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ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

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FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

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Faculty Manager

Vacant

Faculty Administration

Jones, E.	Head

GENERAL INFORMATION

The information regarding degree programmes here published are subject to change and may be amended prior to the commencement of the academic year in 2003.

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 modules closes on 30 September.

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

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

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 module and any further level of that module is presented.

In respect of administrative and other services, a student has the right to choose whether the University should communicate with him or her in Afrikaans or English.

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

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

Welcoming day and academic information week
Details of the parents' day to which all parents are cordially invited, and the subsequent Information Week during which all new first-year students **must** be present, are obtainable from the Dean of Students, University of Pretoria, 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 tuition fees without prior notification.

NEW SYSTEM OF TUITION

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

GLOSSARY OF TERMS

academic year: The duration of the academic year which is determined by the University Council.
admission regulation: A regulation compiled by the Dean concerning the admission of students to a specific School, which includes a provision regarding the selection process.
course: see module.
credit (or **credit value**): A value unit linked to learning activities, calculated in accordance with the SAQA norm of **1 credit = 10 notional hours (learning hours)**. Credits are linked to modules and qualifications. In the School of Engineering modules normally carry credit values of 8 or 16 each, and typically a total of 640 credits is required for the Bachelor of Engineering degree.
curriculum: A series of modules which form a programme, grouped together over a specified period of time and in a certain sequence according to the regulations.
ECSA: Engineering Council of South Africa. This is a statutory council which is *inter alia* responsible for the registration of professional engineers and for the accreditation of the academic programmes for engineers at South African universities.
examination mark: The mark a student obtains for an examination in a module, including practical examinations where applicable.
extended 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 obtains in a particular module according to a formula which is determined from time to time in the regulations for each module with the proviso that should no semester/year mark be required in a module, the examination mark serves as the final mark.
GS: A combined (final) mark (semester/year mark and examination mark) of 40 - 49%.
learning outcome: The end product of a specified learning process, i.e. the learning result (specific skills) that one intends to achieve at the end of the learning process.
level of a module: The academic level (year) of a module which is indicated in the module code, which gives an indication of the complexity of the module.
module: An independent, defined learning unit, designed to result in a specific set of learning outcomes, and which is a component of a programme.
module code: Consists of an equal number of letters and digits, which indicate the name of the module, the year of study, the period of study and the level of the module.

notional hours (learning hours): The estimated number of hours students should spend to master the learning content of a particular module or programme. The total number of learning hours for a module consists of the time needed for lectures, tutorials and practicals (contact hours), as well as for self-study, examination preparation and any other activity required by the study programme. (**notional hours = credits x10)**
NQF: National Qualifications Framework. This is a national framework in which all SAQA-registered qualifications are listed, arranged on eight levels in accordance with the complexity of the qualification.
programme: This is a comprehensively planned, structured and coherent set of teaching and learning units (modules), designed to satisfy a specific set of outcomes at exit-level, which culminates in a student being awarded a particular qualification (diploma, degree).
promotion: Promotion means that for certain modules a student may be exempted from the final examination, provided that a student's semester or year mark for the module exceeds a certain predetermined minimum percentage (e.g. 75%).
qualification: In outcomes-based education, a qualification is a diploma or a degree which is obtained after attaining the learning outcomes as specified in a coherent learning programme, expressed as an accumulation of credits at specific levels.
SAQA: South African Qualifications Authority. This body has been established by law and has as its purpose the registration of qualifications, programmes and unit standards, in order to ensure that specific national and international criteria are achieved.
semester/year mark: The mark a student obtains during the course of a semester or a year for tests, class-work, practical work or any other work in a particular module as approved by regulation.
student-centred learning: Teaching and learning methodology which facilitates the students' own responsibility for the learning process. A prerequisite is that lectures, tutorials and practicals be adapted so that active participation by students is always achieved.
syllabus: Summary of the contents of a module.
weighted average: The weighted average is composed of the marks of the various modules, weighted with the credits of each module as a fraction of the total number of credits for the semester or year.

DEGREES CONFERRED IN THE SCHOOL OF ENGINEERING

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

(a) **Bachelor's degree:**
  (i) Bachelor of Engineering – BEng (four years)
(b) **Honours degrees:** (one year)
  (i) Bachelor of Engineering (Honours) – BEng(Hons)
  (ii) Bachelor of Science (Honours) – BSc(Hons)
(c) **Master's degrees:** (one year)
  (i) Master of Engineering – MEng
  (ii) Master of Science – MSc
(d) **Doctorates:** (one year)
  (i) Doctor of Philosophy – PhD
  (ii) Doctor of Philosophy in Engineering – PhD(Eng)
  (iii) Doctor of Engineering – DEng

REGULATIONS FOR THE BACHELOR'S DEGREE OF ENGINEERING (BEng)

Eng. 1
Admission to study
General Regulations G.1 to G.15 are applicable to all bachelor's degrees. Where the General Rules have vested authority in the Faculty to determine its own provisions, these provisions appear in this publication.
General
To register for a first bachelor's degree at the University, a candidate must, in addition to the required Grade 12 exemption certificate, comply with the specific admission requirements for particular programmes and fields of study as prescribed in the admission regulations and the regulations of the departments.

(a) The following persons may also be considered for admission:
  (i) A candidate who is in possession of a certificate which is deemed by the University to be equivalent to the required Grade 12 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 and prior knowledge. Candidates are advised to contact the specific faculty administration in this regard.

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

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

Language Proficiency
It is expected of all new undergraduate students who wish to study at the University to do a language proficiency test. Certain modules as indicated in Eng. 15.1 and 15.2 are included in the undergraduate curriculum, which address shortcomings in this respect. In addition, modules which have the purpose of developing specific language and communication skills in the context of the requirements of the engineering profession are also included in the curriculum.
Computer and Information Literacy
The first year engineering programme includes Information Technology modules which are compulsory for all students. Students who are of the opinion that they already have these skills, may undertake an exemption test.
Specific requirements
To be admitted to any undergraduate field of study in the School of Engineering, a candidate must obtain at least 60% in Mathematics and Physical Science at 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 to the five-year study programme (see Eng. 5) 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 at Higher Grade.
- An A, B or C symbol for Mathematics and a D symbol for Physical Science, both at Higher Grade.
- An A, B or C symbol for Physical Science and a D symbol for Mathematics, both at 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

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

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

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

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

Eng. 3
Examinations

(a) **Examinations, projects and essays**

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

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

(b) **Examination admission**

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

(c) **Pass requirements**

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

(i) In order to pass a module a student must obtain an examination mark of at least 40% and a final mark of at least 50%. A student passes a module with distinction if a final mark of at least 75% is obtained. The final mark is compiled from the semester/year mark and the examination mark.

(ii) Calculation of the final mark: The semester/year mark must account for no less than 40% and no more than 60% of the final mark, with the exception of modules like design and research projects and essays, as well as in modules where the development of general skills is the primary learning activity, where appropriate alternative norms are determined by individual schools or departments. The specific details and/or formula for the calculation of the final mark are given in the study guide of each module. Also, a schedule listing this information for all the modules presented in each school will be compiled, for approval by the Dean.

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

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

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

(vi) A student may be promoted (exempted from the examination) in certain modules should a specified semester/year mark (minimum 65%) be obtained. For such modules these specific requirements are given in the study guide of the module. Also, a schedule listing this information for all such modules presented in each school will be compiled, for approval by the Dean. Refer also to General Regulation G.10.3.

(d) **Ancillary examinations**

Refer to General Regulation G.12.3

(e) **Supplementary examinations**

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

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

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

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

All other regulations related to supplementary examinations, as given in the General Regulations G.12 (4.2 to 4.5) are also applicable.

(f) **Special examinations (including the aegrotat)**
Refer to General Regulation G.12.5

(g) **Special examinations**
Refer also to General Regulation G.12.6

(i) The Dean may grant a special examination to a student who was registered for the complete first-year programme, and who has failed only one module by the end of the first year, on condition that the student has gained examination admission in the module.

(ii) The Dean may grant a special examination in a module to second and third year students who were registered for the complete programme of the specific year of study, and who have not failed any other module during the preceding years of study, on condition that the module is the only outstanding module by the end of the the specific year of study, and on condition that the student has gained examination admission in the module.

(iii) The Dean may grant a special examination in a module to a student who failed that module in the final year of study, and consequently does not comply with degree requirements. A student may be granted at most two such special examinations on condition that the student has gained examination admission in the module(s).

(iv) To be considered for such special examination(s) ((i) to (iii) above), it is required that the student applies in writing with the Dean before 10 January. The head of the department may prescribe work which must be completed satisfactorily before the special examination is granted.

(v) All special examinations must be concluded before the end of January.

(vi) The pass mark for a special examination is 50% and a higher mark will not be awarded. The semester/year mark is not included in the calculation of the final mark.

(h) **Re-marking of examination scripts**
Refer to General Regulation G.14

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. Provisions regarding promotion, including provisions for first-year students, appear in the regulations of the relevant years of study.

Eng. 5
Five-year study programme

(a) The five-year programme is followed by students whose school achievements have been influenced negatively by disadvantages in the school system, 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. Therefore, candidates who obtain a D symbol for one or both Physical Science and Mathematics at the Higher Grade in the Grade 12 examination, or candidates having an M-score lower than 18 but

higher than 12, are required to write an admissions test. Admission to the extended study programme will then be decided by the Admissions Committee on grounds of the results of the test. Students who have previously studied at a tertiary institution will not be considered for the extended study programme.

(c) Attendance at tutor sessions for students on the extended study programme is compulsory. In addition, the modules Professional Orientation (JPO) 110 and 120 are presented for students with the biggest school handicap and address the development of mathematical, communication and technological skills.

(d) 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 modules at the end of the first semester, will not be permitted to continue with his/her studies at the end of the first semester.

(e) 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 study programme.

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

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

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

Eng. 9
First-aid Certificate
Each student must, before the degree is awarded, obtain a First-aid Certificate which is to be submitted to the Faculty Administration, with the exception of students in Mining, Computer, Electrical and Electronic Engineering.

Eng. 10
Exposure to the practice of engineering
Engineering students are exposed in three ways to the practice of engineering during the course of their studies:

(a) Workshop Practice – a module at the end of the first year of study during which students are trained in workshop practice. Students in electrical and electronic engineering attend the measurement techniques and computer modelling module. Students in computer engineering attend the measurement techniques and computer modelling module and the information technology practice module.

(b) Practical Training – specific periods of work at firms during which experience is gained in the practice of engineering. Students may deviate from this stipulation only with the permission of the Dean.

(c) Excursions – study excursions arranged for students to visit various engineering firms and installations in order to obtain insight into the industry.

This training is compulsory. Details of the modules regarding these aspects of training are explained in the sections of this publication which deal with the curricula and syllabi of the various programmes.

Eng. 11
Registration of modules

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

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

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

Eng. 12
Degree classification

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

(b) ***First class pass**
A student obtains a first class pass if no modules of the fourth year were repeated and a weighted average of at least 60% was obtained in all the modules of the fourth year.

(c) ***Second class pass**
A student obtains a second class pass if no modules of the fourth year were repeated.

(d) ***Third class pass**
A student obtains a third class pass if some modules of the fourth year of study had to be repeated.

(e) **Exceptions**
Exceptional 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 *First Class Pass* are indicated on the degree certificate. Degree classifications are also indicated on the candidate's academic record on request.

CURRICULA FOR THE BEng PROGRAMMES

Eng. 13
Fields of study, learning outcomes and learning contents (syllabi)
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.

All abovementioned fields of study of the BEng degree (except Computer Engineering) have been accredited by the **Engineering Council of South Africa** (ECSA), and comply with the academic requirements for registration as a professional engineer. The programme in Computer Engineering is presently registered with ECSA, but as this is a new field of study, final accreditation can only be obtained after graduation of the first group of finalists in 2002. All the undergraduate programmes were recently restructured and revised and the new programmes have been phased in from 2001. The new programmes are designed in accordance with the outcomes-based model as required by the **South African Qualifications Authority** (SAQA). The learning outcomes and contents of the programmes have been compiled in accordance with the latest accreditation standards (PE-60 and PE-61) of ECSA, which also comply with the SAQA requirements, which are summarised as follows:

Learning outcomes of the BEng degree:
A graduate in engineering should be able to apply the following skills on an advanced level:
(a) An ability for engineering problem solving.
(b) Application of specialist and fundamental knowledge, with specific reference to mathematics, basic sciences and engineering sciences.
(c) An ability for engineering design and synthesis.
(d) An ability for investigation, experimentation and data analysis.
(e) Competence with engineering methods, skills, tools and information technology.
(f) Professional and general communication.
(g) Awareness and knowledge of the impact of engineering activity on society and the physical environment.
(h) An ability to work in teams and in multidisciplinary environments.
(i) An awareness and ability for lifelong learning.
(j) An awareness and knowledge of principles of professional ethics and practice.

Learning contents of the BEng programmes:
Six essential knowledge areas are included in the syllabi of the programmes. The **typical** representation of each knowledge area as a percentage of the total contents of an undergraduate programme is given in brackets ( ) in the list below. This percentage varies for the different study directions, but conforms in all instances to the minimum knowledge area content as stipulated by ECSA.
Knowledge areas:
(a) Mathematics, including numerical methods and statistics. (13%)
(b) Basic sciences: the natural sciences essential to the programme. (15%)
(c) Engineering sciences. (40%)
(d) Engineering design and synthesis. (16%)
(e) Computing and information technology. (5%)
(f) Complementary studies: communication, economy, management, innovation, environmental impact, ethics, engineering practice. (11%)

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

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

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

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

(a) **XYZ 163** : Module code
XYZ : A letter code of which the first letter identifies the department/division in the School of Engineering which offers the relevant module(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 (now part of Civil and Biosystems Engineering)
M	Mechanical and Aeronautical Engineering
N	Materials Science and Metallurgical Engineering
P	Mining Engineering
S	Civil Engineering (now part of Civil and Biosystems Engineering)

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

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

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

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

		Minimum requirement
()	Code in brackets: (XYZ 151)	Examination admission
GS	Code followed by GS: XYZ 151 GS	Average of 40% - 49%
†	Code followed by †: XYZ 151†	Concurrent registration

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

Eng. 15
Curricula

Eng. 15.1 Four-year Programmes

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

(a) Agricultural Engineering

Third year of study
First semester

Module		**Credits**	**Prerequisites**
AGR 313	Primary Food Crops 313	11	
SIN 213	Introduction to Structural Design 213	8	WTW 158, 161 GS, 168 GS, SWK 122 GS
BES 210	Engineering Statistics 210	8	
LPR 310	Processing 310	17	MTX 220
SHC 310	Hydraulics 310	16	
LEK 210	Agricultural Economics 210	11	
GKD 215	Soil Science 215	11	(CMY 152,153)
LSQ 313	Communication 313	2	
	Total	84	

Second semester

IPB 320	Project Management 320	8	
SIN 323	Steel Design 323	8	(SWK 210)

SIN 324	Reinforced Concrete Design 324	8	(SWK 210)
SUR 220	Surveying 220	16	
GMA 220	Remote Sensing 220	11	
LSC 320	Project Preparation 320	2	
LBC 320	Industrial Principles 320	11	
PGW 422	Irrigation 422	17	
	Total	81	
Recess training			
LPY 314	Practical Training 314	16	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
LSC 402	Project 402	8	LSC 320
LLS 410	Agricultural Structures 410	15	
LHL 411	Hydraulics 411	15	
LPR 410	Processing 410	17	(LPR 320)
LGD 410	Soil Dynamics 410	11	
LPW 411	Agricultural Production Equipment 411	13	
	Total	79	
Second semester			
LBP 420	Irrigation 420	15	(SHC 310); (LHL 411); (PGW 422)
LSC 402	Project 402	22	LSC 320
LLI 420	Rural Engineering 420	9	
LOX 421	Design 421	13	
LGH 420	Soil Conservation and Hydrology 420	15	
	Total	74	
Recess training			
LPY 414	Practical Training 414	16	

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

(b) Chemical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
CIL 110	Information Technology 110	8	
CNV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS

SWK 122	Mechanics 122	16	
CHM 181	General Chemistry 181	16	CHM 171 GS
CIR 122	Chemical Engineering 122	16	
	Total	80	
Recess training			
CWP 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module CNV 110 (Innovation 110).

