRK 161	Financial Accounting 161 **and**				6	FRK 151GS;
	*FRK 162	Financial Accounting 162					FRK 152GS
(7)	BSQ 320	Communication 320	0	1	0	1	
		Total	19	9	1	48	

*FRK 181 is a module which extends over 14 weeks and is presented in the first as well as the second semester. Credit for FRK 151, 152, 161 and 162 will only be granted when FRK 181 has also been passed.

(b) Chemical Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	COP 310	Transfer Processes 310	3	2	0	8	
(2)	CTD 310	Thermodynamics 310	3	2	0	8	CTD 222
(3)	CIC 310	Industrial Chemistry 310	4	2	0	10	(CHM 214)
(4)	CPS 310	Piping Systems Design 310	3	2	0	8	CRV 220
(5)	WIS 338	Mathematics 338	4	0	0	8	WTW 218; WTW 286; WTW 228GS; WTW 263GS
(6)	CSQ 311	Communication 311	0	2	0	2	CSQ221, CPY311†
(7)	CPY 311	Practical Training 311	(Attendance and Report)				CSQ 221
		Total	17	10	0	44	

Second semester

(1)	CPD 320	Process Dynamics 320	2	2	0	6	CRV 220; (CIR 222)
(2)	CKN 320	Kinetics 320	2	2	0	6	(CIR 222) (CTD 222)
(3)	CHO 320	Heat Transfer 320	3	2	0	8	(COP 310)
(4)	CLB 320	Laboratory 320	0	0	6	6	(CPS 310); CMO320†; CHO 320†
(5)	CMO 320	Mass Transfer 320	4	2	0	10	(CIR 222)
(6)	BAN 221	Industrial Analysis 221	3	0	0	6	
(7)	IGB 321	Engineering Management 321	2	2	0	6	IGB 220
		Total	16	10	6	48	

(c) Electrical Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	EMZ 310	Electromagnetism 310	4	1	0	9	WTW 228
(2)	ENE 310	Analogue Electronics 310	3	0	0	6	ELK220GS; ESL220GS

(3)	EMK 310	Microprocessors 310	3	0	0	6	ERS220GS
(4)	EAD 310	Electrical Drives 310	3	0	0	6	EBN 210GS ELK 220GS
(5)	WIS 337	Mathematics 337	4	0	0	8	WTW 218; WTW 286; WTW 228GS
(6)	EGP 310	Laboratory 310	1	0	4	6	EGP 210; EMZ 310†or GS; ENE 310† or GS; EMK 310† or GS
(7)	EXF 300	Forum 300	0	1	0	1	
		Total	18	2	4	42	

Second semester

(1)	MSK 321	Theory of Machines and Strength of Materials 321	3	0	1	7	
(2)	ETK 320	Telecommunication 320	3	0	0	6	ESL 220 GS
(3)	EBB 320	Control Systems 320	3	0	0	6	ESL 220 GS
(4)	EKR 320	Power Systems 320	3	0	0	6	ELX 310 GS
(5)	EOV 320	Design and Manufacturing 320	3	0	2	8	
(6)	EGP 322	Laboratory 322	1	0	4	6	EGP 220; ETK 320† or GS; EBB 320† or GS; EKR 320† or GS
(7)	EXF 300	Forum 300	0	1	0	1	
		Total	16	1	7	40	

Note:
In both the written examination and examination project for EOV 320, a subminimum of 40% is required.

(d) Electronic Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	EMZ 310	Electromagnetism 310	4	1	0	9	WTW 228
(2)	ENE 310	Analogue Electronics 310	3	0	0	6	ELK 220 GS; ESL 220 GS
(3)	EMK 310	Microprocessors 310	3	0	0	6	ERS 220 GS
(4)	EAD 310	Electrical Propulsion 310	3	0	0	6	EBN 210 GS; ELK 220 GS
(5)	WIS 337	Mathematics 337	4	0	0	8	WTW 218; WTW 286 WTW 228GS

(6)	EGP 310	Laboratory 310	1	0	4	6	EGP 210; EMZ 310† or GS; ENE 310† or GS; EMK 310† or GS
(7)	EXF 300	Forum 300	0	1	0	1	
		Total	18	2	4	42	

Second semester

(1)	ESS 320	Systems Electronics 320	3	0	0	6	ENE310GS
(2)	EMZ 320	Electromagnetism 320	3	0	0	6	EMZ310
(3)	EBB 320	Control Systems 320	3	0	0	6	ESL220GS
(4)	ETK 320	Telecommunications 320	3	0	0	6	ESL220GS
(5)	EOV 320	Design and Manufacturing 320	3	0	2	8	ENE 310
(6)	EGP 320	Laboratory 320	1	0	4	6	EGP 220; ESS 320† or GS; EMZ 320† or GS; EBB 320† or GS;ETK 320† or GS
(7)	EXF 300	Forum 300	0	1	0	1	
		Total	16	1	6	39	

Note: In both the written examination and examination project for EOV 320, a subminimum of 40% is required.

(e) Agricultural Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	AGR 313	Primary Food Crops 313	2	0	2	6	
(2)	LWO 311	Implement Design 311	3	1	0	7	MSZ 210
(3)	SHC 310	Hydraulics 310	2	1	2	7	
(4)	LSQ 313	Communication 313	0	1	0	1	
(5)	LPR 310	Processing 310	4	1	1	10	MTX 220
(6)	LEK 210	Agricultural Economics 210	3	0	0	6	
(7)	GKD 215	Soil Science 215	2	0	2	6	(CHM 116)
(8)	LPY 314	Practical Training 314	(Attendance and Report)				
		Total	16	4	7	43	

Second semester

(1)	IGB 321	Engineering Management 321	2	2	0	6	IGB 220
(2)	SRO 322	Structural Design 322	2	1	0	5	MSZ 210
(3)	SUR 220	Surveying 220	3	0	4	10	
(4)	GMA 220	Remote Sensing 220	2	0	2	6	
(5)	LSC 320	Project Preparation 320	0	1	0	1	
(6)	LBC 320	Industrial Principles 320	2	0	2	6	
(7)	PGW 422	Irrigation 422	3	0	3	9	
		Total	14	4	11	43	

(f) Mechanical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MOW 312	Machine Design 312	3	0	3	9	MOW 222, MSK222, (MSZ 210) or (220)
(2)	MSY 310	Structural Mechanics 310	3	0	1	7	MSZ 210, WTW 263
(3)	MSX 310	Fluid Mechanics 310	3	0	1	7	WTW 218†, 286†
(4)	MTX 310	Thermodynamics 310	3	0	1	7	MTX 220
(5)	WIS 338	Mathematics 338	4	0	0	8	WTW 218; WTW 286; WTW 228GS; WTW 263GS
(6)	MSQ 314	Communication 314	0	1	0	1	
(7)	MPY 315	Practical Training 315	(Attendance and Report)				
		Total	16	1	6	39	

Second semester

(1)	MOW 322	Machine Design 322	3	0	5	11	(MOW 312)
(2)	MVR 320	Vibrations and Noise 320	3	0	1	7	(MSD 210)
(3)	MTC 321	Internal Combustion Engines 321	3	0	1	7	(MTX 310), (MSX 310)
(4)	ETN 322	Electrotechnics 322	3	0	2	8	EBN 120
(5)	IGB 321	Engineering Management 321	2	2	0	6	IGB 220
(6)	MSQ 324	Communication 324	0	1	0	1	(MSQ 314)
		Total	14	3	9	40	

Note:
A subminimum of 40% is required in each examination paper in MOW 312 and 322.

(g) Metallurgical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	NHM 310	Hydrometallurgy 310	3	0	2	8	(NMX 210)
(2)	NMM 310	Mechanical Metallurgy 310	3	0	4	10	NMC 221
(3)	NEB 310	Ore-Dressing 310	3	0	4	10	
(4)	NVM 310	Refractory Materials 310	3	0	2	8	
(5)	MSX 310	Fluid Mechanics 310	3	0	1	7	WTW 218†, 286†
(6)	NSQ 300	Communication 300	0	1	0	1	(NSQ 200)
(7)	NPY 316	Practical Training 316	(Attendance and Report)				
		Total	15	1	13	44	

Second semester

(1)	NHM 320	Hydrometallurgy 320	3	0	4	10	(NMX 220)

(2)	NOP 320	Transfer Processes 320	3	0	4	10	(WTW 228, 263)
(3)	NPM 320	Pyrometallurgy 320	3	0	2	8	(NMX 220)
(4)	BAN 221	Industrial Analysis 221	3	0	0	6	
(5)	IGB 321	Engineering Management 321	2	2	0	6	IGB 220
(6)	NSQ 300	Communication 300	0	1	0	1	(NSQ 200)
		Total	14	3	10	41	

(h) Mining Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	PRX 310	Rock Breaking 310	3	0	2	8	PMI 110
(2)	NMP 311	Minerals Processing 311	4	0	2	10	
(3)	PMY 310	Mining 310	3	0	4	10	PMM 211
(4)	PDY 310	Surface Mining 310	3	2	0	8	PMI 120
(5)	GLY 114	Mining Geology 114	4	0	2	10	
(6)	PPY 317	Practical Training 317	(Report)				
		Total	17	2	10	46	

Second semester

(1)	PSX 320	Mine Fluid Mechanics 320	3	0	2	8	
(2)	SUR 220	Surveying 220	3	0	4	10	
(3)	PSZ 320	Rock Mechanics 320	3	2	2	10	MSZ 220GS
(4)	GLY 124	Mining Geology 124	4	0	2	10	GLY 114GS
(5)	IGB 220	Engineering Management 220	2	2	0	6	
		Total	15	4	10	44	

(i) Computer Engineering

The following syllabus will be presented from the year 2001

First semester

	Course		L	O	P	E	Prerequisites
(1)	WTW 332	Stochastic Processes 332	3	1	0	7	WTW 218,286
(2)	ESS 310	Signal Processing 310	3	0	0	6	ESL 220 GS
(3)	EMK 310	Microprocessors 310	3	0	0	6	ERS 220 GS
(4)	COS 213	Advanced Programming 213				7	COS 110 or EPE 120
(5)	BBZ 311	Engineering Economics and Entrepreneurship 311	4	1	0	9	
(6)	EGP 311	Laboratory 311	1	0	4	6	EGP 211, ESS310†or GS EMK310†orGS COS213†orGS
(7)	EXF 300	Forum 300	0	1	0	1	
		Total				42	

Second semester

(1)	EOV 320	Design and Manufacturing 320	3	0	2	8	EMK 310
(2)	EBB 320	Control Systems 320	3	0	0	6	ESL 220 GS
(3)	COS 332	Computer Networks 332				7	COS 110 or EPE 120
(4)	COS 221	Data Bases 221				7	COS 110 or EPE 120
(5)	ERI 320	Computer Architecture 320	3	0	0	6	
(6)	EGP 321	Laboratory 321	1	0	4	6	EGP 221 EBB 320† or GS; COS 332† or GS; COS 221† or GS; ERI 320† or GS
(7)	EXF 300	Forum 300	0	1	0	1	
		Total				41	

Note:
In both the written examination and examination project for EOV 320, a subminimum of 40% is required.

(j) Civil Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	SIK 313	Civil Engineering Practice 313	2	2	0	6	SIK 223
(2)	SHC 310	Hydraulics 310	2	1	2	7	
(3)	SVC 312	Transportation Engineering 312	3	0	2	8	
(4)	SIN 312	Structural Engineering 312	3	2	2	10	SIN 212, SIN 222GS
(5)	WIS 338	Mathematics 338	4	0	0	8	WTW 218; WTW 286; WTW 228GS; WTW 263GS
(6)	SSQ 311	Communication 311	1	2	0	4	Second year practical training
		Total	15	7	6	43	

Second semester

(1)	SHC 320	Hydraulics 320	2	1	2	7	SHC 310 GS
(2)	SVC 322	Transportation Engineering 322	2	1	2	7	SVC 312 GS
(3)	SBM 320	Civil Building Materials 320	2	1	2	7	
(4)	SIN 322	Structural Engineering 322	3	2	2	10	SIN 222; SIN 312GS
(5)	SGM 322	Soil Mechanics 322	2	1	2	7	SGM220 GS
(6)	SSQ 321	Communication 321	1	2	1	5	SSQ 311
		Total	12	8	11	43	

Note:
A subminimum of 40% is required in each examination paper in SIN 312 and 322.

FOURTH YEAR OF STUDY FOR THE BEng

Eng. 20
Admission to the fourth year of study:

(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 courses up to the end of the fourth year of study, may at registration be promoted to the fourth year of study.

(b) A student must pass all the prescribed courses of the second year of study, before he or she is admitted to any course of the fourth year of study.

(c) A student who has not passed all the prescribed courses of the third year of study, must register for the outstanding courses. A student may be admitted by the Dean, on the recommendation of the Head of Department concerned, to courses of the fourth year of study, in addition to the outstanding third year courses, provided that he or she complies with the prerequisites of the fourth year courses and no timetable clashes occur. The total number of course credits for which a student registers may not exceed the number of course credits prescribed for the fourth year of study. The number of courses registered for in each semester may not exceed the prescribed number of courses by more than one course. In exceptional cases, the Dean may, on recommendation of the relevant Head of Department, permit a student to register for more than the prescribed number of course credits.

(d) Students in Electrical and Electronic Engineering who fail a third year course for the second time, forfeit the privilege of registering for any courses of the fourth year of study.

(e) Students in Electrical and Electronic Engineering who have passed the third year of study in one academic year and have excelled academically, may on merit, apply to the Head of the Department for permission to register for a maximum of two postgraduate courses for non-degree purposes. These courses will be in addition to the prescribed courses for the fourth year of study. Credit for the postgraduate courses will be retained for postgraduate study in the Department.

(a) Industrial Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	BVS 410	Manufacturing Systems 410	3	1	1	8	(BVS 320)
(2)	BPZ 410	Production 410	4	0	0	8	
(3)	BON 410	Operations Research 410	3	1	0	7	(BON 320)
(4)	BGC 410	Quality Assurance 410	3	1	0	7	
(5)	BSR 850	Management Accounting 850	3	0	0	6	(FRK 151,152)
(6)	BPJ 410	Project 410	0	0	4	4	(Only fourth year students)
(7)	BER 410	Business Law 410	4	0	0	8	
(8)	BPY 410	Practical Training 410	(Attendance and Report)				
		Total	20	3	5	48	

Second semester

(1)	BPJ 420	Project 420	0	0	16	16	(BPJ 410)
(2)	BPZ 420	Production 420	4	0	0	8	(BPZ320, 410) (Only fourth year students)
(3)	ABV 320	Labour Relations 320	3	0	0	6	
(4)	BSR 860	Management Accounting 860	3	0	0	6	
(5)	BSQ 420	Communication 420	0	1	0	1	
		Total	10	1	16	37	

(b) Chemical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	CIR 412	Chemical Engineering 412	3	2	0	8	(COP 310)
(2)	CMK 410	Materials Science 410	4	0	0	8	
(3)	CPB 410	Process Control 410	4	2	0	10	CPD 320
(4)	CRO 410	Reactor Design 410	4	2	0	10	CKN 320
(5)	CSC 410	Project 410	0	0	8	8	CLB 320, CPB410†, CRO 410†
(6)	CPY 411	Practical Training 411	(Attendance and Report)				CSQ311; CPY311
		Total	15	6	8	44	

Second semester

(1)	COI 420	Environmental Engineering 420	3	3	0	9	
(2)	COX 420	Design 420	2	0	1	5	(CPB 410); (CRO 410)
(3)	CPJ 420	Design Project 420	0	1	14	15	(CPB 410); (CRO 410); COX 420†; CPR 420†
(4)	CPR 420	Practice 420	4	0	0	8	
(5)	CSC 420	Project 420	0	0	5	5	CSC 410
(6)	CSQ 421	Communication 421	0	2	0	2	CSQ 311; CPY411†
		Total	9	6	20	44	

(c) Electrical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	EPR 400	Project 400*	1	0	2	4	Final year EOV 320 GS
(2)	EPP 410	Professional Practice 410	4	0	1	9	EOV 320 GS
(3)	EKR 410	Power Systems 410	3	0	1	7	EKR 320 GS ELX 320 GS
(4)	MVK 410	Flow Mechanics and Thermodynamics 410	3	0	1	7	
(5)	EBT 410	Automation 410	3	0	1	7	EBB 310 GS
(6)	EEO 410	Electrical Design 410	3	0	1	7	ELX 320 GS

(7)	EXF 400	Forum 400	0	1	0	1	
		Total	17	1	7	42	

Second semester

(1)	EPR 400	Project 400*	2	0	24	28	Final year EOV 320 GS
(2)	EXF 400	Forum 400	0	1	0	1	
(3)	EPY 422	Practical Training 422	(Attendance)				
(4)	EES 420	Specialisation 420	3	0	1	7	
		Total	5	1	25	36	

Note:
Project 400* may only be taken if a student is able to complete his or her studies in the relevant year.

(d) Electronic Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	EPR 400	Project 400*	1	0	2	4	Final year EOV 320 GS
(2)	EPP 410	Professional Practice 410	4	0	1	9	EOV 320 GS
(3)	EBT 410	Automation 410	3	0	1	7	EBB 310 GS
(4)	EEF 410	Photonics 410	3	0	0	6	
(5)	ETK 410	Telecommunication Systems 410	3	0	0	6	ETS 320 GS
(6)	ERI 410	Computer Engineering 410	3	0	0	6	ERP 210, EMK 310 GS
(7)	EGP 410	Laboratory 410	1	0	3	5	EEF 410† or GS, ETK 410† or GS, ERI 410† or GS
(8)	EXF 400	Forum 400	0	1	0	1	
		Total	18	1	7	44	

Second semester

(1)	EPR 400	Project 400*	2	0	24	28	Final year EOV 320 GS
(2)	EXF 400	Forum 400	0	1	0	1	
(3)	EPY 422	Practical Training 422	(Attendance)				
(4)	EES 420	Specialisation 420	3	0	1	7	
		Total	5	1	25	36	

Note:
Project 400* may only be taken if a student is able to complete his or her studies in the relevant year.

(e) Agricultural Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	LSC 402	Project 402	0	0	4	4	LSC 320
(2)	LLS 410	Agricultural Structures 410	2	2	2	8	
(3)	LHL 411	Hydraulics 411	3	2	0	8	
(4)	LPR 410	Processing 410	4	1	1	10	(LPR 320)
(5)	LGD 410	Soil Dynamics 410	2	1	1	6	
(6)	LPW 411	Agricultural Production Equipment 411	2	1	2	7	
(7)	LPY 414	Practical Training 414	(Attendance and report)				
		Total	13	7	10	43	

Second semester

(1)	LBP 420	Irrigation 420	3	1	3	8	(SHC 310), (LHL 411), (PGW 422)
(2)	LSC 402	Project 402	0	0	10	10	LSC 320
(3)	LLI 420	Rural Engineering 420	2	1	0	5	
(4)	LOX 421	Design 421	2	1	1	6	
(5)	LGH 420	Soil Conservation and Hydrology 420	3	2	0	8	
		Total	10	5	12	37	

Note:
Project 402 may only be taken if a student can complete his or her studies in the relevant year.

(f) Mechanical Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	MSY 410	Structural Mechanics 410	3	0	1	7	MSY 310
(2)	MWX 410	Heat Transfer 410	3	0	1	7	MSX 310GS, MTX 310GS
(3)	MVM 410	Fluid Machines 410	3	0	1	7	MSX 310
(4)	MBB 410	Control Systems 410	3	0	2	8	
(5)	MSQ 413	Communication 413	0	1	0	1	
(6)	MPY 415	Practical Training 415	(Attendance and Report)				
	Option - Mechanical:						
(7)	MOX 410	Design 410	0	0	7	7	MOW 312, MOW 322
(8)	MSC 400	Project 400	0	0	4	4	3 of (MSZ310); (MTX 310), (MSX 310), (MTC 320)
	or Option – Aeronautical:						
(7)	MSC 401	Aeronautical Project 401	0	0	4	4	(MSX 310), (MTX 310), (MSZ 310)

(8)	MLV 780	Flight Mechanics 780	2	3	0	7	
		Total	12	1	16	41	
		or	14	4	16	41	

Second semester

(1)	MTC 420	Thermal Machines 420	3	0	1	7	(MTX 310)
(2)	ETN 420	Electrotechnics 420	3	0	1	7	ETN 322
(3)	MLD 420	Aerodynamics 420	3	0	1	7	MSX 310
(4)	MSQ 423	Communication 423	0	1	0	1	
	Option - Mechanical:						
(5)	MSC 400	Project 400	0	0	10	10	
(6)	Optional course		3	0	1	7	
	or Option - Aeronautical:						
(5)	MSC 401	Aeronautical Project 401	0	0	10	10	
(6)	MLW 780	Aircraft Design 780	2	0	3	7	MOW 312, MOW 322
		Total	12	1	14	39	
		or	11	1	16	39	

Optional courses:

	MEG 420	Megatronics 420 **or**	3	0	1	7	ETN 322; (MBB 410)
	MII 420	Maintenance Engineering 420 **or**	3	0	1	7	
	Postgraduate course		2	3	0	7	

Note:

(1) The postgraduate course above may be taken with special permission from the Head of the Department.