Second year of study

First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
CHM 215	Chemistry 215	16	CHM 171,181
MSD 210	Dynamics 210	16	FSK 116, SWK 122
SWK 213	Strength of Materials 213	8	SWK 122, WTW 168†
CIR 213	Chemical Engineering 213	16	CIR 122
CRV 210	Computer Literacy 210	8	CIL 110†
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
CHM 226	Chemistry 226	8	CHM 171,181
EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
NMC 122	Materials Science 122	16	
CTD 222	Thermodynamics 222	8	CIR 212/213
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	
Recess training			
CPY 211	Practical Training 211	2	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
COP 311	Transfer Processes 311	16	
CTD 311	Thermodynamics 311	16	CTD 222
CIC 311	Industrial Chemistry 311	8	(CHM 214)
CPS 311	Piping Systems Design 311	8	CRV 210

WTW 338	Mathematics 338	16	WTW 258,256 WTW 228 GS; 263 GS
BES 210	Engineering Statistics 210	8	
CSQ 311	Communication 311	8	CPY 311†
	Total	80	

Second semester

CPD 320	Process Dynamics 320	8	CRV 210, (CIR 213)
CKN 320	Kinetics 320	8	(CIR 213), (CTD 222)
CHO 321	Heat Transfer 321	8	(COP 311)
CLB 321	Laboratory 321	8	(CPS 311), CMO320†, CHO 321†
CMO 320	Mass Transfer 320	16	(CIR 213)
CBI 320	Biochemical Engineering 320	8	
COI 321	Environmental Engineering 321	16	
IOB 320	Development Management 320	8	
	Total	80	

Recess training

CPY 311	Practical Training 311	16	CSQ 221

Fourth year of study

First semester

Module		**Credits**	**Prerequisites**
CIR 412	Chemical Engineering 412	15	(COP 310)
CMK 410	Materials Science 410	15	
CPB 410	Process Control 410	17	CPD 320
CRO 410	Reactor Design 410	17	CKN 320
CSC 410	Project 410	15	CLB 320, CPB 410†, CRO 410†
	Total	79	

Second semester

COI 420	Environmental Engineering 420	17	
COX 420	Design 420	9	(CPB 410), (CRO 410)
CPJ 420	Design Project 420	26	(CPB 410), (CRO 410); COX 420†, CPR 420†
CPR 420	Practice 420	15	
CSC 420	Project 420	9	CSC 410
CSQ 421	Communication 421	4	CSQ 311, CPY 411†
	Total	80	

Recess training

CPY 411	Practical Training 411	16	CSQ 311; CPY 311

(c) Civil Engineering

First year of study
First semester

Module		Credits	Prerequisites
SMK 110	Graphics 110	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
CIL 110	Information Technology 110	8	
SNV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
SUR 220	Surveying 220	16	
SSC 120	Civil Engineering Design 120	16	
	Total	80	
Recess training			
SWP 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module SNV 110 (Innovation 110).

Second year of study
First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
SIN 213	Introduction to Structural Design 213	8	WTW 158, 161 GS, 168 GS, SWK 122 GS
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
SGM 210	Geomaterials and Processes 210	16	
TRP 311	Town and Regional Planning 311	8	
BIE 310	Engineering Economics 310	8	
BES 210	Engineering Statistics 210	8	
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168

SIN 223	Structural Analysis 223	16	WTW 161,168, SWK 122, SIN 213 GS
SGM 221	Pavement Materials & Design 220 **or**	16	SGM 210 GS
***** MTX 220	Thermodynamics 220	16	FSK 116
SHC 220	Water Treatment 220	8	
SBZ 221	Civil Engineering Measurement Techniques 221	8	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	

***** Only for students taking the agricultural option.

Third year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 338	Mathematics 338 **or**	16	WTW 258; 256 WTW 228 GS WTW 263 GS
***** SSI 310	Development and Society 310 **and**	8	
***** GIS 310	Geographic Information Systems 310	8	
SHC 310	Hydraulics 310	16	(SHC 220)
SIB 310	Timber Design 310	8	(SIN 223)
SIN 311	Structural Analysis 311	8	(SIN 223)
SVC 310	Transportation Engineering 310	8	
SBZ 310	Civil Construction Economics 310	8	(SIE 213)
SGM 312	Soil Mechanics 312	16	
	Total	80	

***** Only for students taking the environmental option.

Second semester

SHC 320	Hydraulics 320	8	(SHC 310)
SGM 323	Geotechnical Engineering 323	16	(SGM 312)
SIN 323	Steel Design 323	8	(SIN 311)
SIN 324	Reinforced Concrete Design 324	8	(SIN 311)
SVC 324	Highway Design 324	8	
SIB 320	Construction Management & Equipment 320	8	
SBM 321	Civil Building Materials 321	16	
IPB 320	Project Management 320	8	
	Total	80	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
SHC 410	Hydraulics 410	17	SHC 310,320
SSC 410	Civil Engineering Project 410	16	All relevant Third-year modules except WIS 338
SIN 412	Structural Engineering 412	17	SIN 312; SIN 322 GS
SGM 411	Soil Mechanics 411	17	SGM 322 GS

SSQ 411	Communication 411	7	Third year practical tr.
	Total	74	
Second semester			
SON 421	Civil Engineering Design Project 421	80	All preceding modules
	Total	80	

Note
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 in the same semester.

(d) Computer Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
EGA 110	Engineering Graphics 110	8	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
EPE 111	Introduction to Programming 111	16	
EIT 111	Information Technology 111	16	
ENV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
MEG 123	Introductory Mechanics 123	16	
EPE 121	Introduction to Programme Design 121	16	EPE 111
EBN 121	Circuits 121	16	
	Total	80	
Recess training			
EMR 100	Measurement Techniques and Computer Modelling 100	2	
EIW 121	Information Technology Practice 121	4	

Note
Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module ENV 110 (Innovation 110).

Second year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
ERB 210	Operating Systems 210	16	COS 110 or EPE 121

EBN 210	Circuits 210	16	EBN 120, WTW 161
EPE 210	Data Structures and Algorithms 210	16	COS 110 or EPE 121
BIS 210	Engineering Statistics 210	16	
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
ELK 220	Electronic Components 220	16	EBN 121 GS
ELI 220	Linear Systems 220	16	EBN 210 WTW 258,256
ERS 220	Digital Systems 220	16	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	
Recess training			
EIW 221	Information Technology Practice 221	8	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 342	Stochastic Processes 342	16	WTW 258; 256 WTW 228 GS
EMS 311	Digital Modulation Systems 311	16	ELI 220 GS
EMK 310	Microprocessors 310	16	ERS 220 GS
ERN 310	Computer Networks 310	16	COS 222 or ERB 210, EPE 210 or COS 212
EAI 310	Intelligent Systems 310	16	
	Total	80	
Second semester			
EOV 321	Design and Manufacturing 321	16	EMK 310
ESF 320	Digital Communication Systems 320	16	EMS 311 GS
EPE 321	Software Engineering 321	16	ERN 310
EOK 320	Optical Communication Networks 320	16	
EBB 320	Control Systems 320	16	ELI 220 GS
	Total	80	
Recess training			
EIW 320	Information Technology Practice 320	8	EIW 221

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
EPR 402	Project 402	8	Final year EOV 321
EPP 410	Professional Practice 410	16	EOV 321 GS
ESP 411	DSP Programming and Practice 411	16	ESF 320 GS
EAS 410	Computer Engineering: Architecture and Systems 410	16	EMK 310 GS
EHN 410	e-Business and Network Security 410	16	ERN 310 GS

EAI 410	Intelligent Systems 410	16	EPE 320 GS EBB 320 GS
EXF 400	Forum 400	2	
	Total	90	
Second semester			
EPR 402	Project 402	64	Final year EOV 321
EES 420	Specialisation 420	16	
EXF 400	Forum 400	2	
	Total	82	
Recess training			
EPY 421	Practical Training 421	12	

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

(e) Electrical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
EGA 110	Engineering Graphics 110	8	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
EIT 111	Information Technology 111	16	
ENV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
NMC 122	Materials Science 122	16	
EBN 121	Circuits 121	16	
	Total	80	
Recess training			
EMR 100	Measurement Techniques and Computer Modelling 100	2	

Note
Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module ENV 110 (Innovation 110).

Second year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168

MSD 210	Dynamics 210	16	SWK 122, FSK 116
EBN 210	Circuits 210	16	EBN 120, WTW 161
EPE 111	Introduction to Programming 111	16	
BIS 210	Engineering Statistics 210	16	
	Total	80	

Second semester

WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
ELK 220	Electronic Components 220	16	EBN 121 GS
ELI 220	Linear Systems 220	16	EBN 210 WTW 258,256
ERS 220	Digital Systems 220	16	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
WTW 338	Mathematics 338	16	WTW 258,256 WTW 228 GS; 263 GS
EMZ 310	Electromagnetism 310	16	WTW 228
ENE 310	Analogue Electronics 310	16	ELK 220 GS, ESL 220 GS **or** ELI 220 GS
EMK 310	Microprocessors 310	16	ERS 220 GS
ELX 310	Electrical Machines 310	16	EBN 210
	Total	80	

Second semester

MSK 321	Theory of Machines and Strength of Materials 321	16	
EKR 320	Power Systems 320	16	ELX 310
EBB 320	Control Systems 320	16	ELI 220 GS
EDF 320	Power Electronics 320	16	EBN 210
EOV 320	Design and Manufacturing 320	16	ENE 310
	Total	80	

Fourth year of study

First semester

Module		**Credits**	**Prerequisites**
EPR 400	Project 400	8	Final year EOV 320
EPP 410	Professional Practice 410	16	EOV 320 GS
EKR 410	Power Systems 410	16	EKR 320 GS EAD 310 GS
MVK 410	Fluid Mechanics and Thermodynamics 410	16	
EBT 410	Automation 410	16	EBB 310 GS
EEO 410	Electrical Design 410	16	EAD 310 GS

EXF 400	Forum 400	2	
	Total	90	
Second semester			
EPR 400	Project 400	64	Final year EOV 320
EES 420	Specialisation 420	16	
EXF 400	Forum 400	2	
	Total	82	
Recess training			
EPY 422	Practical Training 422	12	

Note

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

(f) Electronic Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
EGA 110	Engineering Graphics 110	8	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
EIT 111	Information Technology 111	16	
ENV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
NMC 122	Materials Science 122	16	
EBN 121	Circuits 121	16	
	Total	80	
Recess training			
EMR 100	Measurement Techniques and Computer Modelling 100	2	

Note

Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module ENV 110 (Innovation 110).

Second year of s tudy
First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	SWK 122, FSK 116
EBN 210	Circuits 210	16	EBN 120, WTW 161

EPE 111	Introduction to Programming 111	16	
BIS 210	Engineering Statistics 210	16	
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
ELK 220	Electronic Components 220	16	EBN 121 GS
ELI 220	Linear Systems 220	16	EBN 210 WTW 258,256
ERS 220	Digital Systems 220	16	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 342	Stochastic Processes 342	16	WTW 258; 256 WTW 228 GS
EMZ 310	Electromagnetism 310	16	WTW 228
ENE 310	Analogue Electronics 310	16	ELK 220 GS, ESL 220 GS **or** ELI 220 GS
EMK 310	Microprocessors 310	16	ERS 220 GS
EMS 310	Modulation Systems 310	16	ELI 220
	Total	80	
Second semester			
EOK 320	Optical Communication Networks 320	16	
EMZ 320	Electromagnetism 320	16	EMZ 310
EBB 320	Control Systems 320	16	ELI 220 GS
ESC 320	Stochastic Communication Systems 320	16	EMS 310 WTW 342
EOV 320	Design and Manufacturing 320	16	ENE 310
	Total	80	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
EPR 400	Project 400	8	Final year EOV 320
EPP 410	Professional Practice 410	16	EOV 320 GS
EBT 410	Automation 410	16	EBB 310 GS
EFC 410	Optical Communication Networks 410	16	
ETK 410	Telecommunication Systems 410	16	ETK 321 GS **or** ETK 320 GS
ECB 410	Cybernetics 410	16	
EXF 400	Forum 400	2	
	Total	90	
Second semester			
EPR 400	Project 400	64	Final year EOV 320
EXF 400	Forum 400	2	

EES 420	Specialisation 420	16
	Total	82

Recess training

EPY 422	Practical Training 422	12

Note

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

(g) Industrial Engineering

First year of study

First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
CIL 110	Information Technology 110	8	
BNV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
NMC 122	Materials Science 122	16	
MOW 122	Machine Design 122	16	MIT 113 GS
	Total	80	
Recess training			
BWP 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module BNV 110 (Innovation 110).

Second year of study

First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
MSD 210	Dynamics 210	16	SWK 122, FSK 116
BPZ 210	Productivity 210	16	
MOW 216	Machine Design 216	8	MOW 121, SWK 122

MPR 210	Programming 210	16	CIL 110
BES 210	Engineering Statistics 210	8	
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
BVS 221	Manufacturing Systems 221	16	
EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
BAN 222	Industrial Analysis 222	8	
IPB 320	Project Management 320	8	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	
Recess training			
BPY 210	Practical Training 210	2	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
BER 310	Business Law 310	8	
BVS 310	Manufacturing Systems 310	16	(BVS 221)
BOB 310	Operational Management 310	16	
BOZ 311	Operations Research 311	16	(BAN 222)
BFB 310	Facilities Planning 310	8	
FBS 110	Financial Management 110	10	
BIE 310	Engineering Economics 310	8	
	Total	82	
Second semester			
BLK 320	Industrial Logistics 320	16	(BOB 310)
BRV 320	Computer-aided Manufacturing 320	8	(BVS 310)
BID 320	Information Systems Design 320	16	
BOZ 321	Operations Research 321	16	(BOZ 311)
BUY 321	Simulation Modelling 321	16	(BAN 222)
FBS 120	Financial Management 120	10	
	Total	82	
Recess training			
BPY 310	Practical Training 310	16	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
BVS 410	Manufacturing Systems 410	15	(BVS 320)
BPZ 410	Production 410	15	
BON 410	Operational Research 410	13	(BOZ 320)
BGC 410	Quality Assurance 410	13	
BSR 850	Management Accounting 850	11	(FRK 151, 152)
BPJ 410	Project 410	7	(Only fourth-year students)
BER 410	Business Law 410	15	
	Total	89	

Second semester			
BPJ 420	Project 420	35	(BPJ 410)
BPZ 420	Production 420	15	(BPZ 320, 410) (Only fourth-year students)
ABV 320	Labour Relations 320	11	BER 410
BSR 860	Management Accounting 860	11	
BSQ 420	Communication 420	2	
	Total	74	
Recess training			
BPY 410	Practical Training 410	16	

(h) Mechanical Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
CIL 110	Information Technology 110	8	
MNV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
NMC 122	Materials Science 122	16	
MOW 122	Machine Design 122	16	MIT 113 GS
	Total	80	
Recess training			
WPM 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module MNV 110 (Innovation 110).