(2) In order to proceed with Project (MSC 400) and the Aeronautical Project (MSC 401), a subminimum of 40% is required in each semester test.

(3) Optional courses may be scheduled in accordance with the postgraduate timetable in mini-blocks.

(4) The medium of instruction for the postgraduate courses in above, is mentioned in the postgraduate brochure of the Department.

Preparation for postgraduate specialisation:

Numerous courses are available for postgraduate specialisation. Consult the postgraduate brochure of the Department for further information.

(g) Metallurgical Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	NKR 410	Corrosion 410	3	0	4	10	(NMM 310)
(2)	NPL 410	Process Metallurgy 410	4	0	4	12	NPM 320
(3)	NSC 400	Project 400	0	0	4	4	
(4)	NSQ 400	Communication 400	0	1	0	1	(NSQ 300)
(5)	NPY 416	Practical Training 416	(Attendance and Report)				
	Manufacturing Metallurgy						
(6)	NSW 410	Welding Engineering 410	3	0	4	10	(NMM 310)
(7)	NMP 410	Materials Processing 410	4	2	2	12	(NMM 310)
		Total	14	3	18	49	

or Extractive Metallurgy

(6)	NEB 410	Ore Dressing 410	3	0	2	8	(NEB 310)
(7)	NHM 410	Hydrometallurgy 410	3	2	4	12	(NHM 310)
		Total	13	3	16	47	

Second semester

(1)	NSC 400	Project 400	0	0	20	20	
(2)	NSQ 400	Communication 400	0	1	0	1	(NSQ 300)
(3)	NON 420	Design 420	4	2	2	12	(NMM 310) (NEB 310)
		Total	4	3	22	33	

(h) Mining Engineering

First semester

	Course		L	O	P	E	Prerequisites
(1)	PKB 410	Mine Climatic Control 410	3	0	2	8	PSX 320
(2)	PMW 410	Mine Valuation 410	3	0	2	8	
(3)	PSZ 410	Strata Control 410	3	0	2	8	PSZ 320 GS
(4)	PSC 410	Project 410	0	2	0	2	
(5)	PME 410	Mineral Economics 410	3	2	2	10	
(6)	GLY 414	Structural Geology 414	2	0	3	7	GLY 114,124
(7)	PPY 417	Practical Training 417	(Report)				
		Total	14	4	11	43	

Second semester

(1)	IGB 321	Engineering Management 321	2	2	0	6	IGB220
(2)	PMX 420	Mining Techniques 420	3	0	2	8	
(3)	PMZ 420	Mine Design 420	4	4	4	16	
(4)	GLY 323	Economic Geology 323	4	0	5	13	GLY 114GS, 124GS
		Total	13	6	11	43	

(i) Computer Engineering

This syllabus will be presented as from the year 2002.

First semester

	Course		L	O	P	E	Prerequisites
(1)	EPR 471	Project 471	1	0	2	4	Final year EOV 320 GS
(2)	EPP 410	Professional Practice 410	4	0	1	9	EOV 320 GS
(3)	ETK 410	Telecommunication Systems 410	3	0	0	6	
(4)	ESP 410	Digital Signal Processing 410	3	0	0	6	ESS 310 GS
(5)	COS 301	Software Engineering 301				7	COS 110 or EPE 120
(6)	ESI 410	Systems Engineering 410	3	0	0	6	

(7)	EGP 411	Laboratory 411	1	0	4	6	EGP 321; EPP 410† or GS; ETK 410† or GS; ESP 410† or GS; COS 301† or GS; ESI410† or GS
(8)	EXF 400	Forum 400	0	1	0	1	
		Total				45	

Second semester

(1)	EPR 471	Project 471	2	0	18	22	Final year EOV 320 GS
(2)	EPG 420	Advanced Program Engineering 420	3	0	1	7	COS 301
(3)	EBI 420	Business Systems Engineering 420	3	0	1	7	ESI 410
(4)	ERN 420	Advanced Computer Networks 420	3	0	1	7	ERI 320
(5)	EXF 400	Forum 400	0	1	0	1	
(6)	EPY 421	Practical Training 421	(Attendance)				
		Total				44	

Note:
Project 471 may only be taken in the relevant year if studies can be completed.

(j) Civil Engineering

First semester

	Course		**L**	**O**	**P**	**E**	**Prerequisites**
(1)	SHC 410	Hydraulics 410	2	3	2	9	SHC 310,320
(2)	SSC 410	Civil Engineering Project 410	0	0	8	8	All relevant third year courses except WIS 338
(3)	SIN 412	Structural Engineering 412	3	2	2	10	SIN 312, SIN 322GS
(4)	SGM 411	Soil Mechanics 411	2	3	2	9	SGM322GS
(5)	SSQ 411	Communication 411	1	1	1	4	Third year practical training
		Total	8	9	15	40	

Second semester

(1)	SON 421	Civil Engineering Design Project 421	10	0	20	40	All preceding courses
		Total	10	0	20	40	

Note:
A subminimum of 40% is required in each examination paper in SIN 412.

A student may only register for SSQ 411 if SSC 410 (Civil Engineering Project) has been passed or if SSQ 411 and SSC 410 are registered for concurrently.

II. BACHELOR OF HONOURS DEGREES

BACHELOR OF ENGINEERING (HONOURS) [BEng (Hons)]

Also consult the General Regulations.

Eng. 22

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

(b) The degree is awarded in the following branches of engineering:

(i)	Industrial Engineering	(Code 12240011)
(ii)	Control Engineering	(Code 12240231)
(iii)	Bio Engineering	(Code 12240201)
(iv)	Chemical Engineering	(Code 12240021)
(v)	Electrical Engineering	(Code 12240031)
(vi)	Electronic Engineering	(Code 12240091)
(vii)	Quality Assurance and Reliability Engineering	(Code 12240291)
(viii)	Geotechnical Engineering	(Code 12240212)
(ix)	Corrosion Engineering	(Code 12240241)
(x)	Agricultural Engineering	(Code 12240041)
(xi)	Mechanical Engineering	(Code 12240051)
(xii)	Metallurgical Engineering	(Code 12240061)
(xiii)	Micro-Electronic Engineering	(Code 12240191)
(xiv)	Mining Engineering	(Code 12240071)
(xv)	Environmental Engineering	(Code 12240221)
(xvi)	Computer Engineering	(Code 12240211)
(xvii)	Urban Engineering	(Code 12240213)
(xviii)	Structural Engineering	(Code 12240121)
(xix)	Technology Management	(Code 12240251)
(xx)	Transportation Engineering	(Code 12240111)
(xxi)	Water Utilisation Engineering	(Code 12240101)
(xxii)	Water Resources Engineering	(Code 12240161)

(c) The curriculum is determined in consultation with the relevant Heads of Departments. A student is required to pass at least 64 course credits.

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

(e) Examinations

(i) The examination in each course 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): On the

understanding that the Dean, on recommendation of the relevant Head of Department, may approve a stipulated limited extension of this time period.

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

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

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

(f) The honours degree is awarded at least one year after attainment of the Bachelor's degree.

(g) A student passes with distinction if he or she obtains a weighted average of at least 75% in the first 64 course credits for which registered (excluding courses which were discontinued timeously). The degree is not awarded with distinction if a student fails any one course (excluding courses which were discontinued timeously).

BACCALAUREUS SCIENTIAE HONORES [BSc(Hons)]

Also consult the General Regulations

Eng. 23

(a) **Admission requirements**: An appropriate bachelor's degree or equivalent qualification.

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

(c) The BSc(Hons) degree may be obtained in the following fields of study:

Applied Sciences	(Code 12243010)
Biosystems	(Code 12241121)
Chemical Technology	(Code 12241011)
Control	(Code 12241181)
Corrosion	(Code 12241191)
Electronics	(Code 12241111)
Electrotechnics	(Code 12241031)
Environmental Technology	(Code 12241171)
Geotechnics	(Code 12241001)
Industrial Systems	(Code 12241161)
Irrigation	(Code 12241041)
Mechanics	(Code 12241201)
Metallurgy	(Code 12241061)
Mine Strata Control	(Code 12241151)
Mining Environment Control	(Code 12241071)
Quality Assurance and Reliability	(Code 12241101)
Structural Materials	(Code 12241141)
Technology Management	(Code 12241072)
Transportation Planning	(Code 12241091)
Water Resources	(Code 12241081)
Water Utilisation	(Code 12241021)

(d) The stipulations of Gen. Reg. Eng. 22 (c) to (g) apply *mutatis mutandis*.

III. MASTER'S DEGREES

MASTER OF ENGINEERING (MEng)

Also consult the General Regulations.

Eng. 24

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

(b) The degree of Master of Engineering is awarded in the following branches of engineering:

		Degree code	Dissertation	Project
(i)	Industrial Engineering	12250011	BIR 890	BSC 895
(ii)	Control Engineering	12250231	CBH 890	CSC 897
(iii)	Bio-Engineering	12250201	EIB 890	
(iv)	Chemical Engineering	12250021	CIR 890	CSC 895
(v)	Electrical Engineering	12250031	EIR 890	ESC 895
(vi)	Electronic Engineering	12250091	EIN 890	ESC 896
(vii)	Quality Assurance and Reliability Engineering	12250291	BGX 890	BSC 896
(viii)	Geotechnical Engineering	12250212	SGT 890	SGT 895
(ix)	Engineering Management	12250171		IGB 895
(x)	Agricultural Engineering	12250041	LIR 890	LSC 895
(xi)	Corrosion Engineering	12250241	NKR 890	
(xii)	Mechanical Engineering	12250051	MIR 890	MSC 895
(xiiii)	Metallurgical Engineering	12250061	MIN 890	NSC 895
(xiv)	Micro-Electronic Engineering	12250191	EEY 890	
(xv)	Mining Engineering	12250071	MYI 890	PSC 895
(xvi)	Environmental Engineering	12250221	COI 890	CSC 896
(xvii)	Project Management	12250261		
(xviii)	Computer Engineering	12250211	ERI 890	
(xix)	Urban Engineering	12250213	SSI 890	SSI 895
(xx)	Structural Engineering	12250121	SIN 890	SSC 896
(xxi)	Technology Management	12250251	ITB 890	
(xxii)	Transportation Engineering	12250111	VIN 890	SSC 898
(xxiii)	Water Utilisation Engineering	12250101	WBI 890	WSC 895
(xxiv)	Water Resources Engineering	12250161	WBK 890	SSC 899

(c) Unless the Dean on recommendation of the relevant Head of Department decides otherwise, the Master's degree is conferred on the basis of examinations and a dissertation (including an examination of the dissertation) or a project.

(d) The curriculum is determined in consultation with the relevant Head of Department. A student must pass in courses with a minimum of 64 course credits if a dissertation is submitted, and in courses with a minimum of 128 course credits if a project is submitted, on the understanding that 16 of the 128 course credits are allocated to the project.

(e) A student who, before registration for the master's degree, e.g. during the BEng(Hons) study, passed appropriate courses, may apply to the Dean for credit of these courses for the MEng degree. Should credit be granted, the marks initially obtained for the courses will be upheld.

(f) Examinations

(i) The stipulations of Eng. 22 (e)(i), (iii), (iv) and (v) are applicable.

(ii) A master's student is required to complete his or her degree studies within 4 years after the first registration: On the understanding 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 is required to pass the dissertation or project separately.

(iv) The Dean may, on recommendation of the relevant Head of Department, grant exemption to a student from the examination of the dissertation.

(g) Guidelines for the preparation and examination of projects 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%.

(h) 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) as well as the weighted average mark which has been obtained for the first 64 course credits for the degree (excluding courses which have been timeously discontinued). Courses which have been credited in terms of Regulation Eng. 24(e) are taken into account. Furthermore, a student must obtain a mark of at least 70% for the dissertation (and examination) and a weighted average of at least 70% in the first 64 course credits completed or credited for the degree (excluding courses which have been timeously discontinued). However, the degree is not awarded with distinction should the student fail any of the courses (of the first 64 course credits) for the MEng degree study (excluding courses which have been timeously discontinued).

(ii) A student who submits a project, passes with distinction if a weighted average mark of at least 75% is obtained in the first 128 course credits obtained for the degree, on the understanding that 16 of the 128 course credits are allocated to the project. Courses credited in terms of Regulation Eng. 24(e) are taken into account. However, the degree is not awarded with distinction should a student fail any of the courses (of the first 128 course credits) for the MEng degree study (excluding courses which have been timeously discontinued). Neither is the degree awarded with distinction if a student obtains less than 70% for the project.

(i) General masters' requirements and draft article

A student must by means of a dissertation or project prove that he or she is capable of planning, instituting and executing a scientific investigation. Unless otherwise decided by the Dean, on the recommendation of the Head of Department concerned, a student shall submit at least one draft article to a recognised journal for publication, before or concurrent with the submission of the dissertation. The draft article has to be based on the research undertaken for the dissertation or project and must be acceptable to the supervisor.

MAGISTER SCIENTIAE (MSc)

Also consult the General Regulations

Eng. 25

(a) Subject to the stipulations of Regulation G.62, an appropriate BSc(Hons) degree or an equivalent qualification is required for admission, except in the directions Engineering Management and Project Management where a relevant Bachelor's degree is required.

(b) The MSc degree is conferred in the same fields of study as the BSc (Hons) degree as well as in the fields of study, Engineering Management and Project Management.

(c) The stipulations of Regulation Eng. 24 (c) to (i) applies *mutatis mutandis*.

IV. DOCTOR'S DEGREES

PHILOSOPHIAE DOCTOR (ENGINEERING) (PhD)

Also consult the General Regulations.

Eng. 26

(a) Subject to the stipulations of Regulations G.45 and G.62, no candidate is admitted to doctoral studies unless he 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 degree is awarded on the basis of a thesis and an examination on the thesis.

(c) Unless otherwise decided by the Dean, on the recommendation of the supervisor, a student shall submit at least one draft article to a recognised journal for publication, before or concurrent with the submission of the thesis. The draft article must be based on the research undertaken for the thesis and must be acceptable to the supervisor.

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

DOCTOR OF ENGINEERING (DEng) (Code 12260001)

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

Eng. 28

(a) Faculty Committee

A Faculty Committee, which is constituted by the Heads of Departments from time to time, considers all applications for admission to the degree, DEng.

(b) Selection Committee

(i) The Faculty Committee appoints a Selection Committee which consists of the Head of the specific Department, two experts in the field of study (on the recommendation of the Head) and two members of the Faculty Committee.

(ii) The Selection Committee determines the suitability of the candidate for examination and also appoints suitable examiners.

(c) Guidelines for examiners

The Selection Committee uses the following guidelines to evaluate the admission of the candidate:

(i) The candidate must submit a short summary of his or her work with the submission, in which the work is put into perspective.

(ii) Suitable candidates will typically at least be equivalent to a B profile at the NRF, in other words candidates who enjoy international recognition as independent researchers, as well as for the high quality and inventiveness of their research contributions.

(iii) Serious consideration will be given to reviewed publications. The stature of the publication will also be taken into consideration.

(iv) Books or published conference papers will only be taken into consideration in exceptional cases, and then only if the relevance thereof can be fully motivated.

(d) Appointment of external examiners

If the Selection Committee is of the opinion that the candidate should be considered for the degree, the committee submits proposals concerning external examiners (the Examination Committee).

(i) The Selection Committee is guided by the stipulations set out in Regulation G. 56.

(ii) The Selection Committee must indicate to what extent the external examiners enjoy international recognition.

(iii) The Dean appoints the external examiners after consultation with the Faculty Committee.

(e) Evaluation of publications

(i) Should any examiner submit a negative report, all the reports are referred back to the Selection and Faculty Committees for the reconsideration of further procedures. Only in highly exceptional circumstances will the appointment of an additional examiner and re-examination be considered.

(ii) Should the reports of the examiners be positive, the rest of the examination process is concluded administratively.

V. DIPLOMA

POSTGRADUATE DIPLOMA IN QUALITY ASSURANCE AND RELIABILITY (Code 12220021)

Eng. 29

(a) Admission requirements

An appropriate bachelor's degree is required.

(b) Duration
The minimum duration of the diploma is two semesters.

(c) Curriculum **Credits**
The following courses are compulsory:

BAN 780	Industrial Analysis 780	8
BGC 780	Quality Assurance 780	8
BGV 780	Quality Assurance Management 780	8
BTK 780	Reliability Engineering 780	8
BPZ 780	Production 780	8

No specific courses are required in addition to the above. Students should submit a meaningful choice of courses to the Head of the Department for approval. For further information, consult the postgraduate brochure of the department of Industrial and Systems Engineering.

(d) Diploma with distinction
A student passes with distinction if he or she has obtained a weighted average of at least 75% in all the courses.

(e) The stipulations of Regulation Eng. 22 (e)(i) to (v) applies *mutatis mutandis*.

SYLLABI

UNDERGRADUATE

BACHELOR OF ENGINEERING

Note:
(1) The different fields of study for which a course is prescribed are indicated in brackets after the name of each course, also mentioning the particular year of study for which the course is prescribed.
(2) The following abbreviations are used for the BEng degree course specialising in:

L – Agricultural
C – Chemical
S – Civil
R – Computer
E – Electrical
Z – Electronic
B – Industrial
M – Mechanical
N – Metallurgical
P – Mining
1 – First year of study
2 – Second year of study
3 – Third year of study
4 – Fourth year of study

Example:
(BAN 221)**INDUSTRIAL ANALYSIS 221 : (B2)**
It follows that the above course is prescribed for students in the second academic year in Industrial Engineering.

(ERN 420**) ADVANCED COMPUTER NETWORKS 420:(R4)**
Introductory concepts of computer network organising with reference to the OSI reference model. Physical layer principles, synchronous/asynchronous communication on levels 1 and 2; FDM, TDM, satellite communication, line switch and packet switching; LAPB (X.25 layer 2); the network layer protocol (layer 3) with routing and control; the transport- and session layer protocol (layer 4 and 5); presentation layer and application layer principles and network data security; LAN, MAN and WAN architectures, protocols and standards such as the IEEE 802.X, FDDI and DQDB, “Frame Relay”, client server principles.

(EPG 420) **ADVANCED PROGRAM ENGINEERING 420:(R4)**
The software process, frames and patterns, real-time principles and related aspects, the Capability Maturity Model, safety critical systems, user centred design, development of military software, binary logic and analysis, distributed objects, object oriented databases. A production case study will be used as an example.

(MLD 420) **AERODYNAMICS 420:(M4)**
Introduction to aeronautics. Basic potential flow: Stream function, potential function, source and vortex flow, circulation, rotational flow, conformal mapping. Magnus effect. Boundary layer theory. Laminar and turbulent flow. Drag and separation. Generation of lift, thin wing theory, finite wings, induced drag and groundeffect. Elementary flight mechanics. Compressible flow, thin wings in supersonic flow. Effect of shockwaves on wings. Experimental techniques in aerodynamics.

(LEK 210) **AGRICULTURAL ECONOMICS 210:(L3)**
Introduction to farm management and production economics, the economic, social and natural environment and the nature of the agricultural industry, production factors, management functions, profitability and farm planning, basic theoretical principles with regard to resource utilisation, resource combinations, product combinations and production cost, risk and uncertainty, profitability; rural development.

(LKW 222) **AGRICULTURAL POWER MACHINERY 222:(L2)**
Working principles of internal combustion engines and components thereof. Ergonomics. Mechanics of the agricultural tractor. Electricity and other energy sources for the agricultural industry.

(LPW 411) **AGRICULTURAL PRODUCTION EQUIPMENT 411:(L4)**
Aims of cultivation. Analysis of forces on implements and hitch systems. Working principles, construction and design theory for different agricultural implements.

(LLS 410) **AGRICULTURAL STRUCTURES 410:(L4)**
Project planning and management. Building materials, building and construction. Quantity surveying, water supply and sewerage. Residence and farmstead planning. Ventilation of farm structures. Functional requirements for and design of farm-related structures, housing systems and handling facilities for different species of animals.

(ENE 310) **ANALOGUE ELECTRONICS 310:(E3, R3)**
Amplifier concepts: gain, input impedance, output impedance, bandwidth. Feedback, stability in amplifiers. Power dissipation and power efficiency. Bipolar - and FET amplifier design: bias and frequency response of small signal loaded single stage -, multistage -, differential stage -, and feedback amplifiers. Large signal power amplifiers.

(EBT 410) **AUTOMATION 410:(E4, Z4)**
The general control problem and the role of sensors and actuators. Static and dynamic properties of measurement systems. Reliability, calibration and maintenance of instrumentation systems. Typical sensor elements as applied for the measurement of e.g. displacement, velocity, temperature, flow, pressure and force. Communication between the process and the control room. Typical plant automation issues. Computer platforms used in plant automation.

(BBZ 210) **BASIC INDUSTRIAL ENGINEERING 210:(B2)**
Microcomputers: Hardware, application software, spreadsheets and word processing.
Productivity: Concepts, theory, hard and soft productivity factors.
Project life cycle: Phases, needs analysis, value and functional analysis.

(BBZ 220) **BASIC INDUSTRIAL ENGINEERING 220:(B2, P2)**
Work-study: Method study – critical examination and process flow charts and diagrams.
Work measurement – time study and activity sampling.
Organisational behaviour: Motivation and motivational theories, incentive schemes, group forming, work teams, job design, change and resistance to change.

(BBZ 310) **BASIC INDUSTRIAL ENGINEERING 310:(B3)**
Engineering economy: time value of money, cash flow calculations, financial evaluations of alternatives, discounted cash flows, inflation and depreciation and income tax, risk and uncertainty.
Entrepreneurship: Market research, small business management, innovation, economic analysis and break even analysis, feasibility studies.

(BBZ 320) **BASIC INDUSTRIAL ENGINEERING 320:(B3)**
Project management: theory and concept of systems, organisation structures and project management functions, the project environment, project planning, scheduling and control, systems engineering, configuration management.
Facilities planning: Market research and product development. Process planning, requirements and selection of equipment and labour. Group technology, manufacturing cells, flexible manufacturing, assembly line balancing and machine coupling. Automation and computer integrated support services. Materials handling – principals, equipment, system design, unit loads, flow lines, grouping and packaging. Storage and warehousing design. Space requirements and layout planning. Visits to industry and facilities planning project.

(CBI 220) **BIOCHEMICAL ENGINEERING 220:(C2)**
Characterisation of biological material. Taxonomy, chemical composition, growth requirements and reproduction. Metabolism and reproduction. Metabolism and product formation. Growth kinetics, batch and continuous cultivation. Reactor design, operation and product recovery. Case studies.

(BER 410) **BUSINESS LAW 410:(B4)**
Introduction to jurisprudence. General law of contract. Specific contracts: purchase contracts, service contracts, employment contracts. Representation law. General aspects of Business Law. Dispute settlement - mediation and arbitration.

(EBI 420) **BUSINESS SYSTEMS ENGINEERING 420:(R4)**
Business system modelling, business process engineering. Integrated business systems consisting of the following modules: human resource management; financial manage-

ment; sales and distribution; materials management; production planning; management information systems (MIS); executive information systems (EIS); decision support systems (eg. data warehousing, decision models); planned maintenance, configuration management. The SAP R/3 system can serve as a framework for projects which will be used to explain important principles. First hand knowledge will be gained during practical sessions.

(SBZ 210) **CALCULATION TECHNIQUES 210:(S2)**
Statistical concepts, procedures, methodology and applications in Civil Engineering. Risk analysis. Acceptance and rejection tests. Measuring techniques, mechanical and electronic, principles of strain-gauge design.

(WTW 114) **CALCULUS 114:(B1, C1, E1, L1, M1, N1, P1, R1, S1, Z1)**
Vector algebra. Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, optimisation and applications. The mean value theorem. The rule of L'Hospital. Definite and indefinite integrals, the fundamental theorem of calculus, the mean value theorem for integrals, integration techniques. This course also includes a formal technique mastering programme.

(WTW 128) **CALCULUS 128:(B1, C1, E1, L1, M1, N1, P1, R1, S1, Z1)**
Important inverse functions. Integration techniques, improper integrals, numerical integration, elementary differential equations. Volume and surface areas, arc lengths. Conic sections. Elementary power series and Taylor's theorem. Plane curves, polar coordinates and Vector-valued functions.

(WTW 218) **CALCULUS 218: (B2, C2, E2, L2, M2, N2, P2, R2, S2, Z2)**
Vector functions and multivariable functions. Multiple integrals. Line and surface integrals, theorems of Green, Gauss and Stokes. Applications.

(WTW 228) **CALCULUS 228: (B2, C2, E2, L2, M2, N2, P2, R2, S2, Z2)**
Sequences and series. Power series. Fourier series. Applications to differential equations.

(CMY 131, CMY 141) **FIRST COURSE IN CHEMISTRY 131, GENERAL CHEMISTRY 141 : (C1, N1)**
Consult Faculty of Science, Rules and Syllabuses.

(CHM 116) **CHEMISTRY 116:(B1, E1, Z1, L1, M1, P1, S1)**
Revision of concepts learnt at school, formulas, terms, reaction equations, measurement of quantity of matter, stoichiometry, chemical equilibrium, acids, bases, gases, liquids, solids, intermolecular forces, electrochemistry and organic chemistry. Practicals: related to the theory.

(CHM 214) **CHEMISTRY 214:(C2)**
Organic chemistry. Chemical properties of organic (including aromatic) compounds. Functional group transformation and synthesis.

(CHM 216) **CHEMISTRY 216:(C2)**
Instrumental analytical chemistry. Atomic spectroscopy: atom emission and absorption, x-ray fluorescence. Molecular spectroscopy: infra-red, UV visible, NMR. Chromatography: gas and liquid chromatography. Electrochemical methods: potentiometics, polarographics, electrogravimetrics, coulometrics, conductance methods.

(CIR 121) **CHEMICAL ENGINEERING 121:(C1)**
Units and dimensions. Methods to express concentration. Specific mass and density, specific volume, bulk density, density of ideal compounds. Temperature and conversions. Pressure, absolute pressure and gauge pressure. Stoichiometric calculations. Elementary material balances. Empirical formulae. Sketching. Flow charts: simplified block flow charts, illustrated flow charts, P&I diagrams, representation of mass balances on flow charts. Isometric drawings of pipes.

(CIR 212) **CHEMICAL ENGINEERING 212:(C2)**
Physical and chemical laws, gas laws, solutions of gases, evaporation, vapour pressures of pure liquids, liquid mixtures and solutions of non-volatile dissolved matter. Material balances. Combustion calculations. Energy balances. Thermochemistry, enthalpies of pure substances and mixtures.

(CIR 222) **CHEMICAL ENGINEERING 222:(C2)**
Data sources, steam tables. Simultaneous material and energy balances. Enthalpy data and enthalpy concentration diagrams; the equilibrium stage. Unsteady state. Industrial instrumentation.

(CIR 412) **CHEMICAL ENGINEERING 412:(C4)**
Humidification and dehumidification of air. Water cooling, drying, crystallisation, ion exchange, particle technology, particle movement in a fluid, sedimentation. Hydrocyclones, flotation, filtration. Centrifuges. Fluidised bed technology. Mixing. Commination. Pneumatic transport.

(EBN 120) **CIRCUITS 120:(E1, R1, Z1, M2)**
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, noninverting amplifiers, summing amplifiers, current sources, integrators.

(EBN 210) **CIRCUITS 210 : (E2, R2, Z2)**
Transient response phenomena in RC. RL- and RLC-circuits, natural response and step response. Alternating current circuits: Impedance's, phasors, solution of singe phase and three phase circuits by use of complex algebra, Ohm's law in AC circuits, Kirchloff's circuit theorems, Thevenin and Norton equivalents, star/delta transformation, power transfer calculations and power measurement, mutual inductance, transformers, controlled sources, operational amplifier applications. Electromechanical transducers, resonance phenomena, computer simulation of AC circuits.

(SBM 320) **CIVIL BUILDING MATERIALS 320:(S3)**
Cement and concrete products, structural steel, structural timber, fibre reinforcing, polimers, masonry work and epoxies.

(SON 421) **CIVIL ENGINEERING DESIGN PROJECT 421:(S4)**
The objective of the course is the development of the student's ability to synthesise his knowledge of a complex real world problem, the further development of communication skills as well as the mastering of additional topics not covered or only partially covered in the contents of the first seven semesters. The additional topics discusses are:
Structural Engineering: Construction methods, materials and cost, building layout, bridge layout, constructability of structures, building regulations, design codes, structural drawings. Traffic and Transportation Engineering: Access design, site layout, traffic engineering, case studies, railway siding design, bus, road and railway transportation, and requirements of taxi commuters. Geotechnical engineering: Soil improvement, foundations, field survey, site survey, subsoil exploration, testing methods, interpretation of field, in-situ and laboratory test results. Hydraulics: Identification of hydraulic controls, backwater curve calculation, lining of dams, water quality control. Civil Engineering Practice: Project management, life cycle phases of a project, planning of projects, contractual arrangements, system approach, contractual relations, contract documentation, schedules of quantities, the RDP, CAD and drawings, estimates and budgets. Architecture: Context and environment. General topics: Requirements of the property developer and owner, land use planning, environmental impact studies, the role of the local authority in the development process. The civil engineer as an entrepreneur.

Specific attention is given to functioning in a group. Communication skills are further developed by feedback within a group context regarding progress and specific problems which are experienced with the finding of solutions for the project. Each student keeps a documented record of the conceptual solution for the project as well as a detail design on a specific aspect of the problem, which is then presented to the examination commission. These designs serve as a basis for the presentation when the student defends his proposals.

(QSG 210) **CIVIL ENGINEERING GEOMETRY 210:(S2)**
Adjustment and use of the following instruments: Plane table, level, compass and theodolite. Elementary site surveying and levelling, tachometry. Definition of surveying. Co-ordinate systems and bearings. Connections and polars. Methods of determining points. Elevation. Tachometry.

(SIK 120) **CIVIL ENGINEERING PRACTICE 120:(S1)**
Computer literacy: Introduction to operating systems, word processing, spreadsheets and programming. Applications in Civil Engineering. The use of drawings as a communication medium in Civil Engineering. Training in computer-aided draughting, with applications in road design, structures and services.

(SIK 213) **CIVIL ENGINEERING PRACTICE 213:(S2)**
Introduction to engineering economics: Basic guidelines, assessment of alternative investment possibilities. Equal annual cash flow, current value, internal rate of return, cost benefit relationship. Introduction to relational data base theory and its application in Civil Engineering.

(SIK 223) **CIVIL ENGINEERING PRACTICE 223:(S2)**
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 313) **CIVIL ENGINEERING PRACTICE 313:(S3)**
Construction equipment: Introduction of basic construction equipment, pre-planning, production planning, working techniques. Planning techniques: Grant diagram, activity on line network, activity on node network, resource scheduling, multiple dependency and the activity on node network.

(SSC 410) **CIVIL ENGINEERING PROJECT 410:(S4)**
In the first semester, at least one full day of the week must be used by final year students for the execution of an analytical and/or experimental research project.

(BSQ 110, 220, 310, 320, 420) **COMMUNICATION 110:(B1); 220 (B2); 310, 320 (B3); 420 (B4)**
Class discussions of papers prepared and presented by students. Principals and requirements for successful written and verbal communication.

(CSQ 221) **COMMUNICATION 221:(C2)**
Principles of good language usage and writing of reports. Discussion of technical and non-technical topics. Meeting procedure.

(CSQ 311) **COMMUNICATION 311:(C3)**
Discussion of practical and aspects of the Chemical Engineering industry. Principles of effective communication and reporting. The elements of a good technical report. Source of information and accessing.

(CSQ 421) **COMMUNICATION 421:(C4)**
Discussion of practical training and aspects of the Chemical Engineering industry. Communication principles, written and verbal reporting. Organisation of information.

(LSQ 313) **COMMUNICATION 313:(L3)**
Principles and forms of verbal and written communication. Delivering speeches on various subjects.

(MSQ 112) **COMMUNICATION 112:(M1)**
Introduction to departmental syllabus and related academic aspects. Important facets of mechanical engineering. Discussion of the role of mechanical engineers in industry.

(MSQ 314, 324) **COMMUNICATION 314, 324:(M3)**
Practical exercise and application of written and verbal communication principles. Presentations on selected topics. Forum for mutual communication and information on practice-oriented topics.

(MSQ 413, 423) **COMMUNICATION 413, 423:(M4)**
Practical exercise and application of written and verbal communication principles. Presentations on selected topics. Forum for mutual communication and information on practice-oriented topics.

(NSQ 200) **COMMUNICATION 200:(N2)**
Principles and requirements for successful public speaking and writing of technical reports. Meeting procedures and tasks of office bearers.

(NSQ 300) **COMMUNICATION 300:(N3)**
Prepared presentations. Requirements for the preparation and presentation of posters. Attendance of forums.

(NSQ 400) **COMMUNICATION 400:(N4)**
Attendance of forums. Participation and presentation of posters at prearranged poster sessions of various subjects. Attendance and if required participation of engineering seminars.

(PSQ 221) **COMMUNICATION 221:(P2)**
Principles of verbal and written communication. Language, layout and evaluation of reports. Practical training in verbal communication.

(SSQ 211) **COMMUNICATION 211:(S2)**
Presentation of practical training reports. Discussion of technical and non-technical topics in Afrikaans and English. Group presentations. Sources of information and accessing.

(SSQ 221) **COMMUNICATION 221:(S2)**
Effective reporting – written and verbal. Procedures at meetings.

(SSQ 311) **COMMUNICATION 311:(S3)**
Presentation of practical training reports in seminar context. Mutual assessment. Introduction to and feedback on communication techniques. The practical training report is written with reference to practical work done during recess, after completion of the first year of study but before registration for the third year of study. Presentation of technical and non-technical topics in English and Afrikaans.

(SSQ 321) **COMMUNICATION 321:(S3)**
Written reports on topics of direct interest to Civil Engineering, such as public participation and entrepreneurship. Prepared and unprepared presentations in English and Afrikaans.

(SSQ 411) **COMMUNICATION 411:(S4)**
Presentation of practical training reports in seminar context. Mutual assessment. Feedback on communication techniques. The practical training report is written with reference to practical work done during recess, after completion of the first year of study but before registration for the fourth year of study. Presentation on the research projects, with evaluation and feedback.

(ERI 320) **COMPUTER ARCHITECTURE 320:(R3)**
Analysis and design. Logical units, organisation, memory and addressing, computer arithmetic, input/output and peripherals. Modern computer architecture including RISC and multiprocessor architecture.

(ERI 410) **COMPUTER ENGINEERING 410:(Z4)**
Computer Architecture: Analysis and design. Logical units, organisation, memory and addressing, computer arithmetic, input/output and peripherals. Modern computer architecture including RISC and multiprocessor architecture. Software engineering: Structured planning and design of software systems. Object oriented analysis and design: Implementation in C++. Distributed and real-time systems. Unix operating system and computer communication.

(CRV 120) **COMPUTER LITERACY 120:(C1)**
Operation and components of the microcomputer. Operating systems: MS-DOS and Windows. Basic commands. Application software: Word processing and spreadsheets. Principles of program design: Loops, branching, use of arrays; sub-programs and the incorporation of pre-written sub-programs into own programs. Development, debugging and compilation of simple programs. Use of the microcomputer network.

(MRV 122) **COMPUTER LITERACY 122:(B1, M1, L1, N2, P2)**
Basic computer architecture: Central processing unit, instructions sets, memory, peripherals, operating systems, compilers and network architecture. Application software: Word processor, spreadsheet and library/reference software. Numerical computation software: Introduction and use of an advanced numerical processing program to solve general engineering problems.

(CRV 220) **COMPUTER LITERACY 220:(C2)**
Solution of typical engineering problems with the aid of self-developed computer programs. Use of MATLAB as computational aid. Introduction to MATLAB-toolboxes. Chemical engineering applications using spreadsheets. Introduction to flowsheeting and the use of flowsheeting packages. Utilisation of computer-based libraries of physical properties.

(MRV 210) **COMPUTER METHODS 210:(M2, L2)**
Principles of program design: Program design cycle, basic and functional specifications, introduction to object-orientated programming, flow charts, testing and documentation. Basic programming: Loops, branches, use of arrays and subroutines. Developments, compiling and debugging of simple programs. Introduction and use of a basic programming language.

(EBB 320) **CONTROL SYSTEMS 320:(E3, Z3)**
Modelling and simulating of physical systems. Block and signal flow diagrams. State space formulation. Time and frequency domain analysis, continuous and discrete time. Stability and sensitivity. Design methods, cascade (e.g. PID) and feedback controllers. Observers.

(MBB 410) **CONTROL SYSTEMS 410:(M4)**
Introduction to control systems. Modelling of dynamic systems. Transfer functions. Block diagrams and block algebra. Linearising of non-linear systems. Disturbance signals. Steady-state accuracy. Control systems performance. Analysis of control systems using Laplace transformations. Root loci. Bode diagrams. Design of compensators using bode diagram and root locus techniques. Digital control. Controls laboratory.

(NKR 410) **CORROSION 410:(N4)**
Theory and practice of different corrosion phenomena: general, galvanic, slot and pitting corrosion, stress corrosion cracking, corrosion fatigue, de-alloying and sensitising. Prevention of corrosion through choice of material, cathodic and anodic protection and by the use of protective coatings. Practicals: corrosion evaluation techniques.

(COS 212) **DATA STRUCTURES AND ALGORITHMS 212:(R2)**
Analysis of efficiency (time and space) of algorithms that manipulate data structures. Formal specifications, representation and implementation techniques for the following: stacks, lists, trees, graphs, collections, strings and data structures on which sorting is

based, criteria which influence the choice of data structures for applications. Programming language C++.

(COX 420) **DESIGN 420:(C4)**
Application of chemical engineering principles for the optimum design of chemical process units and safety systems.

(LOX 421) **DESIGN 421:(L4)**
Application of engineering principles in the execution of a comprehensive design.

(MOX 410) **DESIGN 410:(M4)**
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.

(NON 420) **DESIGN 420:(N4)**
Philosophy of design and the design process. Principles of project planning and management. Unit and process design, simulation; economic evaluation and optimising as applicable to the metallurgical industry. Computer-aided modelling and analysis of these processes.

(EOV 320) **DESIGN AND MANUFACTURING 320:(E3, Z3)**
Systems theory, systems life cycle, systems engineering, design philosophy, generation of ideas, design for manufacturing and maintainability, configuration management and interfaces, packaging technology, manufacturing processes, CAD-CAM principles, production facilities and techniques, industry standards, safety standards, environmental requirements, ergonomics and aesthetics, man/machine interfaces, material procurement, logistics, complete design and construction of a system (including electro-magnetic compatability).

(EOV 321) **DESIGN AND MANUFACTURING 321:(R3)**
Systems theory, systems life cycle, systems engineering, design philosophy, generation of ideas, design for manufacturing and maintainability, configuration management and interfaces, packaging technology, manufacturing processes, CAD-CAM principles, production facilities and techniques, industry standards, safety standards, environmental requirements, ergonomics and aesthetics, man/machine interfaces, material procurement, logistics, complete design and construction of a system (including electro-magnetic compatability).

(CPJ 420) **DESIGN PROJECT 420:(C4)**
Application of chemical engineering principles for the complete design of a chemical plant.

(WTW 286) **DIFFERENTIAL EQUATIONS 286:(B2, C2, E2, L2, M2, N2, P2, R2, S2, Z2)**
Theory and solution methods for linear differential equations as well as systems of linear differential equations. Solution methods for first order non-linear differential equations. The Laplace transform.

(ESP 410) **DIGITAL SIGNAL PROCESSING 410:(R4)**
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 for 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.

(ERS 220) **DIGITAL SYSTEMS 220:(E2, R2, Z2)**
Introduction to digital circuit design, digital representations of numbers, device electronics in digital circuits, representation and simplification of logic functions, analysis and design of combinatorial circuits, components of sequential circuits, analysis and design of sequential circuits, programmable components for combinatorial and sequential logic.

(MSD 210) **DYNAMICS 210:(B2, C2, E2, L2, M2, N2, P2, S2, Z2)**
Kinetics of systems of particles, steady mass flow. Plane kinematics of rigid bodies. Moments and products of inertia, principal aces of inertia. Plane kinetics of rigid bodies, equations of motion, work-energy relations, impulse-momentum equations. Vibration and time response of rigid bodies.

(EKN 151) **ECONOMICS 151:(B2)**
Introduction to Macroeconomics
The economic environment and problem: working and course of the South African economy; functioning and interrelationships of the different economic sectors. Macroeconomic theory and analysis. Analyse and interpret economic performance criteria: economic growth, inflation, job creation, balance of payments and exchange rate stability, income distribution. Calculate and interpret core economic indicators.

(EKN 152) **ECONOMICS 152:(B2)**
Introduction to Microeconomics
Basic microeconomic principles: demand analysis (consumer theory); supply analysis (producer theory). Market analysis: market equilibrium; price determination; market forms; market failure; calculate and interpret price, income and cross elasticities.