Second year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168

MSD 210	Dynamics 210	16	FSK 116, SWK 122
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
MOW 212	Machine Design 212	8	MOW 122, SWK 210†
MPR 210	Programming 210	16	CIL 110
NMC 211	Materials Science 211	8	(NMC 122)
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
EBN 121	Circuits 121	16	
MOW 222	Machine Design 222	8	MOW 212, MSK 222†
MSK 222	Theory of Machines 222	8	FSK 116
MTX 220	Thermodynamics 220	16	FSK 116
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	
Recess training			
MPY 215	Practical Training 215	2	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 338	Mathematics 338	16	WTW 258, 256 WTW 228 GS, 263 GS
MOW 312	Machine Design 312	16	MOW 222, MSK 222, (SWK 210)
MSY 310	Structural Mechanics 310	16	SWK 210, WTW 263
MSX 310	Fluid Mechanics 310	16	WTW 258†, 256†
BES 210	Engineering Statistics 210	8	
BIE 310	Engineering Economics 310	8	
	Total	80	
Second semester			
MOW 323	Machine Design 323	16	(MOW 312)
MVR 320	Vibrations and Noise 320	16	(MSD 210)
MTX 321	Thermodynamics 321	16	MTX 220
ETN 322	Electrotechnics 322	16	EBN 120
IOB 320	Development Management 320	8	
COM 420	Environmental Management 420	8	
	Total	80	
Recess training			
MPY 315	Practical Training 315	16	

Fourth year of study
First semester

Module		Credits	Prerequisites
MSY 410	Structural Mechanics 410	13	MSY 310
MWX 410	Heat Transfer 410	13	MSX 310 GS, MTX 310 GS
MVM 410	Fluid Machines 410	13	MSX 310
MBB 410	Control Systems 410	15	WTW 256 MVR 320 GS
MSQ 413	Communication 413	2	
Option – Mechanical			
MOX 410	Design 410	13	MOW 312, 322
MSC 400	Project 400	8	3 of (MSZ 210), (MTX 310), (MSX 310), (MTC 320)
or Option – Aeronautical			
MSC 401	Aeronautical Project 401	8	(MSX 310), (MTX 310), (MSZ 310)
MLV 780	Flight Mechanics 780	13	
	Total	77	

Second semester
Option – Mechanical

MSC 400	Project 400	16	
MSQ 423	Communication 423	2	
	Four electives from the following:		
MVE 780	Vehicle Engineering 780	16	
MTC 420	Thermal Machines 420	16	(MTX 310)
ETN 420	Electrotechnics 420	16	ETN 322
MLD 420	Aerodynamics 420	16	MSX 310
MII 420	Maintenance Engineering 420	16	
Postgraduate module		16	
	Total	82	
or Option – Aeronautical			
MSC 401	Aeronautical Project 401	16	
MLW 780	Aircraft Design 780	16	MOW 312, 322
MLD 420	Aerodynamics 420	16	MSX 310
MSQ 423	Communication 423	2	
	Four electives from the following:		
MVE 780	Vehicle Engineering 780	16	
MTC 420	Thermal Machines 420	16	(MTX 310)
ETN 420	Electrotechnics 420	16	ETN 322
MII 420	Maintenance Engineering 420	16	
Postgraduate module		16	
	Total	82	
Recess training			
MPY 415	Practical Training 415	16	

Notes
(i) The postgraduate module above may be taken with special permission from the head of the department.
(iii) Postgraduate elective modules may be scheduled in accordance with the postgraduate timetable in mini-blocks.
(iii) The medium of instruction for the postgraduate modules above, is mentioned in the postgraduate brochure of the Department.

Preparation for postgraduate specialisation
Numerous modules are available for postgraduate specialisation. Consult the postgraduate brochure of the Department for more information in this regard.

(i) Metallurgical Engineering

First year of study
First semester

Module		Credits	Prerequisites
MIT 113	Engineering Drawing 113	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
CIL 110	Information Technology 110	8	
NNV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
CHM 181	General Chemistry 181	16	CHM 171 GS
NMC 122	Materials Science 122	16	
	Total	80	
Recess training			
NWP 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes
(i) A report about Workshop Practice is submitted at the beginning of the second year of study.
(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).
(iii) Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module NNV 110 (Innovation 110).

Second year of study
First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168

MSD 210	Dynamics 210	16	FSK 116, SWK 122
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
GMI 210	Mineralogy 210	16	
BES 210	Engineering Statistics 210	8	
CRV 210	Computer Literacy 210	8	CIL 110†
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
NMC 222	Materials Science 222	16	NMC 122
NPT 220	Process Thermodynamics 220	16	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	
Recess training			
NPY 216	Practical Training 216	2	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
NHM 311	Hydrometallurgy 311	16	(NPT 220)
NMM 310	Mechanical Metallurgy 310	16	(NMC 212)
COP 311	Transfer Processes 311	16	
MSX 310	Fluid Mechanics 310	16	WTW 258†, 256†
NEX 310	Excursions 310	8	
BIE 310	Engineering Economics 310	8	
	Total	80	
Second semester			
NHM 321	Hydrometallurgy 321	16	(NPT 220)
NMC 320	Materials Science 320	16	(NMC 212)
NMP 323	Minerals Processing 323	16	
NPM 321	Pyrometallurgy 321	16	(NPT 220)
NVM 321	Refractory Materials 321	8	
IOB 320	Development Management 320	8	
	Total	80	
Recess training			
NPY 316	Practical Training 316	16	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
NKR 410	Corrosion 410	17	(NMM 310)
NPL 410	Process Metallurgy 410	20	NPM 320
NSC 400	Project 400	8	
NSQ 400	Communication 400	2	(NSQ 300)
	Manufacturing Metallurgy		
NSW 410	Welding Engineering 410	17	(NMM 310)

NMP 410	Materials Processing 410	20	(NMM 310)
	Total	84	
or Extractive Metallurgy			
NEB 410	Ore Dressing 410	15	(NEB 310)
NHM 410	Hydrometallurgy 410	20	(NHM 310)
	Total	82	
Second semester			
NSC 400	Project 400	48	
NSQ 400	Communication 400	2	(NSQ 300)
NON 420	Design 420	28	(NMM 310) (NEB 310)
	Total	78	
Recess training			
NPY 416	Practical Training 416	16	

(j) Mining Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
WTW 158	Calculus 158	16	
FSK 116	Physics 116	16	
CHM 171	General Chemistry 171	16	
CIL 110	Information Technology 110	8	
PNV 110	Innovation 110	8	
	Total	80	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
NMC 122	Materials Science 122	16	
PMY 121	Mining 121	16	
	Total	80	
Recess training			
PWP 121	Workshop Practice 121	3	
PYL 120	Practical Training 120	3	

Notes

(i) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(ii) Students who failed the language proficiency test must register for the module **JNV 100 (Innovation 100)**, which must be taken instead of the module PNV 110 (Innovation 110).

Second year of study
First semester

Module		**Credits**	**Prerequisites**
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168

MSD 210	Dynamics 210	16	FSK 116, SWK 122
PMY 210	Mining 210	16	PMY 120
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
BES 210	Engineering Statistics 210	8	
CRV 210	Computer Literacy 210	8	CIL 110†
	Total	80	
Second semester			
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
MTX 220	Thermodynamics 220	16	FSK 116
SUR 220	Surveying 220	16	
EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	80	
Recess training			
PPY 218	Practical Training 218	16	

Third year of study
First semester

Module		**Credits**	**Prerequisites**
PRX 311	Rock Breaking 310	16	(PMY 210)
PSZ 311	Rock Mechanics 311	16	SWK 210 GS
PDY 311	Surface Mining 311	16	PMY 120
GLY 151	Introductory Geology 151	8	
GLY 152	Physical Geology 152	8	
PNB 310	Industrial Excursions 310	8	
BIE 310	Engineering Economics 310	8	
	Total	80	
Second semester			
PEE 320	Mine Environment Engineering 320	16	
PME 320	Mineral Economics 320	16	
NMP 322	Minerals Processing 322	16	
GLY 161	Historical Geology 161	8	GLY 151 GS, 152 GS
GLY 162	Environmental Geology 161	8	GLY 151 GS, 152 GS
PSC 321	Introduction to Project 321	8	
IOB 320	Development Management 320	8	
	Total	80	
Recess training			
PPY 317	Practical Training 317	16	

Fourth year of study
First semester

Module		**Credits**	**Prerequisites**
PKB 410	Mine Climate Control 410	15	PSX 320
PMW 410	Mine Valuation 410	15	
PSZ 410	Strata Control 410	15	PSZ 320 GS

PSC 410	Project 410	8	
PME 410	Mineral Economics 410	17	
GLY 414	Structural Geology 414	12	GLY 114;124
	Total	82	
Second semester			
IOB 320	Development Management 320	8	
PMY 421	Mining 421	16	
PMZ 420	Mine Design 420	30	
GLY 323	Economic Geology 323	18	GLY 114 GS; 124 GS
	Total	72	
Recess training			
PPY 418	Practical Training 418	16	

Eng. 15.2 Five-year Programmes

Please note:

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

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

(ii) A student who failed the language proficiency test, but who is registered for and also pass in the modules JPO 110/120, will be exempted from the module JNV 100. If such a student should fail in the language component of JPO 120, it is required that the student registers for the module JNV 100 in the next year and pass in this module, after which credit for JPO 120 will be granted.

(a) Chemical Engineering

First year of study

First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	
CNV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
CHM 181	General Chemistry 181	8	CHM 171 GS
JPO 120	Professional Orientation 120	8	JPO 110 GS
CIR 122	Chemical Engineering 122	16	
	Total	56	
Recess training			
CWP 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) During registration students will be informed about the choice to be made between CNV 110, JNV 100 and JPO 110/120.

(iv) Students who failed the language proficiency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module CNV 110.

Second year of study

First semester

Module		Credits	Prerequisites
FSK 116	Physics 116	16	
CIL 110	Information Technology 110	8	
CRV 210	Computer Literacy 210	8	CIL 110†
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
	Total	48	

Second semester

FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

Recess training

CPY 211	Practical Training 211	2	

Third year of study

First semester

Module		Credits	Prerequisites
CIR 213	Chemical Engineering 213	16	CIR 122
CHM 215	Chemistry 215	16	CHM 171, 181
SWK 213	Strength of Materials 213	8	SWK 122, WTW 168†
MSD 210	Dynamics 210	16	FSK 126, SWK 122
	Total	56	

Second semester

CHM 226	Chemistry 226	8	CHM 171,181
CTD 222	Thermodynamics 222	8	CIR 212
NMC 122	Materials Science 122	16	
EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
JSQ 226	Communication Skills 226	8	
	Total	56	

(b) Civil Engineering

First year of study

First semester

Module		Credits	Prerequisites
SMK 110	Graphics 110	16	
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	
SNV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
SUR 220	Surveying 220	16	
SSC 120	Civil Engineering Design 120	16	
JPO 120	Professional Orientation 120	8	JPO 110 GS
	Total	56	

Recess training

SWP 121	Workshop Practice 121	4
NHS 400	First-Aid Certificate 400	2

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) During registration students will be informed about the choice to be made between SNV 110, JNV 100 and JPO 110/120.

(iii) Students who failed the language proficiency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module SNV 110.

Second year of study

First semester

Module		Credits	Prerequisites
FSK 116	Physics 116	16	
CIL 110	Information Technology 110	8	
SGM 210	Geomaterials and Processes 210	16	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
	Total	56	

Second semester

FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
JSQ 226	Communication Skills 226	8	
	Total	56	

Third year of study
First semester

Module		Credits	Prerequisites
SIN 213	Introduction to Structural Design 213	8	WTW 158, 161 GS, 168 GS, SWK 122 GS
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
TRP 311	Town and Regional planning 311	8	
BIE 310	Engineering Economics 310	8	
BES 210	Engineering Statistics 210	8	
	Total	48	

Second semester

SIN 223	Structural Analysis 223	16	WTW 168,161, SWK 122 SIN 213 GS
SGM 221	Pavement Materials and Design 220	16	SGM 120/210 GS
or			
***** MTX 220	Thermodynamics	16	FSK 116
SHC 220	Water Treatment 220	8	
SBZ 221	Civil Engineering Measurement Techniques 221	8	
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

***** Only for students taking the agricultural option.

(c) Computer Engineering

First year of study
First semester

Module		Credits	Prerequisites
EPE 111	Introduction to Programming 111	16	
WTW 158	Calculus 158	16	
EIT 111	Information Technology 111	16	
ENV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
EPE 121	Introduction to Programme Design 121	16	EPE 111
EBN 121	Circuits 121	16	
JPO 120	Professional Orientation 120	8	JPO 110 GS
	Total	56	

Recess training

EMR 100	Measurement Techniques and Computer Modelling 100	2
EIW 121	Information Technology Practice 121	8

Notes

(i) During registration students will be informed about the choice to be made between ENV 110, JNV 100 and JPO 110/120.

(ii) Students who failed the language proficiency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module ENV 110.

Second year of study

First semester

Module		Credits	Prerequisites
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
FSK 116	Physics 116	16	
EGA 110	Engineering Graphics 110	8	
BIS 210	Engineering Statistics 210	16	
	Total	56	

Second semester

WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
FSK 126	Physics 126	16	FSK 116 GS
MEG 123	Introductory Mechanics 123	16	
JSQ 226	Communication Skills 226	8	
	Total	56	

Recess training

EIW 221	Information Technology Practice 221	8

Third year of study

First semester

Module		Credits	Prerequisites
ERB 210	Operating Systems 210	16	COS 110 or EPE 121
EBN 210	Circuits 210	16	EBN 120, WTW 126
EPE 210	Data Structures and Algorithms 210	16	COS 110 or EPE 121
	Total	48	

Second semester

ELK 220	Electronic Components 220	16	EBN 121 GS
ELI 220	Linear Systems 220	16	EBN 210 WTW 258, 256
ERS 220	Digital Systems 220	16	
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

(d) Electrical Engineering and Electronic Engineering

First year of study

First semester

Module		Credits	Prerequisites
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	

EIT 111	Information Technology 111	16	
ENV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
JPO 120	Professional Orientation 120	8	JPO 110 GS
NMC 122	Materials Science 122	16	
EBN 121	Circuits 121	16	
	Total	56	
Recess training			
EMR 100	Measurement Techniques and Computer Modelling 100	2	

Notes

(i) During registration students will be informed about the choice to be made between ENV 110, JNV 100 and JPO 110/120.