(GLY 323) **ECONOMIC GEOLOGY 323:(P4)**
Geostatistics: Traditional geostatistical methods; problem evaluation; descriptive statistics; normal, log normal and three parameter log normal distributions; student-t; confidence intervals, Sinchel-t; sampling, cut-off points; timetable generation and polinomial curve fitting techniques; semi-variogram, error estimation; kriging.
Ore deposits: Mineral resources and reserves; origin and classification of ore deposits; discussion of rock and mineral associations of different mineral deposits, as well as coal and natural oil. Practical class: Mineral associations in hand specimens.

(ELK 220) **ELECTRONIC COMPONENTS 220:(E2, R2, Z2)**
Semiconductors and pn junctions. Diodes: Zener-, tunnel-, Schottky- and photo diodes. Piece wise linear models. The diode as circuit element. Limiters, rectifiers and voltage regulators. Opto-electronic devices. Solar cells. Bipolar transistors. Field-effect transistors and mesfets. Small signal analysis. Basic transistor circuit configurations. Transistor biasing concepts. Transistor switches. Digital components. Power devices. Heat sinks. Two-port networks. Noise. Operational amplifiers.

(EEO 410) **ELECTRICAL DESIGN 410:(E4)**
Performing of design examples chosen from electrical machines, cables, switchgear, transformers, etc., as well as electricity supply in large buildings, acoustics, indoor and outdoor illumination. The following steps are followed: formulation of the need, possible

solutions, synthesis, modelling, optimisation, finalisation. Factors influencing electrical designs are taken into account, for example: Theory, physical limitations, costs, statutes, standards, safety, environment,

(EIR 210) **ELECTRICAL ENGINEERING 210:(B2, C2, L2, N2, P2)**
Direct current circuits and measuring instruments, alternating current circuits and measuring instruments. Three-phase circuits with power measurement and power-factor correction. Magnetic circuits, exchange of energy (mechanical-field-electrical), transformer. Machines (d.c., induction and synchronous) and speed control principles. Semiconductor principles, diodes and rectifiers (uncontrolled, controlled), transistors (bipolar and field effect), operational amplifier, analogous and digital electronics. Oscilloscope, apparatus for registering, bridge circuits, transformers. Power supply principles. Experimental procedure.

(EAD 310) **ELECTRICAL DRIVES 310:(E3, Z3)**
Characteristics of semiconductor devices; DC-DC convertors, isolated DC-DC convertors; single phase and 3-phase AC-DC convertors; 4-quadrant AC-DC converters; DC-AC invertors; magnetic circuits, low and high frequency transformers; DC motors; special machines; discussion of conventional AC machines.

(EMZ 310) **ELECTROMAGNETICS 310: (E3, Z3)**
Revision of essential mathematics; principles of electrostatics, Coulomb's Law; Gauss' law, divergence theorem; potentials, gradients and energy; conduction, Ohm's law; dielectrics, capacitance; uniqueness theorem, laPlace and Poisson equations; principles of magnetostatics, Ampere's law, Biot-Savart law, Stokes' theorem, energy, magnetic circuits and forces. Introduction to: Maxwell's equations, Faradays law, time dependent fields, potentials and boundary conditions, propagation and reflection of plane waves, transmission lines, matching, frequency domain analysis of lossless lines, potential functions and basic antennas.

(EMZ 320) **ELECTROMAGNETICS 320:(E3, Z3)**
Electrodynamic fields. Transmission line theory. Distributed circuits, reflection, Smith charts, impedance matching. Reflection on plane waves. Guided waves and waveguides. Radiation from simple antennas. Applications of electromagnetic fields.

(EEE 410) **ELECTRONICS 410:(Z4)**
High frequency electronic components and circuits. Application of transmission lines and hybrid networks in RF circuits. Design of non-linear circuits. Modulation techniques, phase lock loops, methods of impedance matching. Measuring instrumentation.

(ETN 320) **ELECTROTECHNICS 320:(M3)**
Machines and transformers: Characteristics, construction, operation and equivalent circuits of direct current, synchronous and induction machines. Theory, use and maintenance of transformer. Electronics: Electronic components: bipolor and field effect transistor: analogue amplifier circuits, sensors (range, linearity, accuracy, stability, sensitivity, calibration), measuring techniques.

(ETN 420) **ELECTROTECHNICS 420:(M4)**
Digital circuits: Booleau algebra, gates, bistable circuits, registers, counters, A/D and D/A converters, multiplexers and peripheral equipment. power systems: power supply, power factor and power factor correction, regulation, diversity, load factor and tariffs. Protection and reticulation.

(MIT 112) **ENGINEERING DRAWING 112:(B1, C1, E1, L1, M1, N1, P1, S1, Z1)**
Free-hand sketch work covering: Perspective, isometric and orthographic drawings. Drawing conventions, graphic techniques and assembly drawings. Evaluation of drawings and error detection. True lengths, planes, projections and intersection curves. Practical applications of these techniques. Schematic representation in chemical, electrical, electronic, mechanical and civil engineering systems. Introduction to computer aided drawing of components including: Crosshatching, dimensioning and detailing.

(BBZ 311) **ENGINEERING ECONOMICS AND ENTREPRENEURSHIP 311:(R3)**
Engineering economics: time-value of money, cash flow calculations, financial evaluation of alternatives, discounted cash flow, inflation and depreciation, income tax, risk and uncertainty. Entrepreneurship: Market analysis, small business management, business plans, innovation, economics analysis and break even analysis, viability studies.

(IGB 220) **ENGINEERING MANAGEMENT 220:(B2, C2, L2, M2, N2, P3)**
Business Management, Human Resources Management, Technology and Innovation, Decision Analysis, Systems Engineering, Manufacturing.

(IGB 321) **ENGINEERING MANAGEMENT 321:(C3, L3, M3, N3, P4)**
Management Accounting, Marketing, Project Management, Operations and Maintenance, Engineering Economics, Entrepreneurship, Quality.

(ESK 210) **ENGINEERING STATISTICS 210:(E2, R2, Z2)**
Probability theory: Probability concepts, conditional probability, combining probabilities. Random variables: Probability density functions, cumulative, distribution functions, histograms. Expected value: Mean, variance, standard deviation, moments. Statistical data processing: Sampling, hypotheses testing. Reliability of simple networks: Series, parallel, series-parallel combinations, redundancy and standby systems. Application of probability density functions in the theory of reliability: Binomial-, Poisson-, Normal-, Exponential- and Rayleigh-distributions as well as in statistical process control.

(COI 420) **ENVIRONMENTAL ENGINEERING 420:(C4)**
The influence of pollution on the natural environment. Dispersion of air pollution. Water utilisation. South African legislation with regard to air pollution, water pollution, human exposure and the disposal of solid waste. Strategies to prevent or minimise pollution. The design of equipment and plants to combat air and water pollution. Requirements for sites on which solid waste is disposed. Integrated environmental management.

(FRK 151) **COMPUTER ASSISTED TRAINING 151:(B3)**
The nature and function of accounting. The development of accounting, financial position, financial result. The recording process. Processing of accounting data. Elementary income statement and balance sheet.

(FRK 152) **FINANCIAL ACCOUNTING 152:(B3)**
Flow of documents. Accounting systems. Introduction to internal control and internal control measures. Bank reconciliations. Control accounts. Adjustments. Financial statements of a sole proprietor.

(FRK 161) **FINANCIAL ACCOUNTING 161:(B3)**
Elements of financial statements in detail. The conceptual framework.

(FRK 162) **FINANCIAL ACCOUNTING 162:(B3)**
Income statement, balance sheet, cash flow statement and analysis and interpretation of clubs, partnerships close corporations. Introduction to companies.

(FRK 181) **FINANCIAL ACCOUNTING 181:(B3)**
Computer processing of accounting information.

(MVM 410) **FLUID MACHINES 410:(M4)**
(i) Classification: Kinetic and positive displacement pumps and compressors. Incompressible and compressible flow. Pump, compressor and fan theory. (ii) Equipment: Functioning, properties, characteristics and use of well-known pumps and compressors. (iii) Applications: Specific speed, cavitation, water hammer. Pump connections: Pipe system connections. Pumping of solids. Air-pressure systems. (iv) Turbo machines: Turbo machine theory. Impulse and reaction turbines. Analytical analyses. Characteristics: Applications; integration of hydroturbines with power systems.

(MVK 410) **FLUID MECHANICS AND THERMODYNAMICS 410:(E4)**
Theory of machines: Balancing, vibration, isolation. Strength of materials: Bending moments, torsion and elasticity. Theory of thermodynamics and heat transfer: Internal combustion engines, steam turbines, cooling machines, heat pumps. Theory of fluid mechanics: Hydrostatics, fluid dynamics, fluid properties, pipe friction, energy loss calculations.

(MSX 310) **FLUID MECHANICS 310:(M3, N3)**
The Navier-Stokes and continuity equations. Definitions and properties of fluids, fluid statics, fluid dynamics, Euler and Bernoulli equations, momentum equation, laminar and turbulent flow, pipe friction and networks, measurements of flow, dimensional analysis.

FORUM
A general period involving students, external persons and lecturers.

(CHO 320) **HEAT TRANSFER 320:(C3)**
Steady and unsteady state conduction in one to three dimensions. Temperature distributions. Convective heat transfer. Application of boundary layer theory. Determination of film coefficients. Design of heat transfer equipment. Boiling and evaporator calculations. Radiant heat transfer. Process integration.

(MWX 410) **HEAT TRANSFER 410:(M4)**
General principles. Conduction, state, applications. Conduction in two dimensions. Conformity and dimensional analysis. Convection transfer, forced convection, natural convection. Boiling phenomena. Radiation. Heat exchangers. Experimental techniques in heat transfer.

(SHC 310) **HYDRAULICS 310:(S3, L3)**
Fluid properties, hydrostatics, kinematics, measuring flow rate and velocity, potential flow, real fluids, pipe flow and municipal services.

(SHC 320) **HYDRAULICS 320:(S3)**
Pipe networks, pumps, water hammer analyses, free surface flows, introduction to water treatment and model analyses.

(SHC 410) **HYDRAULICS 410:(S4)**
Sediment transport, drainage, controls, flow measurement, hydraulic structures, stormwater drainage, hydrology, hydrological cycle, precipitation, infiltration, run-off, crop water demand, flood estimation, flood routing, dam safety legislation, water resource analysis.

(LHL 411) **HYDRAULICS 411:(L4)**
Dynamics of fluids in motion. Turbines, centrifugal and other pumps for agricultural use. Design of drainage schemes and canal systems.

(NHM 310) **HYDROMETALLURGY 310:(N3)**
Thermodynamic and kinetic principles of hydro and electro-metallurgical processes. Theory and practical examples of unit processes of leaching, concentration, purification and reclamation. Practicals: Experimental characterisation of aspects and extraction processes.

(NHM 320) **HYDROMETALLURGY 320:(N3)**
Extraction routes and metallurgy of gold, uranium, copper, nickel, cobalt, platinum group metals, zinc and manganese. Theory and design of reactors. Practicals: experimental characterisation of key aspects of extraction processes.

(NHM 410) **HYDROMETALLURGY 410:(N4)**
Unit processes in the hydrometallurgy such as thickening, filtration, continuous countercurrent decantation, leaching, adsorption, ion exchange, liquid, liquid extraction and blending. Design of these units, including computer-aided mathematical modelling. Practicals: Development and implementation of design data.

(LWO 311) **IMPLEMENT DESIGN 311:(L3)**
Stress and deformation analysis; bending and shear stress (non symmetrical sections); torsional stress of non uniform shafts, thin walled tubes and open profiles; analysis of statically indeterminate structures by double integration, Macauly's notation, superposition, moment area and moment distribution. Failure criteria and stress concentration, yielding stress and fatigue. Design of joints and specific machine elements.

(BAN 221) **INDUSTRIAL ANALYSIS 221:(B2, C3, N3, P3)**
Theory of probability. Statistical inference. Regression. Experimental design.

(BAN 310) **INDUSTRIAL ANALYSIS 310:(B3)**
Queuing theory: Stochastic processes, terminology, birth and death processes, simple systems, finite population systems.
Forecasting: Moving averages, exponential smoothing, seasonality, regression, ARIMA-models.
Tutorials: Computer programming, stochastic systems, operations research, systems modelling.

(CIC 310) **INDUSTRIAL CHEMISTRY 310:(C3)**
Planning and development of chemical industries. Chemical products, the chemical industry world-wide and in South Africa; selected chemical industries. Physical chemistry of surfaces and catalysis. Polymer technology: Chemistry and production, morphology, analysis, mechanical properties; the polymer industry.

(LBC 320) **INDUSTRIAL PRINCIPLES 320:(L3)**
Laws. Engineering models for agricultural production. Mathematical modelling of implement systems. Project management and contracts.

(EIT 110) **INFORMATION TECHNOLOGY 110:(E1, R1, Z1)**
Information technology in society: history of IT and computer systems, IT at present and in the future and social aspects of IT. Basic computer architecture and organisation: CPU, instruction sets, memory, storage devices, I/O devices and multimedia. Communications technologies: network topologies and protocols, WAN, LAN, routers and switches. Internet: WWW, e-mail, ftp, HTML: writing and publishing WWW pages and JAVA. System software: operating systems, compilers, utility software. Applications software, databases, spreadsheets, word processing, graphics software. Introduction to Artificial Intelligence: neural networks, expert systems, fuzzy logic and genetic algorithms.

(EIW 120) **INFORMATION TECHNOLOGY PRACTICE 120:(R1)**
The course is offered at the end of the first year of study. The duration is at least 2 weeks during which the students receive training in, among other things, computers and computer networks.

(ECG 210) **INTERACTIVE COMPUTER GRAPHICS 210:(R2)**
Introduction to engineering drawing:
Free-hand sketches, three dimensional concepts and projections. Dimensioning drawings.
Computer Graphics:
Graphics architectures. Graphics programming: Primitives and attributes, colour, viewing. Geometric objects and transformations: Scalars, points, vectors; coordinate systems and frames; rotation, translation and scaling. Viewing: Classical and computer; simple projections; projection matrices. Shading: Light sources; reflection, computation of vectors. Implementation: Clipping, display. Working with modes. Curves and surfaces. Buffers and mappings. Virtual Reality.

(MTC 321) **INTERNAL COMBUSTION ENGINES 321:(M3)**
Introduction and history of internal combustion engines. Engine operating parameters for engine design and analysis of engine performance. Engine test methods. Combustion in internal combustion engines. Engine analysis using engine cycles. Engine gas flow. Engine energy balance. Spark ignition engines: Air-fuel requirements, carburettors, fuel injection systems, combustion and ignition systems. Compression ignition engines: Combustion and fuel injection systems. Super and turbo charging of internal combustion engines. Two stroke engines: Operating principles and scavenging. Experimental techniques used during the development and testing of internal combustion.

(SWK 121) **INTRODUCTORY MECHANICS 121:(E2, Z2)**
Force systems: Resultants, moments, couples, force-couple systems, wrenches.
Equilibrium: Particles, rigid bodies. Cable and strut forces. Elasticity: Young's modulus. Centroids of lines, areas and volumes. Pappus. Second moments of area, Steiner's theorem. Beams: Shear forces and bending moments. Law of friction: Dry friction. Potential energy: Stability.

(PMI 110) **INTRODUCTION TO MINING 110:(P1)**
Rock drilling: Different drills including percussion drills, rotation drills and diamond drills. Drilling equipment such as drill steel and bits. Mechanical tunnelling, machines and drilling rigs. Explosives: Mechanisms of explosions and blasting. Different commercial explosives. Explosives: Chemical compositions, blasting accessories and electrical blasting. Blasting rounds.

(PMI 120) **INTRODUCTION TO MINING 120:(P1)**
Strata control: Methods for strata control in shallow and deep mines. Support elements for tunnelling, shafts and stopes, such as rockbolts, supports and matpacks. Surface mining: Different types of surface mining and surface mining methods. Drilling and blasting. Loading equipment and loading methods. Rock transportation systems and their application. Planning and environmental considerations.

(EPE 110) **INTRODUCTION TO PROGRAMMING 110:(R1)**
C programming: design of correct, intelligible, maintainable and efficient programs. The manner in which data/programs are stored and manipulated in a computer: source code, machine code, compilers and libraries. Representation and analysis of algorithms: pseudocode and flowcharts. Structured programming: top-down design and modular design. Debugging techniques, program testing and documentation. Variables and data types. Arithmetic and Logic operators. Control structures. Functions. File operations.

(LBP 420) **IRRIGATION 420:(L4)**
Water and soil suitable for irrigation. Plant, soil and water relations. Evaluation of irrigation systems and practices. Theory and design procedure for flood, sprinkler, drip and micro irrigation systems. Computer software for irrigation design.

(PGW 422) **IRRIGATION 422:(L3)**
Presented in the Faculty of Biological and Agricultural Sciences:
Soil physical principles for water management and water movement in soils. Crop water relations and determination of potential evapotranspiration, crop water requirements and irrigation management. Basic principles of irrigation system design. Practical handling of equipment and visits to irrigation trials and farms.

(CKN 320) **KINETICS 320:(C3)**
Reaction kinetics: Reaction order, rates and mechanisms. Langmuir-Hinshelwood kinetics. Chemical equilibrium, conversion temperature and concentration dependency of reaction rates. Ideal reactor models.

(CLB 320) **LABORATORY 320:(C3)**
Experimental work illustrating the following:
Analysis: Composition of coal and gas, heat of combustion, viscosity. Mass transfer: Gas absorption, batch distillation, azeotropic distillation, fractional distillation and liquid-liquid extraction. Heat transfer: Condenser, shell and tube heat exchanger, heat loss from insulated pipes . Piping system design: Frictional energy loss through pipes and fittings. Measuring equipment: Rate of flow, temperature.

(EGP 210) **LABORATORY 210:(E2, Z2)**
Experimental planning: Fault analysis, combination of errors, graphical analysis, normal distribution, use of equipment, design of experiments. Experimental: Selected experiments from second year syllabus, use of equipment.

(EGP 220) **LABORATORY 220:(E2, Z2)**
Technical communication: Introduction, summary, planning, diagrams, graphs, tables, writing of reports, public speaking. Experimental: Design project and selected experiments from second year syllabus.

(EGP 310) **LABORATORY 310:(E3, Z3)**
Computer based data acquisition: PC's with A/D-converters, sampling theorem aliasing filtering, computer data processing, elementary sensors, fault analysis of computer data. Experiments: Design assignments and selected experiments from the third year curriculum.

(EGP 320) **LABORATORY 320:(Z3)**
Modeling and simulation: system identification. Experiments: selected experiments from third year syllabus.

(EGP 321) **LABORATORY 321:(E3)**
Modelling and simulation: system identification. Experiments: selected experiments from third year syllabus.

(EGP 211) **LABORATORY 211:(R2)**
With emphasis on computer engineering: planning of experiments, fault analysis, combination of faults, graphical analysis, normal distribution, use of equipment, design of experiments, mathematical and scientific software packages used.
Experiments: selected experiments from second year curriculum, the use of measuring equipment and the computer as research aids.

(EGP 221) **LABORATORY 221:(R2)**
With emphasis on computer engineering: Technical communication: introduction, summary, planning, diagrams, graphs, tables, the use of language in reports, public speaking.
Experiments: Design tasks and selected experiments related to second year curriculum.

(EGP 311) **LABORATORY 311:(R3)**
With emphasis on computer engineering: Data acquisition with computers: PC's with A/D converters, sampling theorems, aliasing, filtering, data processing, simplified sensors, data analysis.
Experiments: Design tasks and selected experiments related to third year curriculum.

(EGP 321) **LABORATORY 321:(R3)**
With emphasis on computer engineering: Modelling and simulation: systems identification. Specifications and standards: interpretation of existing specifications (local and international), compiling technical specifications, international standards and design to attain set standards, existing test facilities and quality tests, ISO9000, ETSI and others.

(EGP 411) **LABORATORY 411:(R4)**
Analysis, synthesis, implementation and evaluation of electronic systems and experiments. Project planning as a group: Design, manufacturing, life cycle, costing, marketing and preparation of a business plan.

(EGP 410) **LABORATORY 410:(Z4)**
Analysis, synthesis, implementation and evaluation of electronic systems and experiments. Project planning as a group: Design, manufacturing, life cycle, costing, marketing and preparation of a business plan.

(ABV 320) **LABOUR RELATIONS 320:(B4)**
A systems approach to labour relations. The influence of different variables on the labour relations role players. The management and maintenance of balanced labour relations within an enterprise through representation, communication, grievances and disciplinary procedures. The relation between labour relations management and people power management. The handling of disputes and the keeping of industrial peace.

(WTW 126) **LINEAR ALGEBRA 126:(B1, C1, E1, L1, M1, N1, P1, R1, S1, Z1)**
Matrices and their algebra, systems of linear equations, subspaces of 3^n, bases, determinants. Mathematical induction. Complex numbers and factorisation of polynomials.