(ii) Students who failed the language competetency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module ENV 110.

Second year of study

First semester

Module		**Credits**	**Prerequisites**
FSK 116	Physics 116	16	
EGA 110	Engineering Graphics 110	8	
EPE 111	Introduction to Programming 111	16	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
	Total	56	
Second semester			
FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
JSQ 226	Communication Skills 226	8	
	Total	56	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
BIS 210	Engineering Statistics 210	16	
EBN 210	Circuits 210	16	EBN 120, WTW 161
MSD 210	Dynamics 210	16	FSK 116, SWK 122
	Total	48	

Second semester

ELI 220	Linear Systems 220	16	EBN 210/121 WTW 258, 256
ERS 220	Digital Systems 220	16	
ELK 220	Electronic Components 220	16	EBN 120 GS
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

(e) Industrial Engineering

First year of study
First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	
BNV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	
Second semester			
WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
NMC 122	Materials Science 122	16	
MOW 122	Machine Design 122	16	MIT 113 GS
JPO 120	Professional Orientation 120	8	JPO 110 GS
	Total	56	
Recess training			
BWP 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) During registration students will be informed about the choice to be made between BNV 110, JNV 100 and JPO 110/120.

(iv) Students who failed the language proficiency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module BNV 110.

Second year of study
First semester

Module		**Credits**	**Prerequisites**
FSK 116	Physics 116	16	
CIL 110	Information Technology 110	8	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
BES 210	Engineering Statistics 210	8	
	Total	48	

Second semester

FSK 126	Physics 126	16	FSK 116GS
SWK 122	Mechanics 122	16	
BAN 222	Industrial Analysis 222	8	BES 210 GS
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
	Total	56	

Recess training

BPY 210	Practical Training 210	2	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
MPR 210	Programming 210	16	CIL 110
BPZ 210	Productivity 210	16	
MOW 216	Machine Design 216	8	MOW 121, SWK 122
MSD 210	Dynamics 210	16	SWK 122, FSK 116
	Total	48	

Second semester

EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
BVS 221	Manufacturing Systems 221	16	
JSQ 226	Communication Skills 226	8	
ITI 220	Technological Entrepreneurship 220	8	
IPB 320	Project Management 320	8	
	Total	56	

(f) Mechanical Engineering

First year of study

First semester

Module		**Credits**	**Prerequisites**
MIT 113	Engineering Drawing 113	16	
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	
MNV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
NMC 122	Materials Science 122	16	
MOW 122	Machine Design 122	16	MIT 113 GS
JPO 120	Professional Orientation 120	8	JPO 110 GS
	Total	56	

Recess training

WPM 121	Workshop Practice 121	4	
NHS 400	First-aid Certificate 400	2	

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) During registration students will be informed about the choice to be made between MNV 110, JNV 100 and JPO 110/120.

(iv) Students who failed the language competetency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module MNV 110.

Second year of study

First semester

Module		**Credits**	**Prerequisites**
FSK 116	Physics 116	16	
CIL 110	Information Technology 110	8	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
NMC 211	Materials Science 211	8	NMC 122
	Total	48	

Second semester

FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
JSQ 226	Communication Skills 226	8	
	Total	56	

Recess training

MPY 215	Practical Training 215	2	

Third year of study

First semester

Module		**Credits**	**Prerequisites**
MOW 212	Machine Design 212	8	MOW 121, SWK 210†
MPR 210	Programming 210	16	CIL 110
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
MSD 210	Dynamics 210	16	FSK 116, SWK 122
	Total	56	

Second semester

MOW 222	Machine Design 222	8	MOW 212, MSK 222†
MSK 222	Theory of Machines 222	8	FSK 116
EBN 121	Circuits 121	16	
MTX 220	Thermodynamics 220	16	FSK 116
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

(g) Metallurgical Engineering

First year of study

First semester

Module		Credits	Prerequisites
MIT 113	Engineering Drawing 113	16	
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	
NNV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
CHM 181	General Chemistry 181	16	CHM 171 GS
NMC 122	Materials Science 122	16	
JPO 120	Professional Orientation 120	8	JPO 110 GS
	Total	56	

Recess training

NWP 121	Workshop Practice 121	4
NHS 400	First-aid Certificate 400	2

Notes

(i) A report about Workshop Practice is submitted at the beginning of the second year of study.

(ii) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(iii) During registration students will be informed about the choice to be made between NNV 110, JNV 100 and JPO 110/120.

(iv) Students who failed the language competetency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module NNV 110.

Second year of study

First semester

Module		Credits	Prerequisites
FSK 116	Physics 116	16	
CIL 110	Information Technology 110	8	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
GMI 210	Mineralogy 210	16	
	Total	56	

Second semester

FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
JSQ 226	Communication Skills 226	8	
	Total	56	

Recess training

NPY 216	Practical Training 216	2

Third year of study

First semester

Module		Credits	Prerequisites
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
MSD 210	Dynamics 210	16	FSK 116, SWK 120/122
BES 210	Engineering Statistics 210	8	
CRV 210	Computer Literacy 210	8	CIL 110†
	Total	48	

Second semester

NPT 220	Process Thermodynamics 220	16	
EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
NMC 222	Materials Science 222	16	NMC 122
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

(h) Mining Engineering

First year of study

First semester

Module		Credits	Prerequisites
MIT 113	Engineering Drawing 113	16	
CHM 171	General Chemistry 171	16	
WTW 158	Calculus 158	16	
PNV 110	Innovation 110 **or**	8	
JNV 100	Innovation 100 **or**	8	
JPO 110	Professional Orientation 110	8	
	Total	56	

Second semester

WTW 168	Calculus 168	8	WTW 158 GS
WTW 161	Linear Algebra 161	8	
NMC 122	Materials Science 122	16	
PMY 121	Mining 121	16	
JPO 120	Professional Orientation 120	8	JPO 110 GS
	Total	56	

Recess training

PWP 121	Workshop Practice 121	3
PYL 120	Practical Training 120	3

Notes

(i) Students may be promoted in Engineering Drawing 113, if a semester mark of at least 65% is obtained (refer to Regulation Eng. 3(a)).

(ii) During registration students will be informed about the choice to be made between PNV 110, JNV 100 and JPO 110/120.

(iii) Students who failed the language competetency test must register for the module JNV 100 or JPO 110/120, which must be taken instead of the module PNV 110.

(iv) Five year programme students have a choice to do PWP 121 and/or PYL 120 during the second year.

Second year of study
First semester

Module		Credits	Prerequisites
FSK 116	Physics 116	16	
CIL 110	Information Technology 110	8	
BES 210	Engineering Statistics 210	8	
WTW 258	Calculus 258	8	WTW 158,168
WTW 256	Differential Equations 256	8	WTW 158, WTW 161,168
	Total	48	

Second semester

FSK 126	Physics 126	16	FSK 116 GS
SWK 122	Mechanics 122	16	
WTW 228	Calculus 228	8	WTW 158,168
WTW 263	Numerical Methods 263	8	WTW 161,168
JSQ 226	Communication Skills 226	8	
	Total	56	

Third year of study
First semester

Module		Credits	Prerequisites
MSD 210	Dynamics 210	16	FSK 116, SWK 122
PMY 210	Mining 210	16	PMY 120
CRV 210	Computer Literacy 210	8	CIL 110†
SWK 210	Strength of Materials 210	16	SWK 122, WTW 168†
	Total	56	

Second semester

EIR 220	Electrical Engineering 220	16	WTW 161 GS, 168 GS
SUR 220	Surveying 220	16	
MTX 220	Thermodynamics 220	16	FSK 116
ITI 220	Technological Entrepreneurship 220	8	
	Total	56	

Recess training

PPY 218	Practical Training 218	16	

REQUIREMENTS FOR PROMOTION TO THE FOLLOWING YEAR OF STUDY

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

(a) A new first-year student who has failed in all the prescribed modules of the programme at the end of the first semester, is excluded from studies in the School of Engineering. A student registered for the five-year programme who has passed

the Professional Orientation module, but who has failed in all the other prescribed modules, is also not readmitted.

(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 whose registration can be done in such a way that the degree can still be obtained in the minimum prescribed period, may at registration be promoted to the second year of study, as recommended by the Head of the Department and with approval of the Dean. In any semester the total number of credits registered for may not exceed the normal number of credits per semester by more than 16 credits.

(c) A student who has not passed at least 70% of the credits of the first year of study after the November examinations, must reapply for admission should he/she intend to proceed with his/her studies. Application on the prescribed form must be submitted to the 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, conditions of readmission will be determined by the Admissions Committee.

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

(e) A student who is repeating his or her first year, may, on recommendation of the relevant Heads of Department and with the approval of the Dean, be permitted to enrol for modules of the second year of study in addition to the first-year modules which he or she failed, providing that he or she complies with the prerequisites for the second year modules and no timetable clashes occur. The total number of credits per semester for which a student registers may not exceed the normal number of credits per semester by more than 16 credits.

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

Please note:

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

(ii) Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out under "Summary of Syllabi: Bachelor of Engineering" elsewhere in this publication: (PWP 121), Workshop Practice 121, as well as (PPY 218) Practical Training 218.

Eng. 17

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

(a) A student who complies with all the requirements of the second year of study, is promoted to the third year of study. A student who does not comply with all the requirements, but whose registration can be done in such a way that the degree can still be obtained in the minimum prescribed period, may at registration be promoted to the third year of study, as recommended by the Head of the Department and with approval of the Dean. In any semester the total number of

credits registered for may not exceed the normal number of credits per semester by more than 16 credits.

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

(c) A student who is repeating his or her second year, may, on recommendation of the relevant Head of Department and with the approval of the Dean, be permitted to enrol for modules of the third year of study in addition to the second-year modules which he or she failed, providing that he or she complies with the prerequisites for the third-year modules and no timetable clashes occur. The total number of credits per semester for which a student registers may not exceed the normal number of credits per semester by more than 16 credits.

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

(e) Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out under "Summary of Syllabi: Bachelor of Engineering" elsewhere in this publication: (PWP 121), Workshop Practice 121, as well as (PPY 317) Practical Training 317.

Eng. 18

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

(a) A student who complies with all the requirements of the third year of study is promoted to the fourth year of study. A student who does not comply with all the requirements but who is able to register for all outstanding modules 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 modules of the second year of study, before he or she is admitted to any module of the fourth year of study.

(c) A student who has not passed all the prescribed modules of the third year of study, must register for the outstanding modules. A student may be admitted by the Dean, on the recommendation of the Head of Department concerned, to modules of the fourth year of study, in addition to the outstanding third year modules, provided that he or she complies with the prerequisites of the fourth year modules and no timetable clashes occur. The total number of credits per semester for which a student registers may not exceed the normal number of credits per semester by more than 16 credits. In exceptional cases, the Dean may, on recommendation of the relevant Head of Department, permit a student to exceed the above limit.

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

(e) Students in Computer, 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 modules for non-degree purposes. These modules will be in addition to the prescribed modules for the fourth year of study. Credit for the postgraduate modules will be retained for subsequent postgraduate study in the Department.

POSTGRADUATE PROGRAMMES

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

Eng. 19
Also consult the General Regulations G.16 to G.29.

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

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

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

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

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

(e) **Examinations**

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

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

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

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

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

(f) The honours degree in Engineering 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 128 credits for which registered (excluding modules which were discontinued timeously). The degree is not awarded with distinction if a student fails any one module (excluding modules which were discontinued timeously).

(h) **Credit for modules**

(i) The Dean may grant credit towards the BEng(Hons) degree, for honours-level modules passed at other tertiary institutions or at this university (all departments), on condition that:
- a student is credited at the most for half of the credits required for the honours degree;
- all the prescribed requirements of the specific honours degree are complied with;
- credit in respect of a specific module is not granted for more than two honours degrees.

(ii) A student who has passed postgraduate module(s) as elective/specialist modules as part of the final year BEng programme, may be granted credit for these modules at honours-level, on condition that:
- a maximum of 32 credits is granted as such;
- all the prescribed requirements of the specific honours degree are complied with.

MASTER OF ENGINEERING (MEng)

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

(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) A minimum of 256 credits is required to obtain the MEng degree. Either a project (32 credits) or a dissertation (128 credits) is included in the programme. Recognition is granted for credits acquired during studying for the BEng(Hons), but this qualification is not a prerequisite for admission to the MEng programme.

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

		Degree code	Dissertation	Project
(i)	Agricultural Engineering	12250041	LIR 890	LSC 895
(ii)	Bio-engineering	12250201	EIB 890	
(iii)	Chemical Engineering	12250021	CIR 890	CSC 895
(iv)	Computer Engineering	12250211	ERI 890	
(v)	Control Engineering	12250231	CBH 890	CSC 897
(vi)	Corrosion Engineering	12250241	NKR 890	
(vii)	Electrical Engineering	12250031	EIR 890	ESC 895
(viii)	Electronic Engineering	12250091	EIN 890	ESC 896
(ix)	Engineering Management	12250171		IGB 895
(x)	Environmental Engineering	12250221	COI 890	CSC 896
(xi)	Geotechnical Engineering	12250212	SGT 890	SGT 895
(xii)	Industrial Engineering	12250011	BIR 890	BSC 895
(xiii)	Mechanical Engineering	12250051	MIR 890	MSC 895

(xiv)	Metallurgical Engineering	12250061	MIN 890	NSC 895
(xv)	Micro-Electronic Engineering	12250191	EEY 890	
(xvi)	Mining Engineering	12250071	MYI 890	PSC 895
(xvii)	Project Management	12250261		
(xviii)	Quality Assurance and Reliability Engineering	12250291	BGX 890	BSC 896
(xix)	Structural Engineering	12250121	SIN 890	SSC 896
(xx)	Technology Management	12250251	ITB 890	
(xxi)	Transportation Engineering	12250111	VIN 890	SSC 898
(xxii)	Urban Engineering	12250213	SSI 890	SSI 895
(xxiii)	Water Utilisation Engineering	12250101	WBI 890	WSC 895
(xxiv)	Water Resources Engineering	12250161	WBK 890	SSC 899

(d) 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.

(e) The curriculum is determined in consultation with the relevant Head of Department. A student must pass modules with a minimum of 128 credits if a dissertation is submitted, and modules with a minimum of 256 credits if a project is submitted, on the understanding that 32 of the 256 credits are allocated to the project.

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

(g) **Examinations**

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

(ii) A Master's student is required to complete his or her degree studies within four 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, exempt a student from the examination on the dissertation.

(h) 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%.

(i) **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 128 module credits for the degree (excluding modules which have been timeously discontinued). Modules which have been recognised in terms of Regulation Eng. 21(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 128 module credits completed or recognised for the degree (excluding modules which have been timeously discontinued). However, the degree is not awarded with distinction should the student fail any of the modules (of the first 128 module credits) for the MEng degree study (excluding modules 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 256 credits obtained for

the degree, on the understanding that 32 of the 256 credits are allocated to the project. Modules recognised in terms of Regulation Eng. 21(e) are taken into account. However, the degree is not awarded with distinction should a student fail any of the modules (of the first 256 module credits) for the MEng degree study (excluding modules which have been timeously discontinued). The degree is not awarded with distinction if a student obtains less than 70% for the project.

(j) **General Master's degree 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 decided otherwise 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.

COMBINED CURRICULA FOR THE BEng(Hons) AND THE MEng PROGRAMMES

Eng. 21

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

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

(a) CHEMICAL ENGINEERING

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

BEng(Hons)(Chemical Engineering)(12240021)
MEng(Chemical Engineering)(12250021)

	Code	Credits
Dissertation 890	CIR 890	128
Project 895	CSC 895	32
Advanced Process Control Applications 780	CGP 780	16
Air Pollution Control Design 780	CLO 780	16
Chemical Engineering 701	CIR 701	32
Chemical Engineering 780	CIR 780	16
Cost Optimisation 781	CKO 781	16
Cost Optimisation 782	CKO 782	16
Multivariable Control System Design 780	CBO 780	16
Multivariable Control System Theory 780	CBT 780	16
Plant Design 780	CAO 780	16
Polymer Chemistry 780	CPC 780	16
Polymer Engineering 780	CPI 780	16
Polymer Materials Science 710	CPW 710	16

Polymer Modification 780	CMD 780	16
Polymer Physics 780	CPF 780	16
Polymer Processing 720	CPP 720	16
Process Integration 780	CIP 780	16
Process Modelling 780	CPM 780	16
Process Synthesis 780	CSI 780	16
Reactor Design 700	CRO 700	32
Reactor Design 780	CRO 780	16
Separation Processes 780	CSK 780	16
Systematic Process Control Systems Development 780	CSP 780	16

BEng(Hons)(Control Engineering)(12240231)
MEng(Control Engineering)(12250231)

	Code	**Credits**
Dissertation 890	CBH 890	128
Project 897	CSC 897	32
Advanced Process Control Applications 780	CGP 780	16
Multivariable Control System Design 780	CBO 780	16
Multivariable Control System Theory 780	CBT 780	16
Plant Design 780	CAO 780	16
Process Control Laboratory 780	CPL 780	16
Process Modelling 780	CPM 780	16
Systematic Process Control Development 780	CSP 780	16

BEng(Hons)(Environmental Engineering)(12240221)
MEng(Environmental Engineering)(12250221)

	Code	**Credits**
Dissertation 890	COI 890	128
Project 896	CSC 896	32
Air Pollution Control 781	CLS 781	16
Air Pollution Control Design 880	CLO 880	32
Air Quality Management 780	CLK 780	16
Environmental Management 780	COM 780	16
Environmental System Design 880	COO 880	32
Life Cycle Assessment 780	CLC 780	16
Waste Management 780	WSM 780	16
Waste Treatment and Disposal 780	WST 780	16
Water Management 780	CWB 780	16
Water Treatment 780	CWT 780	16

BEng(Hons)(Water Utilisation Engineering)(12240101)
MEng(Water Utilisation Engineering)(12250101)

	Code	**Credits**
Dissertation 890	WBI 890	128
Project 896	WSC 896	32
Advanced Biological Treatment 780	WBA 780	16
Advanced Unit Processes 780	WUA 780	16
Advanced Water Microbiology 780	WMA 780	16
Advanced Water Treatment 780	WTA 780	16

Biological Treatment 780	WBB 780	16
Biological Water Treatment 780	WBW 780	32
Chemical Water Treatment 780	WCW 780	32
Conventional Water Purification 780	WTB 780	16
Industrial Water Treatment 780	WIB 780	16
Plant Design 780	WAO 780	16
Plant Design 880	WAO 880	32
Plant Design and Waste Water Treatment 880	WRO 880	32
Plant Design and Water Treatment 880	WDO 880	32
Unit Processes 780	WUB 780	16
Waste Management 780	WSM 780	16
Waste Management 780	WAI 780	32
Waste Sources and Impacts 780	WSI 780	16
Waste Treatment and Disposal 780	WTD 780	16
Water Chemistry 780	WCB 780	16
Water Microbiology 780	WMB 780	16
Water Quality Assessment 780	WQA 780	16
Water Quality Management 780	WQM 780	16

(b) CIVIL AND BIOSYSTEMS ENGINEERING

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

BEng(Hons)(Transportation Engineering)(12240111)
MEng(Transportation Engineering)(12250111)

	Code	**Credits**
Dissertation 890	SIR 890	128
Project 898	SSC 898	32
Asphalt Technology 787	SGC 787	16
Geometric Design 783	SVV 783	16
Pavement Design 781	SGC 781	16
Public Transport 780	SVV 780	16
Road Rehabilitation Technology 786	SGC 786	16
Stabilised Materials and Compaction 788	SGC 788	16
Statistical Methods 789	SHC 789	16
Traffic Engineering 787	SVC 787	16
Traffic Flow Theory 784	SVC 784	16
Traffic Safety 781	SVV 781	16
Transportation Economics 782	SVV 782	16
Transportation Logistics 786	SVV 786	16
Transportation Management 787	SVV 787	16
Transportation Planning 781	SVC 781	16
Transportation Special 788	SVC 788	16
Transportation Studies 782	SVC 782	16

BEng(Hons)(Water Resources Engineering)(12240101)
MEng(Water Resources Engineering)(12250161)

	Code	**Credits**
Dissertation 890	WKB 890	128
Project 899	SSC 899	32

Environmental Impact Studies 788	SHC 788	16
Flood Hydrology 783	SHC 783	16
Free Surface Flow 781	SHC 781	16
Geohydrology 710	SGH 710	16
Hydraulic Design 787	SHC 787	16
Pipe Flow 782	SHC 782	16
Rural Water Supply 780	SHC 780	16
Special Aspects of Pump Systems 781	SHW 781	16
Special Hydraulics 785	SHC 785	16
Special Hydrology 786	SHC 786	16
Water Resources Management 784	SHC 784	16

BEng(Hons)(Geotechnical Engineering)(12240212)
MEng(Geotechnical Engineering)(12250212)

	Code	**Credits**
Dissertation 890	SGI 890	128
Project 895	SGT 895	32
Advanced Geotechnical Design 780	SGS 780	16
Advanced Geotechnical Laboratory Testing 783	SGS 783	16
Advanced Soil Mechanics 784	SGT 784	16
Critical State Soil Mechanics 786	SGT 786	16
Geotechnics and Foundation Engineering 780	SGT 780	16
Geotechnics Special 780	SGC 780	16
In-situ Soil Testing and Monitoring 782	SGS 782	16
Slope Stability and Retaining Structures 781	SGS 781	16

BEng(Hons)(Urban Engineering)(12240213)
MEng(Urban Engineering)(12250213)

	Code	**Credits**
Dissertation 890	SSI 890	128
Project 895	SSI 895	32
Community Health 788	SSI 788	16
Community Involvement 786	SSI 786	16
Construction Special 787	SKB 787	16
Infrastructural Information Systems 781	SSI 781	16
Maintenance Special 783	SSI 783	16
Urban Engineering in Society 787	SSI 787	16
Urban Engineering Special 785	SSI 785	16
Urban Planning 721	SBG 721	16

BEng(Hons)(Structural Engineering)(12240121)
MEng(Structural Engineering)(12250121)

	Code	**Credits**
Dissertation 890	SIN 890	128
Project 896	SSC 896	32
Analysis of Plate Structures 784	SIN 784	16
Commercial Buildings 786	SIC 786	24
Concrete Structures I 787	SIC 787	24
Concrete Structures II 788	SIC 788	24

Concrete Technology 784	SGC 784	16
Deterioration and Maintenance of Concrete 789	SGC 789	16
Frame Analysis 782	SIN 782	16
Prestressed Concrete Structures 781	SID 781	24
Steel Structures Design 784	SIC 784	24
Steel Structures II 789	SIC 789	24
Structural Design Special 788	SIN 788	16
Theory of Structures Special 789	SIN 789	16
Timber Structures 782	SID 782	24
Water-retaining Concrete Structures 789	SIB 789	16

BEng(Hons)(Agricultural Engineering)(12240041)
MEng(Agricultural Engineering)(12250041)

	Code	**Credits**
Dissertation 890	LIR 890	128
Project 895	LSC 895	32
Advanced Coursework 803	LTD 803	32
Agricultural Engineering Special 700	LIS 700	32
Agricultural Production Equipment 702	LPW 702	32
Building and Planning 710	LBG 710	16
Food Engineering 720	LVI 720	16
Food Engineering Special 700	LVI 700	32
Irrigation 700	LBP 700	32
Machine Design 700	LWO 700	32
Processing 710	LPR 710	16
Rural Energy Sources 705	LEB 705	16
Rural Natural Resources 704	LHZ 704	32
Rural Services 703	LBD 703	16

(c) ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

A limited number of appropriate modules from other departments and from other divisions of Electrical, Electronic and Computer Engineering are allowed.

BEng(Hons)(Electrical Engineering)(12240031)
MEng(Electrical Engineering)(12250021)

	Code	**Credits**
Dissertation 890	EIR 890	128
Project 895	ESC 895	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Control Practice 780	EBB 780	32
Control Systems Mathematics 781	EBB 781	32
Electrical Drives 780	ETE 780	32
Electromagnetic Compatibility 780	EME 780	32
Energy Management and Electricity Tariffs 880	ENE 880	32
Introduction to Energy Management 780	ENB 780	32
Non-linear Control 780	EBN 780	32
Optimal Control 780	EBO 780	32
Power Electronics 780	EED 780	32
Power Network Information Systems 780	EBF 780	32

Power Network Analysis and Modelling 780	EKE 780	32
Power Network Reliability and Quality of Supply 781	EKE 781	32
Power Network Stability 882	EKE 882	32
Protection 780	EBV 780	32

BEng(Hons)(Electronic Engineering)(12240091)
MEng(Electronic Engineering)(12250091)

	Code	**Credits**
Dissertation 890	EIN 890	128
Project 896	ESC 896	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Advanced Optical Fibre Communication Systems 880	EFC 880	32
Antenna Theory 780	EMA 780	32
Control Systems Mathematics 781	EBB 781	32
Control Practice 780	EBB 780	32
Electromagnetic Compatibility 780	EME 780	32
e-Business Security 880	ETS 880	32
Engineering Practice 780	EIX 780	32
Information Security 780	ETH 780	32
Information Theory and Coding 780	ETI 780	32
Microwave Theory 780	EMM 780	32
Mobile Communications 880	ETR 880	32
Non-linear Control 780	EBN 780	32
Optical Fibre Communication Systems 780	EFC 780	32
Optimal Control 780	EBO 780	32
Radiowave Propagation 780	ERD 780	32

BEng(Hons)(Computer Engineering)(12240211)
MEng(Computer Engineering)(12250211)

	Code	**Credits**
Dissertation 890	ERI 890	128
Project 896	ESC 896	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Advanced Computer Networks 880	ENV 880	32
Advanced Micro-processor System Design 780	ERV 780	32
Advanced Optical Fibre Communication Systems 880	EFC 880	32
Advanced Telecommunication and Network Technology 882	ENV 882	32
Computer Networks 780	ERN 780	32
Digital Electronic Design 780	EDG 780	32
e-Business Security 880	ETS 880	32
Information Theory and Coding 780	ETI 780	32
Optical Fibre Communication Systems 780	EFC 780	32
Pattern Recognition 780	ERP 780	32

BEng(Hons)(Bio-Engineering)(12240201)
MEng(Bio-Engineering)(12250201)

	Code	**Credits**
Dissertation 890	EIB 890	128
Project 896	ESC 896	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32

Bio-Engineering 780	EPN 780	32
Biosystems 780	EPB 780	32
Ergonomics and Bio-Materials 780	EPE 780	32
Neuro Engineering 781	EPH 781	32

BEng(Hons)(Micro-electronic Engineering)(12240191)
MEng(Micro-electronic Engineering)(12250191)

	Code	**Credits**
Dissertation 890	EEY 890	128
Skripsie 896	ESC 896	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Digital Electronics Design 780	EDG 780	32
Electronics 780	EEE 780	32
Integrated Analog Design 780	EEA 780	32

(d) ENGINEERING AND TECHNOLOGY MANAGEMENT

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

MEng (Engineering Management)(12250171)

	Code	**Credits**
Dissertation 890	IGB 890	128
Project 895	IGB 895	32
Decision Analysis 804	IBD 804	16
Development Management 801	IOB 801	16
Engineering Logistics 801	IIX 801	16
Financial Management 830	FBS 830	16
General Management 884	ALB 884	16
Human Resource Management 883	PEM 883	16
Information Management 884	ILB 884	16
Maintenance Management 801	IIB 801	16
Marketing Management 884	BEM 884	16
New Ventures and Entrepreneurship 801	IOE 801	16
Production and Operations Management 801	IPP 801	16
Project Management 803	IPK 803	16
Quality Management 803	IKK 803	16
Safety, Health and Environment 801	IVG 801	16
Strategic Management 802	ISM 802	16
Systems Engineering 801	ISI 801	16
Technology Management 801	ITB 801	16

MEng(Project Management)(12250261)

	Code	**Credits**
Project 895	ISC 895	32
Engineering Logistics 801	IIX 801	16
General Management 801	IAB 801	16
Introduction to Project Management 801	IPM 801	16
Law Aspects of Project Management 802	ILC 802	16

Literature Study 801	ILS 801	16
Literature Study 802	ILS 802	16
New Ventures and Entrepreneurship 801	IOE 801	16
Principles of Project Finance 801	IPF 801	16
Project Cost Management 801	IKB 801	16
Project Human Resource Development 801	IHR 801	16
Project Management Practice 801	IMP 801	16
Project Procurement Management 801	IPJ 801	16
Project Quality Management 801	IQM 801	16
Project Risk Management 801	IRM 801	16
Project Systems Engineering 802	ISI 802	16
Safety, Health and Environment 801	IVG 801	16
Strategic Management 803	ISM 803	16
Systems Engineering 801	ISI 801	16

BEng(Hons)(Technology Management)(12240251)
MEng(Technology Management)(12250251)
This qualification follows upon the BEng(Hons)(Technology Management).