(MOW 121) **MACHINE DESIGN 121:(B1, L1, M1, P1)**
Introduction to engineering design and innovation. Engineering aspects of parts and components, assembly of basic machine components with the aid of functional sketches. Basic machine elements such as bearings, clutches and brakes, including dimensions, fits and geometric tolerances.

(MOW 212) **MACHINE DESIGN 212:(M2, L2)**
Machine design, basic mounting elements and bearing theory, supplemented with design exercise, sketches and drawings. Emphasis is placed on the application of strength of materials in design assignments.

(MOW 215) **MACHINE DESIGN 215:(B2, P2)**
Introduction to machine design. This covers basic machine elements such as gears, gear systems, clutches, brakes, shaft coupling, flywheels and mechanisms. Bearing selection and mounting. The strength of shafts and the deflection of beams. This is supplemented with design exercises, sketches and drawings.

(MOW 222) **MACHINE DESIGN 222:(M2)**
Cover weld construction, casting design and designs covering theory of machines. Detail design will be taken up to the prototype phase with sketch drawings and selected CAD drawings. Design project: Each student must design, built and test a self-propelled system and participate in a competition.

(MOW 312) **MACHINE DESIGN 312:(M3)**
Factories Act, design and use of cable systems. Design and application of gears and gear systems, springs, cams, steal structures. Materials and material selection. Plastics. Design with plastic and rubber. Lubricants. Hydrodynamic bearings. Contact stresses. Welding metallurgy and metal fatigue in welded joints. Ergonomics.

(MOW 322) **MACHINE DESIGN 322:(M3)**
Robotics: Design and use of a robot. Building and programming a robot (in competition context). Steel structures: Applications, design and codes. Mini design: Detailed design of a small system. Computer aided design and manufacturing. 3-D drawing and CAM processes. Programming of CNC machines. Finite element analysis applications. Case

studies – Analysis of failures from a design perspective. Engineering management: Management techniques in the engineering industry and project management systems.

(MII 420) **MAINTENANCE ENGINEERING 420:(M4)**
Introduction: Definition and objectives, statistical concepts. Mathematics of failure: Reliability concepts, fitting distribution to failure data. Maintenance management: Investment decisions, maintenance profit impact. Maintenance structure: Preventive, time based, condition based, corrective, design out. Data analysis: Renewal, repairable systems, Laplace trend test, analysis methodology. Optimising maintenance strategies: Replacement/overhaul age, inspection frequencies, capital replacement, simulation. Reliability Centred Maintenance (RCM). Maintenance systems: Components, structure, computer methods. Tribology: Friction laws, lubrication theory, contamination control. Maintenance Practice: Systems approach, modelling.

(BSR 850, BSR 860) **MANAGEMENT ACCOUNTING 850 and 860:(B4)**
Accounting and management accounting as an aid in management. Accounting principles, policy factors and uses. Alternative approaches in generally accepted accounting principles and its influence. Interpretation of published and other financial reports, assessment of amalgamation and pooling plans. Accounting data as a basis for control, decision making and management decisions. Company and Income Tax legislation. Management accounting in the planning and control of activities; calculation of costs and control; the collection, classification and use of cost data; introduction to budgeting and budget control.

(BVS 220) **MANUFACTURING SYSTEMS 220:(B2)**
Introduction to manufacturing, basic process knowledge, conventional manufacturing processes, modern manufacturing processes, manufacturing aids, safety and loss control.

(BVS 310) **MANUFACTURING SYSTEMS 310:(B3)**
Evaluation of product designs for manufacturability, , choice of material, generic development methodology, design of manufacturing processes, process planning, specification of production facilities.

(BVS 320) **MANUFACTURING SYSTEMS 320:(B3)**
Programming of numerically controlled machines. Computer-aided manufacturing: APY programming and MASTERCAM. Computer-aided manufacturing techniques. Measuring techniques.

(BVS 410) **MANUFACTURING SYSTEMS 410:(B4)**
Logic circuits of process control. Microprocessors for measurement and control. PLC-control. Introduction to robotics.

(MOV 212) **MANUFACTURING TECHNIQUES 212:(M2, L2)**
Continuation of manufacturing processes in MOW 121. All major techniques i.e. machining, casting, welding, pressing and cutting. Excluding the theory for cutting and pressing.

(CMO 320) **MASS TRANSFER 320:(C3)**
Separation by means of equilibrium stages. Degrees of freedom. Graphical and algebraic solutions of binary single-stage, multi-stage and batch distillation problems.

Azeoptropic distillation. Design of plate columns. Graphical and algebraic analysis of absorption, stripping and extraction stage processes.

(NMC 120) **MATERIALS SCIENCE 120:(B1, E1, L1, M1, N1, P1, Z1)**
Introduction to materials: Atomic structure and bonding, crystallographic types and spacial distribution, crystallographic dislocations and diffusion in solids. Properties of materials: Mechanical properties, electrical properties and magnetic properties. Phase diagrams, alloying and heat treatment of important commercial alloys.

(NMC 210) **MATERIALS SCIENCE 210:(M2)**
The iron-carbon systems. Classification and selection of steels. Heat treatment, surface hardening of steel components. Non-ferrous metals; heat treatment and utilisation. Manufacturing techniques: Casting processes, welding processes and power metallurgy. Testing of metal components and compilation of test procedures.

(NMC 221) **MATERIALS SCIENCE 221:(N2)**
Properties of solid solutions and analysis of binary and ternary phase diagrams. Kinetics of phase transformations, including diffusion processes in materials and mechanisms of nucleation and growth. Solidification of pure metals and alloys, and the transformation of austenite to pearlite in carbon steels. Quantitative analysis of the physical properties of materials using electgron microscopy, X-ray diffraction techniques and surface analysis.

(CMK 410) **MATERIALS SCIENCE 410:(C4)**
Structure and properties of construction materials. Corrosion of metals in different media. Corrosion tests and corrosion prevention. The utilisation of non-metallic construction materials in the chemical industry.

(NMP 410) **MATERIALS PROCESSING 410:(N4)**
Processing by means of heat treatment (the use of alloy steels; heat treatment processes and equipment; and the technology and practice of surface treatments). Liquid metal processing (the technology and practice of the production of castings by means of a variety of casting processes). Mechanical processing (the mechanics of hot and cold processing of materials; the production of finished products by means of mechanical processing such as rolling, forging and drawing).

(WIS 337) **MATHEMATICS 337:(E3, Z3)**
Linear algebra, eigenvalues and eigenvectors, partial differential equations and complex functions.

(WIS 338) **MATHEMATICS 338:(C3, M3, S3)**
Linear algebra, eigenvalues and eigenvectors, partial differential equations and numerical methods (finite difference) for the solving of practical problems.

(NMM 310) **MECHANICAL METALLURGY 310:(N3)**
Strengthening mechanisms in materials; the heat treatment of steel; and the characteristics and applications of cast irons. Mechanical testing of materials by means of the tensile test, the bending test and the hardness test. Introduction to fracture mechanics.

(MEG 120) **MECHANICS 120:(R1)**
Force systems: Resultants, moments, couples, force-couple systems, wrenches. Equilibrium: Particles, rigid bodies. Cable and strut forces. Elasticity: Centroids of lines,

areas and volumes. Law of friction. Potential energy. Kinetics of systems of particles, steady mass flow. Impulse-momentum equations. Vibration.

(MEG 420) **MECHATRONICS 420:(M4)**
Modelling and design of systems which includes both mechanical and electrical/electronic components. Modelling: General modelling, bondgraphs, system identification, modelling of a mechatronic system. Implementation: Mechatronic interfaces, microprocessors, digital control, power electronics.

(NMX 210) **METALLURGICAL THERMODYNAMICS 210:(N2)**
First and second laws of thermodynamics and its applications in metallurgical systems. The concepts entropy, free energy and their application, e.g. Ellingham-diagrams. Effect of pressure and temperature on chemical equilibrium. Solutions: Ideal and non-ideal solutions, the effect of composition on chemical equilibrium.

(EMK 310) **MICROPROCESSORS 310:(E3, Z3)**
General microprocessor architecture and assembly language, commonly available microprocessors (including DSP microprosessors), memory interfacing and address decoding, microprocessor input/output and interfacing, general programming concepts, general microprocessor system design principles, programmable logic, current trends and new processors (e.g. PICs for embedded systems).

(PKB 420) **MINE CLIMATIC CONTROL 420:(P4)**
Network analysis, analytical techniques. Thermodynamic principles. Psychometric properties, principles and maps. Principles of heat transfer. The UA factor, blocking factor and logarithmic average temperature difference. Cooling systems and pressure enthalpy diagrams. Chilled water systems. Performance and ability of refrigerated plants and heat exchangers. Human heat exhaustion; acclimatisation. Sources of heat in mines; geothermal heat. Climatic control planning. Mine ventilation in working places. Recirculation of air. Ice for mine cooling.

(PMZ 420) **MINE DESIGN 420:(P4)**
Development of a geological model, ore reserve calculations, selection of applicable mining method, considering technical, financial and safety aspects. Optimal design and positioning of shaft systems, key cuts and surface infrastructure. Production scheduling. Capital and operating cost estimates. Financial and technical evaluation. Risk analysis.

(PSX 320) **MINE FLUID MECHANICS 320:(P3)**
Principles of fluid dynamics, thermodynamic aspects of mine air flow. The Reynolds number, Bernoulli's, Atkinson's and Darcy-Weisbach's equations, energy and pressure equations. Air and water flow measurement. Pressure measurement and surveys. Mine ventilation practice. Drilling flushing agents. Fan types, fan control and fan characteristics. Consequence of noise in fans and elsewhere on people, control measures. Dangers of dust and gases. Dangers of explosion and control measures. Lighting in mines.

(PME 410) **MINERAL ECONOMICS 410:(P4)**
Mineral marketing and shipping. Smelting and refining of concentrates and metals. Supply and demand of minerals. Prices. Macro and micro economic factors influencing the mineral industry. Strategic policy with regard to marketing of minerals, mineral legislation and environmental control. Occurrence, natural resources, production, trade and use of the most important minerals of the RSA.

(GMI 210) **MINERALOGY 210:(N2)**
Crystallography, morphology, Miller symbols, Hermann-Mauguin notation, steoragraphical projections, mineral examples. Mineralogy: Classification, crystal chemistry and physical properties of most important mineral groups – silicates, oxides and sulphides. Use and appearance in SA. Petrology and physical geology: Formation processes and properties of solidification, metamorphical and sedimentary rocks. Structural geology: Stratification, faulting, folds, interpretation of elementary maps. History and stratigraphic geology: Principles of historical geology and stratigraphic successions. Economic geology: A few better-known ore deposits.
Practical classes include crystallography, mineralography and petrology.

(NMP 311) **MINERALS PROCESSING 311:(P3)**
Basic principles of ore-dressing processes and equipment used in practice: commination; classification and concentration of minerals. Flow charts for the extraction of metals such as gold, platinum, copper, iron and lead. Smelting and assaying of gold.

(PMW 410) **MINE VALUATION 410:(P4)**
Technical mine valuation: Sampling, mass and mineral content of ore, mine call and block factor, pay-limits, ore reserves. Gold losses, audit, reclamation and final cleaning. Waste sorting, financial mine valuation: Mining projects with a view to investment decisions and mining cost structures. Application of computer simulations. Investment analysis, pay back period, internal return on capital and net present value methods. Other factors influencing technical mine valuation, namely: inflation, uncertainty, risks. Sensitivity analysis.

(PMY 310) **MINING 310:(P3)**
Mine surveying: Legal aspects; measurement and plan specifications. Problem solving, faulting, excavations, surfaces and volumes. Services: Principles, provision, measurement, control and reticulation of compressed air, electrical power, water and hydro-power. Handling of material in the form of liquids, solids and explosives. Rock handling: Systems and equipment for underground trains, cables, shafts, conveyer belts.

(GLY 114) **MINING GEOLOGY 114:(P3)**
Consists of the modules Earth Materials 112 and General Geology 113.
Earth Materials: Crystallography, elements of symmetry, crystal systems and classes; crystal shapes and Miller symbols: Hermann-Mauguin notation; stereographical projections.
Mineralogy: Macroscopic properties of general rock building and ore minerals; the most important mineral groups. Petrography, classification and identification of general rocks and their origin.
General Geology: Geology and its subsections; cosmology; geological time, plate tectonics; the chemistry of the earth. External geological processes: The geological work of gravity; water, wind, ice, lakes and the sea; stratigraphic synthesis. Earthquakes and magnetic activity.

(GLY 124) **MINING GEOLOGY 124:(P3)**
Consists of the modules Introductory Structural Geology 122, *capita selecta* from Stratigraphy 123 and *capita selecta* from Applied Geology 225.
Introductory Structural Geology: Introduction to geological maps; strike and slope of rock layers. The principles of rock deformation (faulting and folds) according to plate tectonics.

Stratigraphy: Principles of stratigraphy; description of all SA rock units, including their origin, fossil content and economic minerals.
Applied Geology: Engineering geology, geological aspects of construction works.

(PMM 211) **MINING METHODS 211:(P2)**
Underground mining methods in coal, massive ore bodies, wide-seam and narrow seam ore deposits. Technical details of:
Coal mining: Room-and-pillar, pillar recovery, strip pillar recovery, strip mining.
Narrow-seam deposits: Dispersed mining, strip mining, and successive grid mining.
Massive ore bodies: Excavating and filling, sub-surface build-up, block fall and crater filling.
Structural geology: The employment of stereographical projections in Structural Geology, sheet map description.

(PMX 410) **MINING TECHNIQUES 410:(P4)**
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 oreo passes. Fires in gold and coalmines: Causes, prevention, detection, combating and insurance. Flooding: Water sources, results, dangers, sealing and control.

(WTW 263) **NUMERICAL METHODS 263:(B2, C2, E2, L2, M2, N2, P2, R2, S2, Z2)**
Solution of non-linear equations, direct and interactive methods of solving systems of equations (linear and non-linear), solution of differential equations, numerical interpolation and curve fitting.

(COS 222) **OPERATING SYSTEMS 222:(R2)**
Considerations in design and implementation of the following broad functional areas of a UNIX-operating system: Process management; importing and exporting; memory and file management.

(BOZ 310) **OPERATIONS RESEARCH 310:(B3)**
Introduction to Operations Research. Introduction to linear programming, linear algebra, classical linear programming applications, solution algorithms, sensitivity analysis, duality. Computer programming packages.

(BOZ 320) **OPERATIONS RESEARCH 320:(B3)**
Integer programming. Special linear programming applications, shipment problems, allocation problems, transportation problems. Goal programming. Dynamic programming. Network models. Computer programming packages.

(BON 410) **OPERATIONS RESEARCH 410:(B4)**
Formulation of prototype problems. Analysis of algorithm complexity. Complexity theory. Improving search procedures. Constructive heuristics. Independence systems. Relaxations. Heuristic applications of exact solution techniques. Non-linear programming. Routing models.

(NEB 310) **ORE-DRESSING 310:(N3)**
Properties of minerals on which concentration processes are based. Commination: Overview of different types of crushers and mills-basic theory and mechanisms. Size distribution: Sieves and hydrocyclone. Separation processes: Gravity, theory and

functioning of shaking table, pulsator, spirals, etc. Chemical and physical aspects of froth flotation, magnetic and electrostatic separation. Plant flow charts.

(NEB 410) **ORE-DRESSING 410:(N4)**
Laws and theory of commination. Mechanisms, efficiency and capacity of screening. Hydrocyclone theorem and distribution curves. Developments and theories of the froth flotation process. Mechanisms and principles of fine particle aggregation and agglomeration. Calculation and graphic representation of process performance. Flow charts.

(EEF 410) **PHOTONICS 410:(Z4)**
Optical fibre communication systems. 1. Principles of operation of optical fibres (Total Internal Reflection). Second order effects: Attenuation, dispersion, polarisation. Optical fibre and cable manufacturing. Fibre joints, connectors and couplers. 2. Light sources for fibre communications: Laser diode and Light Emitting Diode (LED). 3. Sensors for fibre communications: Photodiode, p-i-n photodiode, avalanche photodiode, phototransistor, photoconductive detector. Detector amplifiers. 4. Fibre communication systems: modulation techniques, signal/noise ratio, bandwidth, wavelength division multiplexing (WDM). Analogue and digital systems. Design of complete optical fibre communication systems. Optical fibre measuring instruments (optical multimeter, OTDR).

(FSK 116) **PHYSICS 116:(B1, C1, E1, L1, M1, N1, P1, R1, S1, Z1)**
Introductory mathematics is a requirement for this course. Elementary theory of heat: Expansion, contraction. Introductory physics: Kinematics and dynamics in three dimensions, rotation. Atom and nuclear physics. Structure of matter. The Bohr atom mode.
A subminimum of 50% is required in the practical examination.

(FSK 126) **PHYSICS 126:(B1, C1, E1, L1, M1, N1, P1, R1, S1, Z1)**
Periodic phenomena. Linear and rotational SHM. Elementary damping, superimposition, electrical oscillations. Waves: Fundamental description, energy and intensity, attenuation mechanisms, Doppler effect, superimposition. Stationary waves, diffraction, reflection, refraction, polarisation. Electromagnetic interaction: Coulomb's law, fields, potential, capacitance; current, resistance, electromagnetic phenomena. A subminimum of 50% is required in the practical examination.

(CPS 310) **PIPING SYSTEMS DESIGN 310:(C3)**
Optimal-economic choice of diameters, pump types, control valves and flow meters. Application of the mechanical energy balance to single-phase, newtonian, non-pulsating, non-compressible, isothermal fluids, Adjustments for multiphase, non-Newtonian, pulsating, compressible and non-isothermal flow systems.

(EKE 320) **POWER SYSTEMS 320:(E3)**
Types of substations, insulation co-ordination, insulation levels, probability of failure, field patterns, switchgear, switching transients, transformers, earthing methods, lightning protection.

(EKR 410) **POWER SYSTEMS 410:(E4)**
Per-unit calculations. Power systems composition and operation: Typical lay-outs, reliability (qualitative), costs, load factor, max. demand, diversity, choosing voltages. Power transformer applications and operation. Power lines: Characteristics and power

transfer. Faults: Symmetrical and unsymmetrical. Power system stability. Introductory power systems protection.

(PYL 120) **PRACTICAL TRAINING 120:(P1)**
At the end of the first year of study, students in Mining Engineering undergo at least 8 weeks of prescribed practical training at a mine. A satisfactory report on the practical training are submitted to the Faculty Administration within one week after registration for the following year.

(BPY 210, CPY 211, LPY 214, MPY 215, NPY 216) **PRACTICAL TRAINING 210, 211, 214, 215, 216:(B2, C2, L2, M2, N2)**
A satisfactory report on workshop practice must be submitted to the Faculty Administration within one week of registration.

(PPY 217, 218) **PRACTICAL TRAINING 217, 218:(P2)**
At the beginning of the second year of study, students in Mining Engineering register for the course PPY 217. A pass mark will be awarded provided that satisfactory reports on the practical training are submitted for PYL 120 and WWP 120. Arrangements must be made for a further training period of at least 8 weeks at the end of the second year of study.

(BPY 310) **PRACTICAL TRAINING 310:(B3)**
During or at the end of the second year of study, students in Industrial Engineering undergo at least 6 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.

(BPY 410) **PRACTICAL TRAINING 410:(B4)**
During or at the end of the third year of study, students in Industrial Engineering undergo at least 6 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.

(CPY 311) **PRACTICAL TRAINING 311:(C3)**
At the end of the second year of study, students in Chemical Engineering undergo at least 6 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.

(CPY 411) **PRACTICAL TRAINING 411:(C4)**
At the end of the third year of study, students in Chemical Engineering undergo at least 6 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.

(EPY 421) **PRACTICAL TRAINING 421:(R4)**
Co-operation with industry: projects in practical training must be done with a partner in industry. Suitable projects and/or tasks must be proposed by partner and accepted by a study leader/lecturer for acceptance.

(EPY 422) **PRACTICAL TRAINING 422:(E4, Z4)**
4 Weeks practice-orientated experience at any institution of the student's choice (preferably in electrical or electronic engineering). The student must acquire experience in the working environment and more specifically work ethics, 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 work experience as determined by the Head of the department.

(LPY 314) **PRACTICAL TRAINING 314:(L3)**
During or at the end of the second year of study, students in Agricultural Engineering undergo at least 6 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.

(LPY 414) **PRACTICAL TRAINING 414:(L4)**
During or at the end of the third year of study, students in Agricultural Engineering undergo at least 6 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.

(MPY 315) **PRACTICAL TRAINING 315:(M3)**
During or at the end of the second year of study, students in Mechanical Engineering undergo prescribed practical training in the industry. The aim is exposure to engineering equipment and processes, the working environment of craftsmen and personnel relations. The duration is at least 6 weeks. A case study on personnel management must be done during this period and submitted, together with a satisfactory report on the practical training, to the Faculty Administration within one week of registration.