	Code	**Credits**
Dissertation 890	ITB 890	128
Decision Analysis 780	IBD 780	16
Engineering Economics 780	IKN 780	16
Engineering Logistics 801	IIX 801	16
Innovation Strategy 780	INV 780	16
Maintenance Management 780	IMC 780	16
New Ventures and Entrepreneurship 780	IOE 780	16
Operational Management 781	IVV 781	16
Project Management 780	IPK 780	16
Systems Engineering 780	ISE 780	16
Technology Management 780	ITB 780	16

(e) INDUSTRIAL AND SYSTEMS ENGINEERING

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

BEng(Hons)(Industrial Engineering)(12240011)
MEng(Industrial Engineering)(12250011)

	Code	**Credits**
Dissertation 890	BIR 890	128
Project 895	BSC 895	32

BEng(Hons)(Quality Assurance and Reliability Engineering)(12240291)
MEng(Quality Assurance and Reliability Engineering)(12250291)

Dissertation 890	BGX 890	128
Project 896	BSC 896	32

Modules from the list below are selected in consultation with the Head of the Department, in order to specialise in one of the abovementioned fields of study:

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

(f) MECHANICAL AND AERONAUTICAL ENGINEERING

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

BEng(Hons)(Mechanical Engineering)(12240011)
MEng(Mechanical Engineering)(12250011)

	Code	Credits
Dissertation 890	MIR 890	128
Project 895	MSC 895	32

Modules are selected in consultation with the Head of the Department, in order to specialise in one of the following fields:
Aeronautical Engineering
Design
Dynamics
Fluid and Thermopower
Maintenance Engineering
Structural Mechanics
Vehicle Engineering

	Code	Credits
Advanced Vehicle Engineering 732	MGV 732	32
Aerodynamics 780	MLD 780	16
Air Conditioning 780	MLR 780	16
Aircraft Design 780	MLW 780	16
Aircraft Propulsion Systems 732	MAY 732	32
Composite Materials	MCM 780	16
Condition-based Maintenance 732	MIC 732	32

Control Systems 732	MBB 732	32
Design 732	MOX 732	32
Dynamics 732	MSD 732	32
Finite Element Methods 732	MEE 732	32
Flight Mechanics 780	MLV 780	16
Fluid Mechanics 732	MSX 732	32
Gas Dynamics 732	MLG 732	32
Heat Transfer 732	MWX 732	32
Mathematical Optimisation 780	MWO 780	16
Numerical Thermoflow 732	MSM 732	32
Reliability Engineering 732	MIR 732	32
Smart Materials 780	MSA 780	16
Structural Integrity 732	MSI 732	32
Thermodynamics 780	MTX 780	16
Tribology 732	MIT 732	32
Vehicle Engineering 780	MVE 780	16
Vibration 732	MEV 732	32

(g) METALLURGICAL ENGINEERING AND MATERIALS SCIENCE

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

BEng(Hons)(Metallurgical Engineering)(12240061)
MEng(Metallurgical Engineering)(12250061)

	Code	**Credits**
Dissertation 890	MIN 890	128

BEng(Hons)(Corrosion Engineering)(12240241)
MEng(Corrosion Engineering)(12250241)

Dissertation 890	CKI 890	128

Modules from the list below are selected in consultation with the Head of the Department, in order to specialise in one of the abovementioned fields of study:

	Code	**Credits**
Corrosion 700	NKR 700	32
Extractive Metallurgy 700	NEM 700	32
Heat Treatment 700	NHB 700	32
Iron and Steel Smelting 700	NYS 700	32
Literature Survey 700	NLO 700	32
Mechanical Metallurgy 700	NMM 700	32
Metallurgical Problems 700	NPR 700	32
Metallurgical Process Analysis and Control 700	NPB 700	32
Minerals Processing 700	NMP 700	32
Physical Metallurgy 700	NFM 700	32
Pyrometallurgy 700	NPM 700	32
Refractory Materials 700	NVM 700	32
Welding Metallurgy 700	NSW 700	32

(h) MINING ENGINEERING

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

BEng(Hons)(Mynbou-Ingenieurswese)(12240071)
MEng(Mynbou-Ingenieurswese)(12250071)

	Code	Credits
Dissertation 890	MYI 890	128
Project 895	PSC 895	32
Advanced Mining Design 780	PMZ 780	16
Airflow and Fans 711	PKB 711	16
Dust, Gasses and Fires 713	PKB 713	16
Economics of Mining Environmental Control 714	PKB 714	16
Financial Mine Evaluation 780	PFZ 780	16
Heat and Cooling 712	PKB 712	16
Rock Breaking – Blasting Technology 785	PRX 785	16
Rock Breaking – Drilling and Explosives 784	PRX 784	16
Rock Support Pillars 790	PSZ 790	16
Slope Stability 781	PHS 781	16
Strata Control – Collieries 788	PSZ 788	16
Strata Control – Hard Rock Service Excavations 787	PSZ 787	16
Strata Control – Hard Rock Stoping 786	PSZ 786	16
Strip Mining 789	PSY 789	16
Surface Mining 783	POY 783	16
Underground Coal Mining 782	POS 782	16

(i) MODULES FROM OTHER DEPARTMENTS

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

Engineering Geology 703	IGL 703
Engineering Geology 704	IGL 704

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

First Semester	
Algebra 711	WTW 711
Combinatorics 785	WTW 785
Functional Analysis 710	WTW 710
Measure Theory and Probability 734	WTW 734
Numerical Analysis 733	WTW 733
Second Semester	
Financial Engineering 742	WTW 742
Finite Element Methods 763	WTW 763
Mathematical Logic 745	WTW 745
Partial Differential Equations 766	WTW 766
Topology 790	WTW 790

Postgraduate modules 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

BACHELOR OF SCIENCE (HONOURS) [BSc(Hons)]

Eng. 22
Also consult the General Regulations G.16 to G.29.

(a) Admission requirements: An appropriate bachelor's degree or equivalent qualification.
(b) The minimum duration of the programme is one year of full-time study.
(c) A minimum of 128 credits is required to obtain the BSc(Hons) degree.
(d) The BSc(Hons) degree may be obtained in the following fields of study:

(i)	Applied Sciences	(Code 12243010)
(ii)	Biosystems	(Code 12241121)
(iii)	Chemical Technology	(Code 12241011)
(iv)	Control	(Code 12241181)
(v)	Corrosion	(Code 12241191)
(vi)	Electronics	(Code 12241111)
(vii)	Electrotechnics	(Code 12241031)
(viii)	Environmental Technology	(Code 12241171)
(ix)	Geotechnics	(Code 12241001)
(x)	Industrial Systems	(Code 12241161)
(xi)	Irrigation	(Code 12241041)
(xii)	Mechanics	(Code 12241201)
(xiii)	Metallurgy	(Code 12241061)
(xiv)	Mine Strata Control	(Code 12241151)
(xv)	Mining Environment Control	(Code 12241071)
(xvi)	Quality Assurance and Reliability	(Code 12241101)
(xvii)	Structural Materials	(Code 12241141)
(xviii)	Technology Management	(Code 12241072)
(xix)	Transportation Planning	(Code 12241091)
(xx)	Water Resources	(Code 12241081)
(xxi)	Water Utilisation	(Code 12241021)

(e) The stipulations of Reg. Eng. 19 (d) to (g) apply *mutatis mutandis*.

MASTER OF SCIENCE (MSc)

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

(a) Subject to the stipulations of Regulation G.62, an appropriate Bachelor's degree is required for admission. In the field of Applied Sciences a BSc(Hons)(Applied Science) is required, except when specialising in Project Management or Engineering 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 directions of Engineering Management and Project Management.
(c) A minimum of 256 credits is required to obtain the MSc degree. Either a Project (32 credits) or a Dissertation (128 credits) is included in the programme. Recognition is

granted for credits acquired during studies for the BSc(Hons), but this qualification is not a prerequisite for admission to most of the MSc programmes.

(d) The stipulations of Regulation Eng. 20 (d) to (j) apply *mutatis mutandis*.

COMBINED CURRICULA FOR THE BSc(Hons) AND THE MSc PROGRAMMES

Eng. 24

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

(a) APPLIED SCIENCES

BSc(Hons)(Applied Sciences)(12243010)
MSc(Applied Sciences)(12253030)
This qualification follows upon the BSc(Hons)(Applied Sciences).

The intended programme for the **BSc(Hons)(Applied Sciences)** and the **MSc(Applied Sciences)** must be discussed and arranged with the relevant Head of Department. The available modules for these programmes are given in the next pages under the various departments and are similar to those for the other BSc(Hons) and MSc programmes. Students registered for the **BSc(Hons)(Applied Sciences)** are also allowed to register for a number of selected modules from the fourth year of the BEng (undergraduate) programmes, which must be chosen in consultation with the Head of the Department. In addition, the following modules are also available to students registered for the **BSc(Hons)(Applied Sciences)**:

	Code	**Credits**
Presented by the Department of Metallurgical Engineering:		
Basic Physical Metallurgy 701	NFM 701	32
Basic Hydrometallurgy 701	NHM 701	32
Basic Pyrometallurgy 701	NPM 701	32
Presented by the Department of Civil Engineering:		
Basic Concrete Structures 781	SIC 781	16
Basic Fundamental Hydraulics 782	SHW 782	16
Basic Mechanics of Structural Members	SID 783	16
Basic Soil Mechanics 782	SGM 782	16
Basic Soil Technology 781	SGM 781	16
Basic Paving Materials and Design	SGM 783	16
Basic Statistical Methods 790	SHC 790	16
Basic Steel Design 783	SIC 783	16
Basic Structural Analysis 782	SIC 782	16
Basic Applied Hydraulics 784	SHW 784	16
Basic Traffic Engineering 785	SVV 785	16
Basic Transportation Engineering 784	SVV 784	16

(b) CHEMICAL ENGINEERING

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

BSc(Hons)(Chemical Technology)(12241011)
MSc(Chemical Technology)(12251011)

	Code	Credits
Dissertation 890	CIR 890	128
Project 891	CSC 891	32
Air Pollution Control Design 787	CLO 787	16
Chemical Engineering 707	CIR 707	32
Chemical Engineering 787	CIR 787	16
Cost Optimisation 781	CKO 781	16
Cost Optimisation 782	CKO 782	16
Multivariable Control Systems Design 787	CBO 787	16
Multivariable Control Systems Theory 787	CBT 787	16
Plant Design 787	CAO 787	16
Polymer Chemistry 780	CPC 780	16
Polymer Engineering 787	CPI 787	16
Polymer Modification 780	CMD 780	16
Polymer Physics 780	CPF 780	16
Polymer Processing 727	CPP 727	16
Polymer Materials Science 710	CPW 710	16
Process Modelling 787	CPM 787	16
Process Integration 787	CIP 787	16
Process Synthesis 787	CSI 787	16
Reactor Design 700	CRO 700	32
Reactor Design 780	CRO 780	16
Separation Processes 787	CSK 787	16
Systematic Process Control Development 787	CSP 787	16

BSc(Hons)(Control)(12241181)
MSc(Control)(12251181)

	Code	Credits
Dissertation 890	CBH 890	128
Project 893	CSC 893	32
Advanced Process Control Applications 787	CGP 787	16
Multivariable Control Systems Design 787	CBO 787	16
Multivariable Control Systems Theory 787	CBT 787	16
Plant Design 787	CAO 787	16
Process Control Laboratory 780	CPL 780	16
Process Modelling 787	CPM 787	16
Systematic Process Control SystemsDevelopment 787	CSP 787	16

BSc(Hons)(Environmental Technology)(12241171)
MSc(Environmental Technology)(12251171)

	Code	Credits
Dissertation 890	COI 890	128
Project 894	CSC 894	32
Air Pollution Control 781	CLS 781	16
Air Pollution Control Design 887	CLO 887	32
Air Quality Management 780	CLK 780	16
Environmental Management 780	COM 780	16

Environmental System Design 887	COO 887	32
Life Cycle Assessment 780	CLC 780	16
Waste Management 780	WSM 780	16
Waste Treatment and Disposal 787	WST 787	16
Water Management 780	CWB 780	16
Water Treatment 787	CWT 787	16

BSc(Hons)(Water Utilisation)(12241021)
MSc(Water Utilisation)(12251021)

	Code	**Credits**
Dissertation 890	WBI 890	128
Project 897	WSC 897	32
Advanced Biological Treatment 787	WBA 787	16
Advanced Unit Processes 787	WUA 787	16
Advanced Water Microbiology 780	WMA 780	16
Advanced Water Treatment 787	WTA 787	16
Biological Treatment 787	WBB 787	16
Biological Water Treatment 787	WBW 787	32
Chemical Water Treatment 787	WCW 787	32
Conventional Water Purification 787	WTB 787	16
Industrial Water Treatment 787	WIB 787	16
Plant Design 787	WAO 787	16
Plant Design and Waste Water Treatment 887	WRO 887	32
Plant Design and Water Treatment 887	WDO 887	32
Unit Processes 787	WUB 787	16
Waste Management 787	WSM 787	16
Waste Management 780	WAI 780	32
Waste Sources and Impacts 787	WSI 787	16
Waste Treatment and Disposal 787	WTD 787	16
Water Chemistry 780	WCB 780	16
Water Microbiology 780	WMB 780	16
Water Quality Assessment 780	WQA 780	16
Water Quality Management 780	WQM 780	16

(c) CIVIL AND BIOSYSTEMS ENGINEERING

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

BSc(Hons)(Transportation Planning)(12241091)
MSc(Transportation Planning)(12251091)

	Code	**Credits**
Dissertation 890	SIR 890	128
Project 898	SSC 898	32
Asphalt Technology 787	SGC 787	16
Geometric Design 783	SVV 783	16
Pavement Design 781	SGC 781	16
Public Transport 780	SVV 780	16
Road Rehabilitation Technology 786	SGC 786	16
Stabilised Materials and Compaction 788	SGC 788	16

Statistical Methods 789	SHC 789	16
Traffic Engineering 787	SVC 787	16
Traffic Flow Theory 784	SVC 784	16
Traffic Safety 781	SVV 781	16
Transportation Economics 782	SVV 782	16
Transportation Logistics 786	SVV 786	16
Transportation Management 787	SVV 787	16
Transportation Planning 781	SVC 781	16
Transportation Special 788	SVC 788	16
Transportation Studies 782	SVC 782	16

BSc(Hons)(Water Resources)(12241081)
MSc(Water Resources)(12251154)

	Code	**Credits**
Dissertation 890	WKB 890	128
Project 899	SSC 899	32
Environmental Impact Studies 788	SHC 788	16
Flood Hydrology 783	SHC 783	16
Free Surface Flow 781	SHC 781	16
Geohydrology 710	SGH 710	16
Hydraulic Design 787	SHC 787	16
Pipe Flow 782	SHC 782	16
Rural Water Supply 780	SHC 780	16
Special Aspects of Pipe Systems 781	SHW 781	16
Special Hydraulics 785	SHC 785	16
Special Hydrology 786	SHC 786	16
Water Resources Management 784	SHC 784	16

BSc(Hons)(Geotechnics)(12241001)
MSc(Geotechnics)(12251201)

	Code	**Credits**
Dissertation 890	SGI 890	128
Project 895	SGT 895	32
Advanced Geotechnical Design 780	SGS 780	16
Advanced Geotechnical Laboratory Testing 783	SGS 783	16
Critical State Soil Mechanics 786	SGT 786	16
Geotechnics and Foundation Engineering 780	SGT 780	16
Geotechnics Special 780	SGC 780	16
In situ Soil Testing and Monitoring 782	SGS 782	16
Slope Stability and Retaining Structures 781	SGS 781	16

BSc(Hons)(Structural Materials)(12241141)
MSc(Structural Materials)(12251141)

	Code	**Credits**
Dissertation 890	SIN 890	128
Project 896	SSC 896	32
Analysis of Plate Structures 784	SIN 784	16
Commercial Buildings 786	SIC 786	24
Concrete Structures I 787	SIC 787	24

Concrete Structures II 788	SIC 788	24
Concrete Technology 784	SGC 784	16
Frame Analysis 782	SIN 782	16
Prestressed Concrete Structures 781	SID 781	24
Steel Structures Design 784	SIC 784	24
Steel Structures II 789	SIC 789	24
Structural Design Special 788	SIN 788	16
Theory of Structures Special 789	SIN 789	16
Timber Structures 782	SID 782	24
Water-retaining Concrete Structures 789	SIB 789	16

BSc(Hons)(Irrigation)(12241041)
MSc(Irrigation)(12251041)

	Code	**Credits**
Dissertation 890	LIR 890	128
Project 895	LSC 895	32
Advanced Coursework 803	LTD 803	32
Agricultural Engineering Special 700	LIS 700	32
Agricultural Production Equipment 702	LPW 702	32
Building and Planning 710	LBG 710	16
Food Engineering 720	LVI 720	16
Food Engineering Special 700	LVI 700	32
Irrigation 700	LBP 700	32
Machine Design 700	LWO 700	32
Processing 710	LPR 710	16
Rural Energy Sources 705	LEB 705	16
Rural Natural Resources 704	LHZ 704	32
Rural Services 703	LBD 703	16

(d) ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

A limited number of appropriate modules from other Departments and from other divisions of Electrical, Electronic and Computer Engineering are allowed.