(MPY 415) **PRACTICAL TRAINING 415:(M4)**
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 6 weeks. A case study on occupational safety must be done in this period and submitted to the Faculty Administration together with a satisfactory report on the practical training within one week of registration.

(NPY 316) **PRACTICAL TRAINING 316:(N3)**
During or at the end of the second year of study, students in Metallurgical Engineering undergo at least 6 weeks of prescribed training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration.

(NPY 416) **PRACTICAL TRAINING 416:(N4)**
During or at the end of the third year of study, students in Metallurgical Engineering undergo at least 6 weeks of prescribed training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration.

(PPY 317) **PRACTICAL TRAINING 317:(P3)**
Mining students must do at least 8 weeks prescribed practical training at a mine at the end of the second year of study. A satisfactory report on such work must be submitted to

the Faculty Administration within one week after registration for PPY 317. Arrangements must be made for a further training period of at least 8 weeks at the end of the third year of study.

(PPY 417) **PRACTICAL TRAINING 417:(P4)**
Mining students must do at least 8 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 at the Faculty Administration within one week after registration for PPY 417.

(CPR 420) **PRACTICE 420:(C4)**
Design economics and process evaluation. Estimation of cost and time value of money. Applied process control. Choice of control instrumentation. Safety: Layout and location of plant, area classification, hazard analysis and operability studies. Optimisation. Process integration. Flow sheeting. Physical property estimation. Occupational Safety and Health Act, Engineering Profession's Act.

(SPZ 110) **PRACTICE ORIENTATION 110:(S1)**
Introduction to several aspects of Civil Engineering. Examples of the application of the basic natural sciences. Application of communication principles.

(SPZ 120) **PRACTICE ORIENTATION 120:(S1)**
Principles of good language usage in technical writing. Meeting procedures and minutes. Composition of a speech. Framework of technical report. Types of letters.

(AGR 313) **PRIMARY FOOD CROPS 313:(L3)**
Presented in the Faculty of Biological and Agricultural Sciences:
The cultivation and utilisation of important food and vegetable crops, such as grain, leguminous plants, potatoes, tomatoes and a few other vegetable crops. Botanical characteristics, growth requirements and exploitation of the plant-environment interaction by means of appropriate cultivation practices. Visits to marketing councils, research institutions and producers to get acquainted with grading regulations and topical practical problems.

(CPB 410) **PROCESS CONTROL 410:(C4)**
Dynamic properties of equipment, instruments and processes. Mathematical modelling and computer simulation of processes in the time, Laplace and frequency domains. Linearisation and non-linear processes. Stability of control systems. Controller setting. Methods for process identification. Digital process control. Z-transforms. Use of computers and microprocessors. Introduction to modern control theory: State-space approach.

(CPD 320) **PROCESS DYNAMICS 320:(C3)**
Process dynamics: Time dependent behavior of linear systems, linearisation. Transfer functions. Elements of a control loop. Control principles and mechanisms.

(NPI 220) **PROCESS ENGINEERING 220:(N2)**
Metallurgical unit processes. Stoichiometric principles and solving of different types of mass balance problems. The law of Conservation of Energy, calculation of enthalpy change and the development of energy balances. Computer-aided numeric-mathematical solutions for metallurgical problems. Properties of metallurgical fuels and combustion calculations. Furnace technology and effective fuel utilisation.

(NPL 410) **PROCESS METALLURGY 410:(N4)**
Quantitative description of metallurgical processes, for analysis and prediction of process operation. Development and use of mathematical models by applying principles of heat transfer, equilibrium and reaction kinetics. Elements of metallurgical process control.

(LPR 310) **PROCESSING 310:(L3)**
Handling, cleaning and sorting as well as milling, mixing and compacting of agricultural products. Processes of heat transfer and heat transfer calculations.

(LPR 410) **PROCESSING 410:(L4)**
Psychometrics. Mechanised cooling systems. Drying of agricultural products. Principles of biochemical engineering.

(BPZ 310) **PRODUCTION 310:(B3)**
Introduction to operations management, operations strategy and competitiveness. Manufacturing planning and control and the manufacturing management environment. Production/aggregate planning, demand management, forecasting, master production scheduling, capacity planning and control, materials requirements planning, manufacturing resource planning and distribution requirements planning.

(BPZ 320) **PRODUCTION 320:(B3)**
Alternative approaches to manufacturing -MRP, JIT and TOC (synchronous manufacturing). Production activity (shop floor) control and scheduling. Integration and implementation of manufacturing management systems. Inventory management. Business logistics management. Business process engineering.

(BPZ 410) **PRODUCTION 410:(B4)**
System requirement analysis, structural analysis, system specification, structured designing of systems, data flow charts, database content and normalisation, software design, the test plan, the control plan, implementation.

(BPZ 420) **PRODUCTION 420:(B4)**
Integration of engineering functions, strategic planning, integrated product definition, business and information management, configuration management, systems engineering and logistic support, Japanese production planning and control systems, modern planning and control techniques.

(EPP 410) **PROFESSIONAL PRACTICE 410 : (E4, Z4)**
Project management: Concepts of acquisition, tenders and contracts, general legal aspects. Management of technology and technological innovation. Entrepreneurship. General management: Strategic management, management functions, composition of organisations, sorts of business. Organisational behaviour: Individual behaviour, group behaviour, communication, conflict and leadership. Negotiation. Business ethics and morality, ethical codes of conduct. The Engineering Profession of South Africa Act, vocational society.

(BPJ 410) **PROJECT 410:(B4)**
Choice of a project topic. Allotment of a project leader. Project planning. Literature study, analysis, creation of alternatives and narrowing of choice. Writing of first semester report and presentation of project.

(BPJ 420) **PROJECT 420:(B4)**
Detailed solution of chosen alternative. Writing of final project report and presentation of project.

(EPR 400) **PROJECT 400:(E4, Z4)**
The planning and execution of a given engineering project from concept to delivery, the practical application of project management principles. Problem statement: Literature study; requirement analysis; project planning and scheduling; theoretical analysis and/or simulation and/or experimental work; synthesis (design and manufacture). Verbal reporting. Written report.

(EPR 471) **PROJECT 471:(R4)**
The planning and execution of a given engineering project from concept to delivery, the practical application of project management principles. Problem statement: Literature study; needs analysis project planning and time scheduling; theoretical analysis and/or simulation and/or experimental work; synthesis (design and manufacture). Verbal reporting. Written report.

(CSC 410) **PROJECT 410:(C4)**
The execution of a complete literature study and research project on a chosen subject.

(CSC 420) **PROJECT 420:(C4)**
Interpretation of the research results of CSC 420. The writing of a project report and scientific article.

(LSC 320) **PROJECT PREPARATION 320:(L3)**
Identification of a suitable subject for Project 402. Detailed literature study with accompanying report. Planning of project execution.

(LSC 402) **PROJECT 402:(L4)**
Execution of the research project on chosen subject. Detailed project report. Oral presentation of project.

(MSC 400, 401) **PROJECT 400, AERONAUTICAL PROJECT 401:(M4)**
The project involves the execution of an engineering project under guidance of a lecturer. This includes: Analysis of the problem, literature and background study, complete planning (including co-aspects, available apparatus and required target dates), execution of the project (including complete calculations and working sketches of all apparatus and components to be manufactured), meaningful interpretation of the results and a complete written engineering report.

(NSC 400) **PROJECT 400:(N4)**
The project involves the execution of an analytical and/or experimental research project under the guidance of a lecturer. Each student must choose a project topic in the second semester of the third year. A complete reference list of literature and the intended experimental program must be submitted to the particular lecturer before the experimental work can begin. A complete project report must be submitted at the end of the year.

(PSC 410) **PROJECT 410:(P4)**
The student project involves the execution of an analytical and/or experimental research project under guidance of a lecturer. During the second semester of the this year of

study students must be selected a suitable research topic, to be approved by the Head of Department. Information for the project will be collected during the practical training period at the end of the third year of study. A comprehensive and detailed project report must be submitted on the prescribed date.

(NPM 320) **PYROMETALLURGY 320:(N3)**
The pyrometallurgical extraction of copper. Iron and steel making. The thermodynamics of multicomponent solutions and ionic slag theories. Development of predictive models for the quantitative analysis of refining reactions in pyrometallurgical extractions processes.

(BGC 410) **QUALITY ASSURANCE 410:(B4)**
Introduction to quality assurance and quality management systems. Background of statistics. Statistical process control. Statistical acceptance control.

(CRO 410) **REACTOR DESIGN 410:(C4)**
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, fluidised and other reactor stability, dynamic reactor behaviour and non-ideal flow in reactors.

(NVM 310) **REFRACTORY MATERIALS 310:(N3)**
Principles of ternary phase diagrams. Manufacturing principles of refractory materials: silica, aluminum silicates, magnesia, magnesia-chrome, doloma, zirconia, carbon and graphite, silicon carbide and nitride, monoliths. Refractory systems. Specification and testing of refractory products. Applications in manufacturing or iron and steel, ferro-alloys, non-iron metals, non-metallic products.

(GMA 220) **REMOTE SENSING 220:(L3)**
Consult "Rules and Syllabuses", Faculty of Science.

(PRX 310) **ROCK BREAKING 310:(P3)**
Rock breaking: Specific energy of rocks, energy transfer from drill steel to drill bits. Cutting removal. Performance of pneumatic, hydraulic and electrical drills. Economic aspects. Maintenance of machines and equipment. Mechanical tunnelling, equipment and continuous mines. Explosives: Properties of commercial explosives, detonation mechanisms, energy release, shock energy and gas pressure. Timing with different accessories. Blasting: Explosive/rock interactions, rock breaking mechanisms. Blasting sessions for tunnelling, shaft construction, stooping and coal mining. Importance of safety during blasting operations.

(PSZ 320) **ROCK MECHANICS 320:(P3)**
Two dimensional stress and deformation. Strength and failure modes of rock and rock failure criteria. The characteristics of joints in rock. Collection of joint information and interpretation thereof. The characteristics of a rock mass, classification methods and determination of strength. Stress surrounding simple underground excavations and the behaviour of rock in vicinity of such excavations. Rock failure due to gravity. Slope stability, joint failure, wedge failure, circular and non-circular failure in surface mines.

(LLI 420) **RURAL ENGINEERING 420:(L4)**
The planning, utilisation and management of natural resources in rural areas on a sustainable basis, planning and management irrigation systems, surface and subsurface drainage, soil and water conservation and structures, waste control and environmental planning.

(ESS 310) **SIGNAL PROCESSING 310:(R3)**
Analogue and digital signal processing. The Fourier transform and spectra of signals. Analogue modulation (amplitude and phase). Quantisation noise and digital modulation techniques, ASK, FSK and PSK. Sampling theory, invariant systems and the FFT. Introduction to DSP: Decimation, convolution and correlation, principles of digital filters (FIR, IIR).

(BUY 320) **SIMULATION MODELLING 320:(B3)**
Introduction to simulation. Simulation methodology. Formulation of problem situations in terms of simulation models with the emphasis on discrete models. Input and output analysis. Introduction to simulation software.

(EPE 120) **SOFTWARE ENGINEERING 120:(R1)**
Object-oriented analysis and design. Modelling of data and the use of advanced data structures. State diagram modelling of behaviour. Modelling of functional relationships. Application in object-oriented programming language: program and file structure, simple data types, control structures, functions, classes, reusability of software, use of utility libraries and application w.r.t. WWW- and computer network programming.

(EPE 220) **SOFTWARE ENGINEERING 220:(B2)**
Software engineering, structured software design principles, object-orientated modelling and design, implementation in a high-level programming language.

(ERP 210**) SOFTWARE ENGINEERING 210:(E2, Z2)**
Software engineering, structured software design principles, object-orientated modelling and design, implementation in a high-level programming language.

(LGH 420) **SOIL CONSERVATION AND HYDROLOGY 420:(L4)**
Soil conservation: erosion and control measures to prevent it. Drainage control planning. Construction of earth dams. Hydrology: the hydrological cycle. Flood calculations for small and medium size catchment areas. Determination of dam capacities for small catchment areas.

(LGD 410) **SOIL DYNAMICS 410:(L4)**
Dynamic soil properties and its measuring, basic soil mechanics, stress caused by different loads, bearing capacity of soils, soil dynamics as applicable to soil cultivation, traction and soil compaction.

(SGM 120) **SOIL MECHANICS 120:(S1)**
Stratification and types of rock. Geological structure. Surface processes. Description and behaviour of soil and rock. Introduction to and application of Engineering Geology with specific reference to the geology of Pretoria.

(SGM 220) **SOIL MECHANICS 220:(S2)**
Geological origin. Soil tests and classification systems. Compaction, stabilisation. Bitumen and tar. Polymers. Introduction to pavements. Overview of road building materials. Pavement design principles and methods.

(SGM 322) **SOIL MECHANICS 322:(S3)**
Introduction to soil mechanics. Soil composition: Weight, volume relationships and structure. Flow of water in soil: Permeability and seepage. Effective stress concepts: Stresses in saturated and partially saturated soils. In-situ soil stresses "Mohr's circle of stresses for soils and stresses induced by point loads, line loads and loaded areas. Compressibility of soil: Fundamentals of consolidation and settlement.

(SGM 411) **SOIL MECHANICS 411:(S4)**
Stresses at and stability of retaining walls. Bearing capacity of in-siti soil. Stability of slopes and excavations. Pressure and buried structures. Piles. Ground anchors. Foundation investigation and design.

(GKD 215) **SOIL SCIENCE 215:(L3)**
Appearance and properties of soil. Soil fertility and classification. Aspects of soil conservation's and pollution.

(EES 420) **SPECIALISATION 420:(E4, Z4)**
Specific niche areas from practice are addressed. The specific choice of content will be done in consultation with the Head of Department.

(SWK 110) **STATICS 110:(B1, C1, L1, M1, N1, P1, S1)**
Vectors: Geometrical vectors, co-ordinate systems, algebraic vectors, position vectors, dot, cross and triple products. Force systems: Resultants, moments, couples, force-couple systems, wrenches. Equilibrium of particles and rigid bodies. Action-reaction. Forces in cables and rods. Composite bodies. Trusses: Method of joints, method of sections. Light cables. Beams: Forces, moments, distributed forces.

(SWK 120) **STATICS 120:(B1, C1, L1, M1, N1, P1, S1)**
Centres of mass. Centroids of lines, area and volumes. Pappus. Second moment of area, Steiner's theorem. Beams: Bending moments and shear forces. Friction: Dry friction, wedges, screws, journal and thrust bearings, rolling resistance, belt friction. Hydrostatics: Forces on submerged surfaces, buoyancy. Virtual work. Potential energy.

(MSS 220) **STATISTICS FOR ENGINEERS 220:(M2, L2)**
Definitions of statistics. Probability distributions. Regression and correlation. Curve fitting. Applications to industrial analysis, engineering processes, quality control and maintenance. Response surface methodology.

(WTW 332) **STOCHASTIC PROCESSES 332:(R3)**
Mathematical formulations of a number of probability models, properties of random variables, theory of Poisson and Markov processes with applications in Mathematics of Finance and Engineering.

(PSZ 410) **STRATA CONTROL 410 : (P4)**
Mine safety and ground falls: Seismicity and rock bursts in mines, control of energy releases during mining. Energy release rates and excessive shear stress criteria. Backfilling and regional support lay-outs. Support of underground slopes, service

excavations. Lay-out of mining excavations. Strata control in coal mines, bord and pillar workings, high extraction coal mines, shafts and massive mining operations. Application of stress analysis methods in design of excavations, surface subsidence.

(MSZ 210, 220) **STRENGTH OF MATERIALS 210 : (M2), 220 : (C2, N2, P2)**
Stresses, strains and material behaviour: Normal and shear stresses, factors and safety. Bar structures with axial loads: Displacements and stresses of statically determinate and indeterminate structures, thermal effects, transformation of stress, strain energy, dynamic loads. Torsion: Torsion of round bars, transformation of shear stress, relationship between E, G, y, transmission of power, statically indeterminate axles, strain energy. Shear and bending of beams: Shear force and bending moment, strains and stresses, Analysis of stress and strain: Plane stress, tri-axial stress, 3-D stress, plane strain. Deflections of beams. Buckling. Experimental techniques in strength of materials.

(SRO 322) **STRUCTURAL DESIGN 322 : (L3)**
Concrete design: Properties of reinforced concrete, principles of boundary state design. Design of sections in bending, shear and torsion. Bond and anchorage.

(SIN 212) **STRUCTURAL ENGINEERING 212 : (S2)**
Elasticity, tensile and compressive stress, torsion of circular bars, reactions, static stability and determinance, shear force and bending moment, bending stresses, plastic bending, deflections of beams, virtual work, introduction to influence lines.

(SIN 222) **STRUCTURAL ENGINEERING 222:(L2, S2)**
Euler buckling of columns with different boundary conditions. Analysis of statically indeterminate structures using the methods of super-position, slape-deflection and moment distribution (with sway and support displacement).

(SIN 312) **STRUCTURAL ENGINEERING 312 : (S3)**
Section 1 : Analysis.
Analysis of statically indeterminate structures using methods of superposition, slope-deflection (with saw) and moment distribution. Plastic analysis of portal frames.
Section 2: Strength of Materials.
Basic theory of elasticity and plasticity. Stresses in thin walled open sections (steel profiles) as a result of shear and torsional forces. Lateral buckling of narrow rectangular beams.

(SIN 322) **STRUCTURAL ENGINEERING 322 : (S3)**
Section 1: Steel design.
Design of steel elements bending and bending combines with tension and compression. Connectors and connections (bolted and welded). Design of two-dimensional portal frames. Composite construction: Moment of resistance of composite sections, shear connectors.
Section 2: Concrete design.
Properties of reinforced concrete, principles of limit state design. Design of sections in bending, shear and torsion. Bond and anchorage.

(SIN 412) **STRUCTURAL ENGINEERING 412 : (S4)**
Analysis: Moment distribution and slope deflection (structures with sway), symmetrical structures, plastic design, three-dimensional frames, matrix methods. Reinforced concrete design: Design of beams, behaviour and design of slabs (solid slabs, ribbed and waffle slabs, flat plates, and slabs), columns (slender columns and biaxial bending),

foundations (simple and combined bases) and stairs. Pre-stressed concrete design: Design for flexure (service-ability limit-state and ultimate limit-state) and shear, calculation of losses.

(GLY 414) **STRUCTURAL GEOLOGY 414:(P4)**
The behaviour of strata relative to stress; brittle and ductile; deformation of rock mass; folding mechanisms; tectronic structures; faulting systems; practical work includes Mohr diagrams and the use of stereographic projections in structural geology; mining related structural geology; mining related structural problems; topocadastral plan.

(MSY 310) **STRUCTURAL MECHANICS 310 : (M3)**
Part A : Introduction to structural analysis using the finite element method: FEA process. Direct stiffness method. Spring, bar and beam elements. Slop deflection equations. Coordinate transformations. Analysis of statically indeterminate trusses and frames. Internal hinges. Continuous loads. Continuous beams with normal loads. Computer assignments.
Part B : Failure analysis: Fatigue-finite life – SN approach: Analysis methods. Influencing factors. Non-zero means. Cumulative fatigue damage. Rainflow cycle counting. Elastic instability: Euler theory. Equivalent length. Eccentric loads. Secants equation. Linear lastic mechanics: Stress intensity factor. Fracture toughness. Fatigue crack growth. Structural fatigue testing: Multi-axial simulation testing. Experimental techniques in structural mechanics.

(MSY 410) **STRUCTURAL MECHANICS 410 : (M4)**
Part A : Theory of elasticity: Stress: Stress vector, stress tensor, transformation of stress, equilibrium, surface traction, principal stress, notation. Deformation and strain: Stretch and shear, strain tensor, infinitesimal strain. Material laws: Linear elasticity, plane stress, -strain. The boundary value problem.
Part B : The finite element method in solid mechanics (FEM): Review-bar analysis: Equilibrium, compatibility, material laws, approximation functions, strain operator, stiffness matrix, solution, stress. Plane stress, plane strain: Triangular element, body and boundary forces, solution. Practical considerations in modelling, computer application, convergence, Patch Test, constant strain triangle, linear strain triangle. Axisymmetry. Isoparametric formulation: Quadrilateral element, numerical integration, stiffness matrix. Structural dynamics: Bar element, mass matrix, natural frequencies. Computer analysis. Experimental techniques in structural mechanics.

(PDY 310) **SURFACE MINING 310 : (P3)**
Mining methods for open pits and strip mines. Drilling and blasting practice, face shovels and loading methods. Truck transport, roads, truck allocation and electrical trolley assist. Dragline operations and strip mining practices. Continuous transport systems and in-pit crushes. Bucket wheel excavators. Economic cut-off limits with regard to waste stripping and ore grade. Environmental rehabilitation. Mine risk analysis, basic computerised mine planning, equipment maintenance, mine water control, slope stability.