BSc(Hons)(Electrotechnics)(12241031)
MSc(Electrotechnics)(12251031)

	Code	**Credits**
Dissertation 890	EIR 890	128
Project 895	ESC 895	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Control Practice 780	EBB 780	32
Control Systems Mathematics 781	EBB 781	32
Electrical Drives 780	ETE 780	32
Electromagnetic Compatibility 780	EME 780	32
Energy Management and Electricity Tariffs 880	ENE 880	32
Engineering Mathematics 780	ENM 780	32
Introduction to Energy Management 780	ENB 780	32
Non-linear Control 780	EBN 780	32
Optimal Control 780	EBO 780	32

Power Electronics 780	EED 780	32
Power Network Information Systems 780	EBF 780	32
Power Network Analysis and Modelling 780	EKE 780	32
Power Network Reliability and Quality of Supply 781	EKE 781	32
Power Network Stability 882	EKE 882	32
Protection 780	EBV 780	32

BSc(Hons)(Electronics)(12241111)
MSc(Electronics)(12251111)

	Code	**Credits**
Dissertation 890	EIN 890	128
Project 896	ESC 896	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Advanced Optical Fibre Communication Systems 880	EFC 880	32
Antenna Theory 780	EMA 780	32
Control Mathematics 781	EBB 781	32
Control Practice 780	EBB 780	32
Electromagnetic Compatibility 780	EME 780	32
Engineering Mathematics 780	ENM 780	32
e-Business Security 880	ETS 880	32
Engineering Profession 780	EIX 780	32
Information Security 780	ETH 780	32
Information Theory and Coding 780	ETI 780	32
Microwave Theory 780	EMM 780	32
Mobile Communications 880	ETR 880	32
Non-linear Control 780	EBN 780	32
Optical Fibre Communication Systems 780	EFC 780	32
Optimal Control 780	EBO 780	32
Radiowave Propagation 780	ERD 780	32

BSc(Hons)(Biosystems)(12241121)
MSc(Biosystems)(12251121)

	Code	**Credits**
Dissertation 890	EIB 890	128
Project 896	ESC 896	32
Advanced Literature Study 788 *(only M-students)*	EXL 788	32
Bio-Engineering 780	EPN 780	32
Biosystems 780	EPB 780	32
Engineering Mathematics 780	ENM 780	32
Ergonomics and Bio-Materials 780	EPE 780	32
Neuro Engineering 781	EPH 781	32

(e) ENGINEERING AND TECHNOLOGY MANAGEMENT

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

MSc (Engineering Management)(12251071)

	Code	Credits
Dissertation 890	IGB 890	128
Project 896 (MSc)	IGB 896	32
Decision Analysis 804	IBD 804	16
Development Management 801	IOB 801	16
Engineering Logistics 801	IIX 801	16
Financial Management 830	FBS 830	16
General Management 884	ALB 884	16
Human Resource Management 883	PEM 883	16
Information Management 884	ILB 884	16
Maintenance Management 801	IIB 801	16
Marketing Management 884	BEM 884	16
New Ventures and Entrepreneurship 801	IOE 801	16
Production and Operations Management 801	IPP 801	16
Project Management 803	IPK 803	16
Quality Management 803	IKK 803	16
Safety, Health and Environment 801	IVG 801	16
Strategic Management 802	ISM 802	16
Systems Engineering 801	ISI 801	16
Technology Management 801	ITB 801	16

MSc(Project Management)(12251073)

	Code	Credits
Project 896 (MSc)	ISC 896	32
Engineering Logistics 801	IIX 801	16
General Management 801	IAB 801	16
Introduction to Project Management 801	IPM 801	16
Law Aspects of Project Management 802	ILC 802	16
Literature Study 801	ILS 801	16
Literature Study 802	ILS 802	16
New Ventures and Entrepreneurship 801	IOE 801	16
Principles of Project Finance 801	IPF 801	16
Project Cost Management 801	IKB 801	16
Project Human Resource Development 801	IHR 801	16
Project Management Practice 801	IMP 801	16
Project Procurement Management 801	IPJ 801	16
Project Quality Management 801	IQM 801	16
Project Risk Management 801	IRM 801	16
Project Systems Engineering 802	ISI 802	16
Safety, Health and Environment 801	IVG 801	16
Strategic Management 803	ISM 803	16
Systems Engineering 801	ISI 801	16

BSc(Hons)(Technology Management)(12241072)
MSc(Technology Management)(12251072)
This qualification follows upon the BSc(Hons)(Technology Management)

	Code	Credits
Dissertation 891	ITB 891	128

Decision Analysis 780	IBD 780	16
Engineering Economics 780	IKN 780	16
Engineering Logistics 801	IIX 801	16
Innovation Strategy 780	INV 780	16
Maintenance Management 780	IMC 780	16
New Ventures and Entrepreneurship 780	IOE 780	16
Operational Management 781	IVV 781	16
Project Management 780	IPK 780	16
Systems Engineering 780	ISE 780	16
Technology Management 780	ITB 780	16

(f) INDUSTRIAL AND SYSTEMS ENGINEERING

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

BSc(Hons)(Industrial Systems)(12241161)
MSc(Industrial Systems)(12251161)
and
BSc(Hons)(Quality Assurance and Reliability)(12241101)
MSc(Quality Assurance and Reliability)(12251101)

	Code	**Credits**
Dissertation 890	BIR 890	128
Project 895	BSC 895	32

Modules from the list below are selected in consultation with the Head of the Department, in order to specialise in one of the abovementioned fields of study:

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

(g) MECHANICAL AND AERONAUTICAL ENGINEERING

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

BSc(Hons)(Mechanics)(12241201)
MSc(Mechanics)(12251151)

	Code	Credits
Dissertation 890	MIR 890	128
Project 895	MSC 895	32
Advanced Vehicle Engineering 732	MGV 732	32
Aerodynamics 780	MLD 780	16
Air Conditioning 780	MLR 780	16
Aircraft Design 780	MLW 780	16
Aircraft Propulsion Systems 732	MAY 732	32
Composite Materials	MCM 780	16
Condition-based Maintenance 732	MIC 732	32
Control Systems 732	MBB 732	32
Design 732	MOX 732	32
Dynamics 732	MSD 732	32
Finite Element Methods 732	MEE 732	32
Flight Mechanics 780	MLV 780	16
Fluid Mechanics 732	MSX 732	32
Gas Dynamics 732	MLG 732	32
Heat Transfer 732	MWX 732	32
Mathematical Optimisation 780	MWO 780	16
Numerical Thermoflow 732	MSM 732	32
Reliability Engineering 732	MIR 732	32
Smart Materials 780	MSA 780	16
Structural Integrity 732	MSI 732	32
Thermodynamics 780	MTX 780	16
Tribology 732	MIT 732	32
Vehicle Engineering 780	MVE 780	16
Vibration 732	MEV 732	32

(h) METALLURGICAL ENGINEERING AND MATERIALS SCIENCE

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

BSc(Hons)(Metallurgy)(12241061)
MSc(Metallurgy)(12251061)
and
BSc(Hons)(Corrosion)(12241191)
MSc(Corrosion)(12251191)

Dissertation 890	MIN 890	128

Modules from the list below are selected in consultation with the Head of the Department, in order to specialise in one of the abovementioned directions of study:

	Code	Credits
Corrosion 700	NKR 700	32
Extractive Metallurgy 700	NEM 700	32

Heat Treatment 700	NHB 700	32
Iron and Steel Smelting 700	NYS 700	32
Literature Survey 700	NLO 700	32
Mechanical Metallurgy 700	NMM 700	32
Metallurgical Problems 700	NPR 700	32
Metallurgical Process Analysis and Control 700	NPB 700	32
Minerals Processing 700	NMP 700	32
Physical metallurgy 700	NFM 700	32
Pyrometallurgy 700	NPM 700	32
Refractory Materials 700	NVM 700	32
Welding Metallurgy 700	NSW 700	32

(i) MINING ENGINEERING

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

BSc(Hons)(Mine Environment Control)(12241071)
MSc(Mine Environment Control)(12251081)
and
BSc(Hons)(Mine Strata Control)(12241151)
MSc(Mine Strata Control)(12251152)

	Code	**Credits**
Dissertation 890	MYI 890	128
Project 895	PSC 895	32

Modules from the list below are selected in consultation with the Head of the Department, in order to specialise in one of the abovementioned fields of study:

Advanced Mine Design 780	PMZ 780	16
Airflow and Fans 711	PKB 711	16
Dust, Gasses and Fires 713	PKB 713	16
Economics of Mining Environmental Control 714	PKB 714	16
Financial Mine Evaluation 780	PFZ 780	16
Heat and Cooling 712	PKB 712	16
Rock Breaking – Blasting Technology 785	PRX 785	16
Rock Breaking – Drilling and Explosives 784	PRX 784	16
Rock Support Pillars 790	PSZ 790	16
Slope Stability 781	PHS 781	16
Strata Control – Collieries 788	PSZ 788	16
Strata Control – Hard Rock Service Excavations 787	PSZ 787	16
Strata Control – Hard Rock Stoping 786	PSZ 786	16
Strip Mining 789	PSY 789	16
Surface Mining 783	POY 783	16
Underground Coal Mining 782	POS 782	16

DOCTOR'S DEGREES

DOCTOR OF PHILOSOPHY (ENGINEERING) [PhD(Engineering)]

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

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

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

(c) Unless 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 PHILOSOPHY (PhD)

Eng. 26
Also consult the General Regulations G.45 to G.62.

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

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

(c) Unless 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)

Eng. 27
The degree DEng is awarded on the basis of publications. The admission requirement is a PhD in Engineering or eqivalent qualification. Subject to General Regulation G.56, the following procedure is followed:

(a) **Faculty Committee**
A Faculty Committee, which is constituted by the Heads of Department 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 relevant 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 identifies suitable examiners.

(c) **Guidelines for the Selection Committee**
The Selection Committee uses the following guidelines to evaluate the candidate for the purpose of admission:
(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 (with the view on constituting the Examination Committee).
(i) The Selection Committee is guided by the stipulations set out in Reg. 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.

SUMMARY OF SYLLABI: BACHELOR OF ENGINEERING

Explanation of the codes attached to the name of each module:

Example: (MSD 210) **Dynamics 210, (16), 3-1-2, (C2, E2, L2, M2, N2, P2, Z2)**

(MSD 210): Module Code
MSD: A letter code of which the first letter identifies the department/division in the School of Engineering which is responsible for the presentation of the module, 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 (now part of Civil and Biosystems Engineering)
M	Mechanical and Aeronautical Engineering
N	Materials Science and Metallurgical Engineering
P	Mining Engineering
S	Civil Engineering (now part of Civil and Biosystems Engineering)

210: Numerical code
First digit: The level of the module (year of study in which the module is normally presented)
Second digit: 1, 5 or 7 = First Semester; 2, 6 or 8 = Second Semester
Third digit: Module number

(16): SAQA credit value of the module.

3-1-2: Division of the contact time during presentation of the module.
First digit: Number of lectures per week (50 minutes each)
Second digit: Number of tutorial classes per week (50 minutes each)
Third digit: Number of practical periods per week (45 minutes each)

(C2, E2, L2, M2, N2, P2, Z2): Field of study and year of study for which the module is offered.

Symbol	Field of Study
B	Industrial Engineering
C	Chemical Engineering
E	Electrical Engineering
R	Computer Engineering
Z	Electronic Engineering
L	Agricultural Engineering (now part of Civil and Biosystems Engineering)
M	Mechanical Engineering
N	Metallurgical Engineering
P	Mining Engineering
S	Civil Engineering (now part of Civil and Biosystems Engineering)

Summary of the syllabi of the undergraduate modules, alphabetically, in accordance with the module names:

(MLD 420) **AERODYNAMICS 420, (16), 3-0-1, (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, (11), 3-0-0, (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.

(LPW 411) **AGRICULTURAL PRODUCTION EQUIPMENT 411, (13), 2-1-2, (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, (15), 2-2-2, (L4)**
Project planning and management. Building materials, building appliances 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, (16), 3-1-1, (E3, Z3)**
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, (16), 3-1-1, (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.

(CBI 320) **BIOCHEMICAL ENGINEERING 320, (8), 2-0-1, (C3)**
Characterization 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 310/410) **BUSINESS LAW 310/410, (16), 4-0-0, (B3, 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.

(WTW 158) **CALCULUS 158, (16), 4-4-0, (B1, C1, E1, M1, N1, P1, R1, S1, Z1)**
Vector algebra with applications to geometry. Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, applications. The mean value theorem, the rule of L'Hospital. Definite and indefinite integrals, the fundamental theorem of Calculus, the mean value theorem for integrals, integration techniques. This module also includes a formal technique-mastering programme. This module is designed for first-year engineering students as well as students who require Mathematics at 100 level only.

(WTW 168) **CALCULUS 168, (8), 2-2-0, (B1, C1, E1, M1, N1, P1, R1, S1, Z1)**
Integration techniques, improper integrals. Applications of integration, introduction to differential equations. Elementary power series and Taylor's theorem. Vector functions, space curves and arc lengths. Quadric surfaces and multivariable functions. This module also includes a formal technique-mastering programme. This module is designed for first-year engineering students as well as students who require Mathematics at 100 level only.