(SUR 220) **SURVEYING 220 (L3, P3, S2)**
Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and levelling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

(ESL 220) **SYSTEMS ANALYSIS 220 : (E2, R2, Z2)**
Frequency domain analysis of linear time-invariant systems. Laplace, Fourier and z-transforms applied to periodic, aperiodic and sampled signals; exponential and trigonometric Fourier series. Nyquist sampling theorem, transfer functions, poles and zeros, bandwidth and rise time, frequency response, impulse response, Bode diagrams, natural frequency, natural and forced response. Instability and oscillations. Computer simulation.

(ESS 320) **SYSTEMS ELECTRONICS 320: (Z3)**
Operational circuits: instrumentation amplifiers, logarithmic amplifiers, multipliers, oscillators, filters, translinear circuits and voltage regulators. Communication electronics: wideband amplifiers, tuned RF amplifiers, AM and FM modulators and demodulators, phase locked loops.

(ESI 410) **SYSTEMS ENGINEERING 410:(R4)**
Systems engineering principles with the focus on computers (hardware, software and communication): The system design process – conceptual design, preliminary design, detail design and development, test and evaluation. Support tools for system design – Decision making, economic evaluation, optimisation, statistical methods, queuing theory and control. Design philosophy – design for operational feasibility e.g. reliable, maintainability, supportability, etc. System engineering management – organisation, planning (SIBP), control, etc.

(EXI 110) **TECHNOLOGICAL INNOVATION 110 : (E1, R1, Z1)**
The history of Engineering, the relationship between Engineering and Science and Technology, innovation and innovation capabilities, concept and technological innovation; dynamics of technological change, substitution and diffusion, evolution of products and processes; ageing of technology; social impact of technology; social and environmental responsibilities.

(ETK 320) **TELECOMMUNICATION 320:(E3, Z3)**
Revise spectra of signals and the use of the Fourier Transform. Modulation and demodulation of AM and FM (without noise). Noise models. The effect of noise on the different modulation schemes. Analogue modulation techniques: Amplitude and angle modulation in the presence of noise. The spectra of the various modulated signals and noise are studied. Pulse modulation techniques: Delta modulation, pulse width, pulse position and pulse code modulation. Quantisation noise. Digital modulation techniques: Amplitude shift keying, frequency shift keying and phase shift keying. Introduction to signal spaces – quadrature phase shift keying.

(ETK 410) **TELECOMMUNICATION SYSTEMS 410 : (Z4)**
A study of the various systems forming a modern telecommunication network. Telephony: Introduction to the theory of traffic flow. Blocking probabilities, Erlang-B and C formulae, systems with buffers. Switching networks and exchanges. Broadband networks, B-ISDN and ATM. Television and digital speech and image. Packet switching. Optical fibre communication. Radio wave propagation. Satellite communication: Link analysis. Geo-stationary and polar orbit satellite systems. Mobile communication: The cellular concept. The GSM and DECT systems. The problem of handover of calls.

(MSK 222) **THEORY OF MACHINES 222 : (M2, L2)**
Theory of mechanisms, couplings, brakes, flywheels, drive belts and screws.

(MSK 321) **THEORY OF MACHINES AND STRENGTH OF MATERIALS 321:(E3)**
Theory of machines: Movement, velocity, acceleration and inertia forces in machines. Mechanics of machine elements like couplings, clutches, gears, cams, belt drives and hoists. Balancing of rotating machines and vibration isolation.

(MTC 420) **THERMAL MACHINES 420 : (M4)**
(i) Thermodynamics: Introductory thermodynamics with reference to power cycles. Energy systems and views, transformation of energy. Nuclear power. (ii) Steam generators: Work fluids, fire-tube boilers, water-pipe boilers, heat exchange boilers, power nuclear reactors. Feedwater. Industrial uses of steam. (iii) Combustion technique: Types of fuels – oil, coal, gas; their combustion methods. Ash and its properties. Air pollution. (iv) Steam engines: Turbo machine theory; types of turbines - properties and uses. Blades, rotors, sealing, balancing. Parallel industry of turbo generators in a power network.

(MTX 220) **THERMODYNAMICS 220 : (L2, M2, P2)**
Application overview. Concepts: System, control volume, properties. Pure materials, property tables, ideal gases. Work and heat. Internal energy, enthalpy, specific heat capacity. First Law of thermodynamics for system and control volume. Entropy. Introduction to vapour power, cooling and gas cycles.

(CTD 222) **THERMODYNAMICS 222 : (C2)**
Simple applications of the First and Second Laws of thermodynamics. The concepts of work, heat, enthalpy and entropy. Equations of state for gases and gas mixtures, the calculation of internal energy, enthalpy and entropy using the equations of state. Simple heat engine cycles.

(CTD 310) **THERMODYNAMICS 310 : (C3)**
The First and Second Laws of thermodynamics. Generalised correlation's for physical and thermodynamic properties. Refrigeration's and liquefaction of gases. Process efficiency by means of energy. Equilibrium composition in multiphase non-reacting systems with due allowance for non-ideality in the phases and the mixtures. Equilibrium compositions in reacting systems; also under conditions of non-ideality and competing reactions.

(MTX 310) **THERMODYNAMICS 310 : (M3)**
The ideal gas, real gases. State equations. Mixtures, air and vapour compounds. Cooling cycles, analysis, components, practice. Fuels, chemistry of combustion. Combustion equilibrium, combustion of different fuels, products of combustion and their analysis. Experimental techniques in thermodynamics.

(COP 310) **TRANSFER PROCESSES 310 : (C3)**
Momentum transfer. Navier-Stokes equation, derivation and applications. Laminar boundary layer. Velocity distribution and disturbance in turbulent flow. Heat transfer: Transfer in laminar, developing and turbulent flow. Condensation. Mass transfer: Diffusion, mass transfer coefficients.

(NOP 320) **TRANSFER PROCESSES 320 : (N3)**
Heat transfer by means of conduction, radiation and flow. Analytical and numeric solutions of the relevant differential equations. Mass transfer: Diffusion and mass transfer diffusion coefficient. Practical class: The analysis of heat transfer problems in the metallurgical industry by means of computer-aided numeric-mathematical methods.

(SVC 312) **TRANSPORTATION ENGINEERING 312 : (S3)**
Introduction to Transportation Engineering: Systems approach, different modes of transportation, public transportation, road financing and commuter subsidies, vehicle characteristics and capacity, traffic safety, pedestrian characteristics and capacity, pedestrian design considerations. Railway engineering: Train composition, limiting grades, railway tracks in industrial areas, continuous welded rails. Airport engineering: Aviation in the RSA, airport layout and terminology, aeroplane characteristics for airport design, obstruction limits, geometrical design, air-side capacity and delays, airport terminals. Town and regional planning. Land-use models. The four-step process in transportation demand studies.

(SVC 322) **TRANSPORTATION ENGINEERING 322 : (S3)**
Traffic Engineering: Traffic characteristics and interaction, traffic movement, intersections, serviceability analysis, data collection. Geometrical road design: Rural roads: (AASHTO), cross-section design, horizontal design, vertical design, intersections, road quantities, mass haul diagrams. Urban streets (SAICE and Community Development): Layout considerations, intersection design, typical plans. Practical applications of engineering surveys in road construction.

(MVR 320) **VIBRATION AND NOISE 320:(M3)**
Introduction to vibration. Single degree of freedom systems: Free vibration, harmonic excitation, general excitation. Multidegree of freedom systems. Continuum systems. Sound and noise. Vibration control. Vibration and sound measurement.

(NSW 410) **WELDING ENGINEERING 410:(N4)**
Welding processes (process with gas shielding and/or flux shielding, special processes, gas welding and brazing). Selection of welding processes. Welding metallurgy (weldability of ferrous and non-ferrous alloys, solidification and the origin of weld microstructures, heat flow in welds, the causes and detection of weld defects). Design principles and the integrity of welded constructions, fatigue behaviour of welded joints.

(WWP 120) **WORKSHOP PRACTICE MW 120:(B1, C1, E1, L1, M1, N1, Z1)**
The course is offered at the end of the first year of study. The duration is at least 2 weeks during which the students receive training in, among other things, the following workshops: Electronic, electrical (electrical engines and switchgear), electrical (wiring in general), automotive wiring, soldering, welding, vehicle repair, general machine workshop equipment, turning work, fitting work and sheet metal work.

(WWP 120) **WORKSHOP PRACTICE:(P1)**
The course will be 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 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.

(WWP 120) **WORKSHOP PRACTICE MW 120:(S1)**
The course is offered at the end of the first year. The duration is at least 2 weeks during which the student receive training in, among other things, the following: the application of formwork, scaffolding, masonry and structural steel.

POSTGRADUATE COURSES

(a) INDUSTRIAL AND SYSTEMS ENGINEERING

Consult the departmental brochure for further information. Courses offered, include amongst others, the following:

	Course Code	Course credits
Business Architecture 780	BBA 780	8 credits
Business Engineering 780	BSI 780	8 credits
Computer-aided Manufacturing 780	BRV 780	8 credits
Engineering Logistics 780	BIX 780	8 credits
Industrial Analysis 780	BAN 780	8 credits
Industrial Logistics 780	BLK 780	8 credits
Information Systems 780	BIZ 780	8 credits
Knowledge Management 780	BBB 780	8 credits
Maintenance Management 780	BIH 780	8 credits
Manufacturing Facilities 780	BVF 780	8 credits
Operations Research 780	BOZ 780	8 credits
Probability Models 780	BHM 780	8 credits
Probability Models 781	BHM 781	8 credits
Production 780	BPZ 780	8 credits
Production 780	BRY 780	8 credits
Project 780	BPJ 780	8 credits
Project: Industrial 895	BSC 895	16 credits
Project: Quality Assurance & Reliability 896	BSC 896	16 credits
Quality Assurance Management 780	BGV 780	8 credits
Quality Assurance 780	BGC 780	8 credits
Reliability Engineering 780	BTK 780	8 credits
Robotics 780	BVS 780	8 credits
Simulation Modelling 780	BUY 780	8 credits
Systems Engineering 700	BTY 700	8 credits
Value Management 780	BWB 780	8 credits

(b) CHEMICAL ENGINEERING

The following courses are offered for postgraduate study in Chemical Engineering: Chemical Technology, Water Utilisation Engineering, Water Utilisation, Polymer Engineering, Polymer, Control Engineering, Control, Environmental Engineering and Environmental Technology.

Consult the Department's postgraduate brochure for further information concerning course combinations. All courses are not necessarily offered each year – consult the respective Head of Department.

	Course Code	Course credits
Advanced Process Control Application 780	CGP 780	8 credits
Advanced Process Control Application 787	CGP 787	8 credits

Air Pollution 780	CLS 780	8 credits
Air Pollution Control 787	CLS 787	8 credits
Air Pollution Control 781	CLS 781	8 credits
Air Pollution Control Design 780	CLO 780	8 credits
Air Pollution Control Design 787	CLO 787	8 credits
Chemical Engineering 780	CIR 780	8 credits
Chemical Engineering 707	CIR 707	16 credits
Chemical Engineering 787	CIR 787	8 credits
Chemical Engineering 701	CIR 701	16 credits
Cost Optimisation 781	CKO 781	8 credits
Cost Optimisation 782	CKO 782	8 credits
Environmental Management Systems 780	COB 780	8 credits
Environmental Management Systems 787	COB 787	8 credits
Materials Science 782	CMK 782	8 credits
Materials Science 781	CMK 781	8 credits
Materials Science 787	CMK 787	8 credits
Materials Science 707	CMK 707	16 credits
Materials Science 700	CMK 700	16 credits
Membrane Technology 780	CMT 780	8 credits
Membrane Technology 787	CMT 787	8 credits
Multicomponent Separations 780	CMS 780	8 credits
Multicomponent Separations 787	CMS 787	8 credits
Multivariable Control Theory 780	CBT 780	8 credits
Multivariable Control Theory 787	CBT 787	8 credits
Multivariable Control Systems Design 780	CBO 780	8 credits
Multivariable Control Systems Design 787	CBO 787	8 credits
Plant Design 787	CAO 787	8 credits
Plant Design 780	CAO 780	8 credits
Polymer Chemistry 780	CPC 780	8 credits
Polymer Engineering 780	CPI 780	8 credits
Polymer Engineering 787	CPI 787	8 credits
Polymer Modification 780	CMD 780	8 credits
Polymer Physics 780	CPF 780	8 credits
Polymer Processing 720	CPP 720	8 credits
Polymer Processing 727	CPP 727	8 credits
Polymer Science 710	CPW 710	8 credits
Process Control Laboratory 780	CPL 780	8 credits
Process Modelling 787	CPM 787	8 credits
Process Modelling 780	CPM 780	8 credits
Project: Chemical Engineering 895	CSC 895	16 credits
Project: Chemical Technology 891	CSC 891	16 credits
Project: Control 893	CSC 893	16 credits
Project: Control Engineering 897	CSC 897	16 credits
Project: Corrosion 892	CSC 892	16 credits
Project: Environment Engineering 896	CSC 896	16 credits
Project: Environment Technology 894	CSC 894	16 credits
Reactor Design 780	CRO 780	8 credits
Reactor Design 700	CRO 700	16 credits
Systematic Process Control Development Systems 780	CSP 780	8 credits
Systematic Process Control Development Systems 787	CSP 787	8 credits

Environmental Engineering 780	WOI 780	8 credits
Environmental Engineering 787	WOI 787	8 credits
Industrial Effluent 780	WAN 780	8 credits
Industrial Effluent 787	WAN 787	8 credits
Plant Design 780	WAO 780	8 credits
Plant Design 787	WAO 787	8 credits
Project: Water Utilisation 897	WSC 897	16 credits
Project: Water Utilisation Engineering 895	WSC 895	16 credits
Sewerage Purification 787	WAR 787	8 credits
Sewerage Purification 780	WAR 780	8 credits
Solid Waste Disposal 787	WVA 787	8 credits
Solid Waste Disposal 780	WVA 780	8 credits
Unit Processes 780	WAE 780	8 credits
Water Chemistry 780	WCH 780	8 credits
Water Microbiology 780	WMB 780	8 credits
Water Purification 787	WWS 787	8 credits
Water Purification 780	WWS 780	8 credits
Water Quality Management 780	WWG 780	8 credits
Water Treatment 780	WWB 780	8 credits
Water Treatment 787	WWB 787	8 credits

Selected courses from other departments are also acceptable for postgraduate study. Further information is available in the brochure for postgraduate studies.

(c,d) ELECTRICAL AND ELECTRONIC ENGINEERING

The Department of Electrical and Electronic Engineering offers postgraduate training in electrical, electronic, computer as well as bio-engineering. Consult the department's postgraduate brochure for further details. Possible courses include the following:

	Course code	**Course credits**
Advanced Computer Networks 780	ENV 780	16 credits
Advanced Literature Study 788	EXL 788	16 credits
Advanced Microprocessors 780	ERV 780	16 credits
Antenna Theory 780	EMA 780	16 credits
Automation Infrastructure System Design 780	EOT 780	16 credits
Bio-engineering 780	EPN 780	16 credits
Biosystems 780	EPB 780	16 credits
Computer Architecture 780	ERR 780	16 credits
Computer Network Technology, Management & Practice 781	ENV 781	16 credits
Computer Networks 780	ERN 780	16 credits
Control Mathematics 781	EBB 781	16 credits
Control Practice 780	EBB 780	16 credits
Digital Electronics Design 780	EDG 780	16 credits
Electrical Drives 780	ETE 780	16 credits
Electrical Energy and Applications 780	EWE 780	16 credits
Electronics 780	EEE 780	16 credits
Electronics and Applications 780	EWT 780	16 credits
Energy Management & Electricity Tariffs 780	ENE 780	16 credits

Engineering Mathematics 780	ENM 780	16 credits
Engineering Profession 780	EIX 780	16 credits
Ergonomics & Biomaterials 780	EPE 780	16 credits
Information Security 780	ETH 780	16 credits
Information Theory and Coding 780	ETI 780	16 credits
Integrated Analogue Design 780	EEA 780	16 credits
Introduction to Energy Management 780	ENB 780	16 credits
Microwave Circuit Design 780	EMO 780	16 credits
Microwave Theory 780	EMM 780	16 credits
Mobile Communication 780	ETR 780	16 credits
Nonlinear Control 780	EBN 780	16 credits
Optical Fibre Communication Systems 780	EFC 780	16 credits
Optimal Control 780	EBO 780	16 credits
Pattern Recognition 780	ERP 780	16 credits
Photonics 780	EEF 780	16 credits
Power Electronics 780	EED 780	16 credits
Power Network Analysis & Modelling 780	EKE 780	16 credits
Power Network Information Systems 780	EBF 780	16 credits
Power Network Reliability & Quality of Supply 781	EKE 781	16 credits
Power Network Stability 780	EKE 782	16 credits
Protection 780	EBV 780	16 credits
Radiowave Propagation 780	ERD 780	16 credits
Rehabilitation Engineering 780	EPH 780	16 credits
Renewable Electrical Energy Sources 780	EGH 780	16 credits
Teletraffic Engineering 780	ETL 780	16 credits

(e) ENGINEERING AND TECHNOLOGY MANAGEMENT

An honours programme is offered in Technology Management. Masters' programmes are offered in Engineering Management and Technology Management. Details with regard to presentation, prescribed course combinations and other requirements are available in the departmental brochure. The following courses, amongst others, are offered:

	Course code	**Course credits**
Decision Analysis 780	IBD 780	8 credits
Decision Analysis 801	IBD 801	8 credits
Decision Analysis 802	IBD 802	8 credits
Development Management 801	IOB 801	8 credits
Development Management 802	IOB 802	8 credits
Engineering Economics 780	IKN 780	8 credits
Engineering Logistics 801	IIX 801	8 credits
General Management 801	IAB 801	8 credits
Innovation Strategy 780	INV 780	8 credits
International Industrial Marketing 801	IIM 801	4 credits
Introduction to Project Management 801	IPM 801	8 credits
Maintenance Management 780	IMC 780	8 credits
Maintenance Management 801	IIB 801	8 credits
Maintenance Management 802	IIB 802	8 credits
Manufacturing 780	IVV 780	8 credits

New Product Development 780	INP 780	8 credits
New Ventures and Entrepreneurship 780	IOE 780	8 credits
New Ventures and Entrepreneurship 801	IOE 801	8 credits
Principles of Project Finances 801	IPF 801	8 credits
Production and Operations Management 801	IPP 801	8 credits
Production and Operations Management 802	IPP 802	8 credits
Project Communication Management 801	ICM 801	8 credits
Project Contract Management 801	ICB 801	8 credits
Project Cost Management 801	IKB 801	8 credits
Project: Engineering Management 895	IGB 895	16 credits
Project: Engineering Management 896	IGB 896	16 credits
Project: Engineering Management 897	IGB 897	16 credits
Project Human Resources Management 801	IHR 801	8 credits
Project Management 780	IPK 780	8 credits
Project Management 801	IPK 801	8 credits
Project Quality Management 801	IQM 801	8 credits
Project Risk Management 801	IRM 801	8 credits
Quality Management 801	IKK 801	4 credits
Quality Management 802	IKK 802	4 credits
Research and Development Management 780	INB 780	8 credits
Safety, Health and Environment 801	IVG 801	8 credits
Strategic Management 801	ISM 801	4 credits
Systems Engineering 801	ISI 801	8 credits
Technology Management 801	ITB 801	8 credits
Technology Management 802	ITB 802	8 credits
Technology Management 783	ITB 783	8 credits
The Law of Contract 801	ILC 801	8 credits

Faculty of Economics and Management Sciences:

Financial Management 883	FBS 883	4 credits
General Management 883	ALB 883	4 credits
Human Resources Management 883	WKB 883	4 credits
Information Management 883	ILB 883	4 credits
Management Accounting 883	BSR 883	4 credits
Management Economics 883	BEK 883	4 credits
Marketing Management 883	BEM 883	4 credits
Organisational Behaviour 883	ORG 883	4 credits

All courses are not necessarily offered each year - consult the departmental brochure.

(f) AGRICULTURAL AND FOOD ENGINEERING

Courses which may be chosen in consultation with the Head of Department, include amongst others, the following:

	Course Code	**Course credits**
Advanced Coursework 803	LTD 803	16 credits
Agricultural Engineering Special 700	LIS 700	16 credits
Agricultural Production Equipment 702	LPW 702	16 credits
Buildings and Planning 710	LBG 710	8 credits

Food Engineering 720	LVI 720	8 credits
Food Engineering Special 700	LVI 700	16 credits
Irrigation 700	LBP 700	16 credits
Machine Design 700	LWO 700	16 credits
Processing 710	LPR 710	8 credits
Project: Agricultural Engineering 895	LSC 895	16 credits
Rural Energy Sources 705	LEB 705	8 credits
Rural Natural Resources 704	LHZ 704	16 credits
Rural Services 703	LBD 703	8 credits

(g) MECHANICAL AND AERONAUTICAL ENGINEERING

Courses are chosen in consultation with the Head of Department for specialisation in one of the following fields:
Structural Mechanics
Fluid and Thermopower
Control Systems
Vehicle Engineering
Aeronautical Engineering

Courses include the following:

	Course code	**Course Credits**
Advanced Finite Element Methods 781	MEE 781	8 credits
Aerodynamics 780	MLD 780	8 credits
Aero-elasticity 780	MAE 780	8 credits
Aeronautical Structures 780	MLT 780	8 credits
Air Conditioning and Refrigeration 780	MLR 780	8 credits
Aircraft Design 780	MLW 780	8 credits
Computational Fluid Dynamics 780	MBV 780	8 credits
Computational Structural Dynamics 780	MED 780	8 credits
Condition Based Maintenance 780	MIC 780	8 credits
Control Systems 780	MBB 780	8 credits
Design 780	MOX 780	8 credits
Dynamics 780	MSD 780	8 credits
Failure Analysis 780	MIF 780	8 credits
Fatigue 780	MSV 780	8 credits
Finite Element Methods 780	MEE 780	8 credits
Flight Mechanics 780	MLV 780	8 credits
Fluid Mechanics 780	MSX 780	8 credits
Fluid Machines 780	MVM 780	8 credits
Fracture Mechanics 780	MSF 780	8 credits
Gas Dynamics 780	MLG 780	8 credits
Heat Transfer 780	MWX 780	8 credits
Independent Study 781	MSS 781	8 credits
Independent Study 782	MSS 782	8 credits
Maintenance Operation 780	MIB 780	8 credits
Maintenance Practice 780	MIP 780	8 credits
Mathematical Optimisation 780	MWO 780	8 credits
Numerical Thermo Flow 780	MSM 780	8 credits
Numerical Methods 780	MWN 780	8 credits
Project: Mechanical Engineering 895	MSC 895	16 credits

Research Methods 780	MNV 780	8 credits
Smart Materials 780	MSA 780	8 credits
Structural Inputs 780	MOI 780	8 credits
Thermodynamics 780	MTX 780	8 credits
Tribology 780	MIT 780	8 credits
Vehicle Dynamics 780	MVI 780	8 credits
Vehicle Engineering 780	MVE 780	8 credits
Vehicle Manufacturing 780	MVV 780	8 credits
Vehicle Propulsion 780	MVD 780	8 credits
Vibration 780	MEV 780	8 credits

Further information is available in the department's postgraduate brochure.

(h) METALLURGICAL ENGINEERING

Two or more postgraduate courses are offered annually, after hours, should student numbers justify their presentation. Some include formal lectures, other self-study and seminars. Consult the Head of Department for details. Postgraduate courses include, amongst others, the following:

	Course code	**Course credits**
Basic Hydrometallurgy 701	NHM 701	16 credits
Basic Physical Metallurgy 701	NFM 701	16 credits
Basic Pyrometallurgy 701	NPM 701	16 credits
Corrosion 700	NKR 700	16 credits
Extractive Metallurgy 700	NEM 700	16 credits
Iron and Steel Smelting 700	NYS 700	16 credits
Literature Survey 700	NLO 700	16 credits
Mechanical Metallurgy 700	NMM 700	16 credits
Metallurgical Problems 700	NPR 700	16 credits
Metallurgical Process Analysis and Control 700	NPB 700	16 credits
Ore Beneficiation 700	NEB 700	16 credits
Physical Metallurgy 700	NFM 700	16 credits
Pyrometallurgy 700	NPM 700	16 credits
Refractory Materials 700	NVM 700	16 credits
Welding Metallurgy 700	NSW 700	16 credits

(i) MINING ENGINEERING

Consult the Head of the Department for details. The following courses are offered, amongst others, should student numbers justify their presentation:

	Course code	**Course credits**
Advanced Mining Design 780	PMZ 780	8 credits
Coal Mining 782	POS 782	8 credits
Dust, Gasses and Fires 713	PKB 713	8 credits
Economy of Mining Environment 714	PKB 714	8 credits
Financial Mine Valuation 780	PFZ 780	8 credits
Heat and Refrigeration 712	PKB 712	8 credits
Mine Environmental Management Systems 715	PKB 715	8 credits

Mine Water and Airflow Dynamics 711	PKB 711	8 credits
Occupational Health 716	PKB 716	8 credits
Open Pit Mining 783	POY 783	8 credits
Project: Mining Engineering 895	PSC 895	16 credits
Rock Breaking - Blasting Technology 785	PRX 785	8 credits
Rock Breaking - Drilling and Explosives 784	PRX 784	8 credits
Rock Support Pillars 790	PSZ 790	8 credits
Slope Stability 781	PHS 781	8 credits
Strata Control - Collieries 788	PSZ 788	8 credits
Strata Control - Hard Rock Service Excavations 787	PSZ 787	8 credits
Strata Control - Hard Rock Stoping 786	PSZ 786	8 credits
Strip Mining 789	PSY 789	8 credits

(j) CIVIL ENGINEERING

Provision for specialisation is made at postgraduate level. A student plans his or her course in consultation with the Head of Department. For further details, a departmental brochure is available. All courses are not necessarily offered each year.

Postgraduate courses offered by the Department of Civil Engineering are:

Section Transportation Engineering

Asphalt Technology 787	SGC 787	8 credits
Basic Paving materials and Design 783	SGM 783	8 credits
Basic Traffic Engineering 785	SVV 785	8 credits
Basic Transportation Engineering 784	SVV 784	8 credits
Geometric Design 783	SVV 783	8 credits
Pavement Design 781	SGC 781	8 credits
Project: Transportation Engineering 898	SSC 898	16 credits
Public Transportation 780	SVV 780	8 credits
Road Rehabilitation Technology 786	SGC 786	8 credits
Stabilised Materials and Compaction 788	SGC 788	8 credits
Statistical Methods 789	SHC 789	8 credits
Traffic Engineering 787	SVC 787	8 credits
Traffic Safety 781	SVV 781	8 credits
Traffic Flow Theory 784	SVC 784	8 credits
Transportation Planning 781	SVC 781	8 credits
Transportation Special 788	SVC 788	8 credits
Transportation Studies 782	SVC 782	8 credits

Section Water Resources Engineering

Basic Applied Hydraulics 784	SHW 784	8 credits
Environmental Impact Studies 788	SHC 788	8 credits
Flood Hydrology 783	SHC 783	8 credits
Free Surface Flow 781	SHC 781	8 credits
Geohydrology 710	SGH 710	8 credits
Hydraulic Design 787	SHC 787	8 credits
Pipe Flow 782	SHC 782	8 credits
Project: Water Resources Engineering 899	SSC 899	16 credits
Rural Water Supply 780	SHC 780	8 credits

Special Aspects of Pump Systems 781	SHW 781	8 credits
Special Hydraulics 785	SHC 785	8 credits
Special Hydrology 786	SHC 786	8 credits
Water Resources Hydrology 784	SHC 784	8 credits

Section Geotechnical Engineering

Advanced Foundation Engineering 783	SGT 783	8 credits
Advances Geotechnical Design 780	SGS 780	8 credits
Advanced Geotechnical Laboratory Testing 783	SGS 783	8 credits
Basic Fundamental Hydraulics 782	SHW 782	8 credits
Basic Pump Flow 783	SHW 783	8 credits
Basic Soil Mechanics 782	SGM 782	8 credits
Basic Soil Technology 781	SGM 781	8 credits
Critical State Soil Mechanics 786	SGT 786	8 credits
Geotechnics and Foundation Engineering 780	SGT 780	8 credits
Geotechnics Special 780	SGC 780	8 credits
Geotechnical Engineering in Railroad Design 787	SGT 787	8 credits
In-situ Soils Testing & Monitoring 782	SGS 782	8 credits
Project: Geotechnical Engineering 895	SGT 895	16 credits
Slope Stability and Retaining Structures 781	SGS 781	8 credits

Section Urban Engineering

Community Involvement 785	SSI 785	8 credits
Community Health 786	SSI 786	8 credits
Community Involvement and Community Health 782	SSI 782	8 credits
Construction Special 787	SKB 787	8 credits
Financial Systems for Local Authorities 780	SSI 780	8 credits
Infrastructure Information Systems 781	SSI 781	8 credits
Institutional Framework for Local Authorities 784	SSI 784	8 credits
Maintenance Special 783	SSI 783	8 credits
Planning Techniques 789	SKB 789	8 credits
Project: Urban Engineering 895	SSI 895	16 credits
Town Planning 721	SBG 721	8 credits
Urban Engineering in the Community 787	SSI 787	8 credits
Urban Engineering Special 788	SSI 788	8 credits

Section Structural Engineering

Analysis of Plate Structures 784	SIN 784	8 credits
Basic Concrete Structures 781	SIC 781	8 credits
Basic Steel Design 783	SIC 783	8 credits
Basic Structural Analysis 782	SIC 782	8 credits
Commercial Buildings 786	SIC 786	12 credits
Concrete Structures I 787	SIC 787	12 credits
Concrete Structures II 788	SIC 788	12 credits
Concrete Technology 784	SGC 784	8 credits
Frame Analysis 782	SIN 782	8 credits
Prestressed Concrete Structures 781	SID 781	12 credits
Project: Structural Engineering 896	SSC 896	16 credits
Steel Structures II 789	SIC 789	12 credits
Steel Structural Design 784	SIC 784	12 credits
Structural Design Special 788	SIN 788	8 credits

Theory of Structures Special 789	SIN 789	8 credits
Timber Structures 782	SID 782	12 credits
Water-retaining Concrete Structures 789	SIB 789	8 credits

Postgraduate courses offered by the Department of Computer Science:

Computer Networks 780	RNW 780
Graphics 780	GRF 780
Office Systems 715	KAS 715
Programming Languages 780	PGT 780
Software Engineering 780	PIN 780

Postgraduate courses offered by the Department of Geography:

Engineering Geology 703	IGL 703
Engineering Geology 704	IGL 704

Postgraduate courses offered by the Department of Mathematics and Applied Mathematics:

First Semester

WTW 711	Algebra 711
WTW 785	Combinatorics 785
WTW 710	Functional Analysis 710
WTW 734	Measure Theory and Probability 734
WTW 733	Numerical Analysis 733

Second Semester

WTW 742	Financial Engineering 742
WTW 763	Finite Element Methods 763
WTW 745	Mathematical Logic 745
WTW 766	Partial Differential Equations 766
WTW 790	Topology 780

PRIZES AND MEDALS IN THE FACULTY

Name	Donor	Award
Faculty of Engineering		
Medal of the Engineering Council of SA	Engineering Council of South Africa	For the most outstanding achievement in the final year
AECI Book Prize	AECI	For a first year student in each of the following fields for the most outstanding achievement: (i) Industrial Engineering (ii) Chemical Engineering (iii) Electrical Engineering (iv) Electronic Engineering (v) Mechanical Engineering (vi) Metallurgical Engineering
GENMIN Prize Scheme Genmin cash prize for the best student in the mentioned field in South Africa. Evaluation criteria include: Academic and personal achievement, leadership qualities	GENMIN	R5 000 for the most outstanding student in South Africa in: (i) Mechanical, Electrical, Electronic and Civil Engineering (ii) Metallurgical and Chemical Engineering; BSc Chemistry (iii) Mining Engineering and Mine Surveying
G H Marais and Partners Award	G H Marais and Partners	For an outstanding third year student in either Electrical, Electronic or Mechanical Engineering (Medal plus R1 000)
Henk van der Merwe Floating Trophy	SRC	For the student who made the most active and versatile contributions to university and engineering student life overall: Academic, social and sport
Five Year Study Programme	**All departments**	
Prizes for the best academic achievement and the best progress	Firms and institutions which contribute to the Academic Development Programme in the Faculty	For the first year students registered for the course JPO who: (i) achieved the highest average mark in all the prescribed courses of the first year of study (ii) achieved the highest academic progress marks from the first test series to the final test series in the first year of study
Prize for leadership qualities and personality	Firms and institutions that contribute to the Academic Development Programme in the Faculty	For the first year student registered for the course JPO who showed leadership potential and was actively involved in promoting a positive image of the Five Year Programme

Name	Donor	Award
Departments of Chemical, Metallurgical and Mining Engineering		
University of Pretoria Golden Jubilee Merit Bursary	Chamber of Mines	Postgraduate bursary for the most outstanding student in either Chemical, Metallurgical or Mining Engineering for further study locally or abroad
Department of Industrial and Systems Engineering		
Medal of the South African Institute of Industrial Engineers	SA Institute for Industrial Engineers	For the best final year student in Industrial Engineering
LHA Prize	LHA Management Consultants	For the best final year project in Industrial Engineering (R500)
Cash prize of the National Productivity Institute	National Productivity Institute	For the undergraduate or postgraduate student who made an outstanding contribution to the increase of productivity with his or her project, dissertation or thesis (R250)
Xcel Prize	Xcel	For the student with the highest average mark in all the prescribed courses of the third year of study (R500)
Paradigm Prize	Paradigm Systems Technology	For the best second year student in Industrial Engineering (R500)
Sasol Prize	Sasol Ltd	For the most outstanding consistent academic achievement for the duration of the degree course (R1 500)
Department of Chemical Engineering		
Medal of the SA Institute for Chemical Engineering	SA Institute for Chemical Engineering	For the best final year student in Chemical Engineering
Department of Electrical, Electronic and Computer Engineering		
Gustav Heymann Gold Medal and Prize	Firms and institutions in the field of Electrical Engineering	For the best final year student in Electrical Engineering (R5 000 plus medal)
Gustav Heymann Silver Medal and Prize	Firms and institutions in the field of Electrical Engineering	For the second best final year student in Electrical Engineering (R3 000 plus medal)
Gustav Heymann Bronze Medal and Prize	Firms and institutions in the field of Electrical Engineering	For the third best final year student in Electrical Engineering (R2 000 plus medal)
Louis van Biljon Gold Medal and Prize	Firms and institutions in the field of Electronic Engineering	For the best final year student in Electronic Engineering (R5 000 plus medal)

Name	Donor	Award
Louis van Biljon Silver Medal and Prize	Firms and institutions in the field of Electronic Engineering	For the second best final year student in Electronic Engineering (R3 000 plus medal)
Louis van Biljon Bronze Medal and Prize	Firms and institutions in the field of Electronic Engineering	For the third best final year student in Electronic Engineering (R2 000 plus medal)
South African Institute of Measure and Control Prize	Schneider Automation	R750 and a gold medal for the best final year project in Measure and Control
SAMES Prize	South African Micro-electronic Systems	For the best report of satisfactory standard on the laboratory project of the final year in Electronic Engineering in the specialist field of Micro-electronics (R1 000)
Prize and Medal of the Society of Telkom Engineers	Society of Telkom Engineers	For the best final year student in the Telecommunication field (R400 plus medal)
ABB Powertech Prize	ABB Powertech (Pty) (Ltd)	For the best student in the course Electrical Machines in the third year of study in Electrical Engineering (R500) For the best design project in Electrical Engineering in the fourth year of study (R500)
Siemens Prize	Siemens (Pty)(Ltd)	For the best report of satisfactory standard on the laboratory project of the final year of study in Electronic/Electrical Engineering (alternate years) (R1 000)
SAIEE prize	South African Institute of Electrical Engineers	For the best third year student in Electrical/Electronic Engineering (R400)
Mintek Prize	Mintek	For the best final year student in the field of Measurement and Control (R1 000)
Department of Agricultural and Food Engineering		
Bronze Medal of the SA Institute of Agricultural Engineers	SA Institute of Agricultural Engineers	For the best achievement in the final year of study
EVN Prize	EVN Advisory Engineers	For the best final year student
MBB Merit Prize	Murry, Biesenbach and Badenhorst	For the best project in the final year
Rüsch and Van Biljon Prize	Pieter Rüsch and Gert van Biljon	For the final year project which shows the best economic potential

Name	Donor	Award
Department of Mechanical and Aeronautical Engineering		
C A du Toit Medal and Prize	C A du Toit and Partners	For the student with the highest weighted average mark in the courses: Project, Design and Refrigeration and Airconditioning in the final year of study (R250)
Sasol Merit Medal	Sasol Ltd	For the best second year student in Mechanical Engineering (R750)
Sasol Merit Medal	Sasol Ltd	For the best third year student in Mechanical Engineering (R1 000)
Sasol Merit Medal	Sasol Ltd	For the best final year student in Mechanical Engineering (R1 500)
Sasol Merit Medal	Sasol Ltd	For the best third year student in Design (R1 000)
Sasol Merit Medal	Sasol Ltd	For the best final year student in Design (R1 500)
Sasol Merit Medal	Sasol Ltd	For the best master's student in Mechanical Engineering (R2 000)
Department of Metallurgical Engineering		
Book Prize Grant of the SA Institute of Mining and Metallurgy	SA Institute of Mining and Metallurgy	For the best achievement in a specific field or study in the final year (R250)
Prestige Award of the SA Institute of Mining and Metallurgy	SA Institute of Mining and Metallurgy	For distinguished achievement in the third or fourth year of study (R500)
Iscor Prize	Iscor	For the best achievement in the third year of study (R1 000)
Iscor Prize	Iscor	For the best achievement in the second year of study (R800)
Vecor Prize	VECOR	For the first year student who submitted the most outstanding report for the first year project (R350)
Department of Mining Engineering		
Book Prize Grant of the SA Institute of Mining and Metallurgy	SA Institute of Mining and Metallurgy	For the best achievement in the final year of Mining Engineering
Medal and Prize of the UP Mining Alumni Society	UP Mining Alumni Society	Medal plus R600 for the best achievement in Mine Design 420
Mine Ventilation Society of South Africa Prize	Mine Ventilation Society of SA	For the best achievement in Mine Climatic Control 420 (R400)
Prestige Award of the SA Institute of Mining and Metallurgy	SA Institute of Mining and Metallurgy	For the best achievement in the fourth year of study (R500)
SANGORM Prize for Rock Mechanics	The SA National Group on Rock Mechanics	For outstanding achievement in Strata Control 410 (R500)
Mine Managers' Association of SA Prize	Mine Managers' Association of SA	For the best achievement in the second year of study (R500)

Name	Donor	Award
Department of Civil Engineering Fourth Year Prizes		
D W de Vos Gold Medal	BKS Incorporated	For the best student in the fourth year of study (R2 000)
D W de Vos Silver Medal	BKS Incorporated	For the second best student in the fourth year of study (R1 000)
D W de Vos Bronze Medal	BKS Incorporated	For the third best student in the fourth year of study (R500)
Awards for the best investigation or design in Civil Engineering Design Project 421 in:		
A C Pipes Medal	A C Pipes	Water Resources (R400)
Joint Structural Division of SAICE and ISE Prize	The Joint Structural Division of SAISI and IStructE	Structural Analysis (R800)
Cement & Concrete Institute Prize	Cement & Concrete Institute	Prestressed Concrete (R500)
Prize of the SA Lumber Millers Association	SA Lumber Millers Association	Structural Timber (Book Prize)
SA Institute for Steel Construction Prize	SA Institute for Steel Construction	Structural Steel (R300)
Stanway Edwards Prize	Stanway Edwards Consulting Engineers	Transportation (R500)
Africon Engineering International (Pty) Ltd Prize	Africon Engineering International (Pty) Ltd	Geotechnics (R750)
Third Year Prizes - Awards for the best third year students in		
A C Pipes Prize	A C Pipes	Hydraulics 310 and 320 (R500)
G P R von Willich Prize	BKS Incorporated	Third year of study (R1 000)
Hans Merensky Prize	Hans Merensky Foundation	Structural Engineering 312 (R500)
LTA Prize	LTA	Geotechnics (Soil Mechanics 322 and 411) (R500)
Prize of the Training Council	SA Federation of Constructors for Civil Engineering	Civil Engineering Practice 323 (R1 000)
Venter and Grobler Prize	Venter en Grobler Consulting Engineers	Transportation Engineering 312 and 322 (R500)
Vibro Bricks Prize	Vibro Bricks (Pty) Ltd	Structural Engineering 312 and 322 (R1 000)
Second Year Prizes		
G P R von Willich Prize	BKS Incorporated	For the best student in the second year of study (R600)
Raubex Prize	Raubex Construction (Pty) Ltd	Civil Engineering Practice 213 and 223 (R1 000)

Name	Donor	Award
First Year Prize		
Departmental Prize	D W de Vos Training Fund	For the best first year student (R500)
Other		
HAUM Medals	HAUM Book Shops	6 Medals for service to the student community
* SRC Medal of Honour	Students Representative Council	To the student who has contributed most to student community life

* Not limited at the Faculty of Engineering.