(WTW 258) **CALCULUS 258, (8), 2-2-0, (B2, C2, E2, M2, N2, P2, R2, S2, Z2)**
Calculus of multivariable functions, directional derivatives. Extrema and Lagrange multipliers. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green. Surface integrals and the theorems of Gauss and Stokes.

(WTW 228) **CALCULUS 228, (8), 2-2-0, (B2, C2, E2, M2, N2, P2, R2, S2, Z2)**
Sequences and series, convergence tests. Power series and Fourier series with applications to differential equations.

(CHM 215) **CHEMISTRY 215, (16,) 3-1-3, (C2)**
Organic chemistry. Chemical properties of organic (including aromatic) compounds. Functional group transformation and synthesis.
Physical chemistry. Colloid chemistry. Surface chemistry and processes at solid surfaces. PVT properties of real gases.

(CHM 226) **CHEMISTRY 226, (8), 2-0-3, (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: potentiometrics, polarographics, electrogravimetrics, coulometrics, conductance methods.

(CIR 122) **CHEMICAL ENGINEERING 122, (16), 4-2-0, (C1)**
Units and dimensions. Methods to express concentration. Specific mass and density, specific volume, bulk density, density of ideal mixtures. Temperature and conversions. Pressure, absolute pressure and gauge pressure. Empirical formulae. Stoichiometric calculations. Material balances. Combustion calculations. Energy balances. Thermochemistry, enthalpies of pure substances and mixtures.

(CIR 213) **CHEMICAL ENGINEERING 213, (16), 4-2-0, (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. Miscible and immiscible systems. 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, (15), 3-2-0, (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 121) **CIRCUITS 121, (16), 3-1-1, (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 and noninverting amplifiers, summing amplifiers, current sources, integrators.

(EBN 210) **CIRCUITS 210, (16), 3-1-1, (E2, R2, Z2)**
Transient response phenomena in RC, RL and RLC circuits, natural response and step response. Alternating current circuits: Impedances, phasors, solution of single-phase and three-phase circuits by use of complex algebra, Ohm's law in AC circuits, Kirchoff's circuit theorems, matrix methods, 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 321) **CIVIL BUILDING MATERIALS 321, (16), 3-1-2, (S3)**
The behaviour, properties and application of cement and concrete products, structural steel, structural timber, fibre reinforcing, polimers, masonry work, epoxies and bituminuous materials.

(SBZ 310) **CIVIL CONSTRUCTION ECONOMICS 310, (8), 2-1-1, (S3)**

(SSC 120) **CIVIL ENGINEERING DESIGN 120, (16), 2-2-4, (S1)**
The use of drawings as a communication medium in Civil Engineering. Training in computer-aided draughting, conceptual design and group work with applications in road design, structures and services.

(SON 421) **CIVIL ENGINEERING DESIGN PROJECT 421, (80), 10-0-20, (S4)**
The objective of the module is the development of the student's ability to synthesise his/her 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) by means of a physical, complex project on Civil Engineering. The additional topics discussed 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 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.

(SBZ 221) **CIVIL ENGINEERING MEASUREMENT TECHNIQUES 220, (8), 2-0-1, (S2)**
Measurement instruments and measurement techniques used in engineering applications. Theory of the Wheatstone bridge and the application of strain gauges to measurement instruments. Accuracy, precision, resolution, hysteresis and linearity. Load cells, pressure transducers, displacement transducers, stress cells and inclinometers.

(SSC 410) **CIVIL ENGINEERING PROJECT 410, (16), 0-0-8, (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.

(JSQ 226) **COMMUNICATION SKILLS 226, (8), 1-2-0, (B2, C2, E2, M2, N2, P2, R2, S2, Z2)**
The module focuses on the development of effective communication skills within the field of engineering. It builds on the first-year module *Innovation 110*. The approach is problem-centred. Through the preparation of projects and assignments, practice is provided in listening, reading, writing, the interpretation of data and information (in graphic, tabular and diagrammatic form), as well as in reflection, in the expression of opinion, and in exercising judgement. Some exercise is given in creative problem solving techniques and effective co-operation, as well as in negotiation skills and conflict resolution. The main focus of the module, however, is on report writing, public speaking, making presentations, handling meetings and questions, and thoroughly preparing for these. In order to illustrate the complementarity of different styles of thinking and action, a co-operative approach to learning is encouraged.

(BSQ 420) **COMMUNICATION 420, (2), 0-1-0, (B4)**
Class discussions of papers prepared and presented by students. Principles and requirements for successful written and verbal communication.

(CSQ 311) **COMMUNICATION 311, (8), 2-2-0, (C3)**
Discussion of practical training and aspects of the Chemical Engineering industry. Principles of effective communication and reporting. The elements of a good technical report. Sources of information and accessing. Communication

(CSQ 421) **COMMUNICATION 421, (4), 0-2-0, (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, (2), 0-1-0, (L3)**
Principles and forms of verbal and written communication. Delivering speeches on various subjects.

(MSQ 413) **COMMUNICATION 413, (2), 0-1-0, (M4)**
(MSQ 423) **COMMUNICATION 423, (2), 0-1-0, (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 400) **COMMUNICATION 400, (2), 0-1-0, (N4)**
Attendance of forums. Participation and presentation of posters at prearranged poster sessions. Attendance at and participation of engineering seminars.

(SSQ 411) **COMMUNICATION 411, (7), 1-1-1, (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 second-year of study but before registration for the fourth year of study. Presentation on the research projects, with evaluation and feedback.

(BRV 320) **COMPUTER-AIDED MANUFACTURING 320, (8), 2-0-1, (B3)**
Basic manual programming of CNC machines. Advanced three-dimensional surface programming. Parameter programming. Post-processors for CNC machines. High-speed machining.

(EAS 410) **COMPUTER ENGINEERING: ARCHITECTURE AND SYSTEMS 410, (16), 3-1-1, (R4)**
A systems approach to advanced computer architecture. The features of RISC and SISC architecture, detailed examination of the instruction cycle. Multiprocessor techniques. SIMD, MIMD and SISD systems.

(CRV 210) **COMPUTER LITERACY 210, (8), 0-4-0, (C2, L2, N2, P2)**
Solution of typical chemical engineering problems with the aid of self-developed computer programmes. 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.

(ERN 310) **COMPUTER NETWORKS 310, (16), 3-1-1, (R3)**
Terminology of communication systems, hierarchy of protocols according to OSI model, applications to communication systems, high-speed networks, ISDN and distributed systems. LAN and WAN technologies.

(SIB 320) **CONSTRUCTION MANAGEMENT AND EQUIPMENT 320, (8), 2-1-0, (S3)**
Construction equipment: Introduction of basic construction equipment, pre-planning, production planning, working techniques. Contract Documentation: Bill of Quantities and specifications.

(EBB 320) **CONTROL SYSTEMS 320, (16), 3-1-1, (E3, R3, Z3)**
Modelling and simulation of physical systems. Block and signal flow diagrams. State variable formulation. Time and frequency domain analysis, continuous and discrete time. Stability and sensitivity. Design methods, cascade (eg. PID) and feedback controllers. Observers.

(MBB 410) **CONTROL SYSTEMS 410, (15), 3-0-2, (M4)**
Introduction to control systems. Modelling of dynamic systems. Transfer functions. Block diagrams and block diagramme algebra. Linearising of non-linear systems. Disturbance signals. Steady-state accuracy. Control systems characteristics. Analysis of control systems using Laplace transformations. Root loci. Bode diagrams. Design of compensators using bode diagram and root locus techniques. Controls laboratory.

(NKR 410) **CORROSION 410, (17), 3-0-4, (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.

(ECB 410) **CYBERNETICS 410, (16), 3-1-1, (Z4)**
Bioengineering: The role of the bioengineer, electrical safety and legislation. Measurement and application of biological signals: Organization of the human body, homeostasis, building blocks of life, neurophysiology, cardiovascular system and biopotentials, muscle physiology and biopotentials, biopotential amplifiers, biopotential electrodes, therapeutic and prosthetic devices. Use of biological models in design: Physiological versus engineering control systems, control of simple robots by biologically based controllers like neural networks, fuzzy logic and genetic algorithms.

(EPE 210) **DATA STRUCTURES AND ALGORITHMS 210, (16), 3-1-1, (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 is C++.

(COX 420) **DESIGN 420, (9), 2-0-1, (C4)**
Application of chemical engineering principles for the optimum design of chemical process units and safety systems.

(LOX 421) **DESIGN 421, (13), 2-1-1, (L4)**
Application of engineering principles in the execution of a comprehensive design.

(MOX 410) **DESIGN 410, (13), 0-0-7, (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, (28), 4-2-2, (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, (16), 3-1-1, (E3, Z3)**
(EOV 321) **DESIGN AND MANUFACTURING 321, (16), 3-1-1, (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, (26), 0-1-14, (C4)**
Application of chemical engineering principles for the complete design of a chemical plant.

(SSI 310) **DEVELOPMENT AND SOCIETY 310, (8), 2-1-0, (S3)**
Engineering and public health, community development, sustainability of engineering infrastructure, community participation, urban engineering services.

(IOB 320) **DEVELOPMENT MANAGEMENT 320, (8), 2-1-0, (C3, M3, N3, P3)**
Elements of Systems and Projects: life cycle of systems, products and projects, technical systems and the environment, selection of systems or products. Systems engineering: evolution of systems engineering, system concept and philosophy, system hierarchy, systems and system characteristics, design and development of complex systems, system effectiveness, test and evaluation, system engineering tools, documentation and configuration management, technology management. Project management: evolution of project management, definitions and terminology, project organisations, work breakdown structures, planning and scheduling, network diagrams, critical paths, project budgets, project control. Case studies of development management.

(WTW 256) **DIFFERENTIAL EQUATIONS 256, (8), 2-2-0, (B2, C2, E2, M2, N2, P2, R2, S2, Z2)**
Theory and solution methods for linear differential equations as well as for systems of linear differential equations. Theory and solution methods for first order non-linear differential equations. The Laplace transform with application to differential equations. Application of differential equations to model problems.

(ESF320) **DIGITAL COMMUNICATION SYSTEMS 320, (16), 3-1-1, (R3)**
Basic Signals Theory, Transform theory (Fourier, Laplace and Z-transform) and Linear Systems. Overview of stochastic processes: Stationarity and ergodicity. Noise and channel models. Transmission effects. Definition of information and coding of analog information sources. Shannon's Channel Capacity Theorem. Introduction to channel (error) detection and correction coding: Block and Convolutional coding. Maximum-Likelihood Sequence Decoding: The Viterbi algorithm. Analysis of Digital Modulation Techniques in AWGN. Optimal Receiver design. Nyquist and Partial-Response systems. Power Spectral Density (PSD) of random data signals. Digital Transmission through bandlimited channels: ISI, Nyquist criteria and equalizers. Data communication

standards and protocols. The focus will be on applications in the computer and network environments.

(EMS 311) **DIGITAL MODULATION SYSTEMS 311, (16), 3-1-1, (R3)**
Review of Signal Theory, Linear System Theory and the Fourier Transform (time-frequency relationships). Convolution and Correlation. Analog and hybrid modulation systems: AM, PM, FM, PAM, PCM, Delta-Modulation, PWM. Carrier synchronization. Communication channels and transmission effects. Sampled Systems. Source digitization (D/A conversion), quantisation noise. Formatting and line codes. Spectral characteristics of random data signals. Introduction to digital modulation. Binary modulation techniques: PSK, FSK and ASK. Symbol synchronization. PLL theory. Matched filter concepts. Simulation and practical implementation of simple digital communication building blocks. The focus will be on digital modulation techniques in landline and line networks.

(ERS 220) **DIGITAL SYSTEMS 220, (16), 3-1-1, (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.

(ESP 411) **DSP PROGRAMMING AND APPLICATION 410, (16), 3-1-1, (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 and DSP-processors; Mapping of DSP-algorithms onto DSP-hardware. Projects: Simulation (in C) and real-time implementation of selected signal processing algorithms on DSP-hardware.

(MSD 210) **DYNAMICS 210, (16), 3-2-0, (B2, C2, E2, M2, N2, P2, Z2)**
Kinetics of systems of particles, steady mass flow. Plane kinematics of rigid bodies. Moments and products of inertia. Plane kinetics of rigid bodies, equations of motion, work-energy relations. Vibration and time response.

(EHN 410) **e-BUSINESS AND NETWORK SECURITY 410, (16), 3-1-1, (R4)**
Commerce via the Internet, electronic payment systems, virtual organizations and electronic business. Introduction to data security, system security, network security, user considerations, firewalls, encryption, access control and social engineering.

(GLY 323) **ECONOMIC GEOLOGY 323, (18), 4-0-5, (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: Sedimentary petrography, ore microscopy, mineral associations, hand specimens.

(EEO 410) **ELECTRICAL DESIGN 410, (16), 3-1-1, (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 220) **ELECTRICAL ENGINEERING 220, (16), 3-1-1, (B2, C2, 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.

(ELX 310) **ELECTRICAL MACHINES 310, (16), 3-1-1, (E3)**
Magnetic circuits: Flux, flux density, reluctance, hysteresis, MMF. Circuit principles: Balanced three phase circuit analysis, per unit analysis. Machine principles: Torque, speed, efficiency and heat loss. Machinery: Power transformers, DC generators, DC motors, three-phase and single-phase induction motors.

(EMZ 310) **ELECTROMAGNETICS 310, (16), 3-1-1, (E3, Z3)**
Vector analysis, gradient, divergence, curl. Static electric fields. Static magnetic fields. Potential. Materials. Energy, magnetic circuits, force and torque. Faraday's law, time-varying fields, Maxwell's equations, potential functions and boundary relations. Introduction to transmission lines.

(EMZ 320) **ELECTROMAGNETICS 320, (16), 3-1-1, (Z3)**
Propagation and reflection of plane waves and power flow. Transmission lines; Smith Charts, matching networks, lossy lines. Waveguides; planar transmission lines, rectangular waveguides, resonant cavities. Antennas; antenna parameters, dipoles, linear arrays, aperture antennas, Friis transmission equation, radar equation.

(ELK 220) **ELECTRONIC COMPONENTS 220, (16), 3-1-1, (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 MESVETS. Small-signal analysis. Basic transistor circuit configurations. Transistor biasing concepts. Transistor switches. Digital components. Power devices. Heat sinks. Two-port networks. Noise. Operational amplifiers.

(ETN 322) **ELECTROTECHNICS 322, (16), 3-1-1, (M3)**
AC theory: Phasors, impedance, power, filters, resonance. Machines and transformers: Characteristics, construction, operation and equivalent circuits of direct current, synchronous and induction machines. Theory, use and maintenance of transformers. Electronics: Electronic components: bipolor and field effect transiston: analogue amplifier circuits, sensors (range, linearity, accuracy, stability, sensitivity, calibration), measuring techniques.

(ETN 420) **ELECTROTECHNICS 420, (13), 3-1-1, (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 113) **ENGINEERING DRAWING 113, (16), 3-0-3, (B1, C1, N1, P1)**
Freehand sketching covering the following: perspective, isometric and orthographic drawings. Drawing conventions, graphical techniques and assembly drawings. Evaluation of drawings and error detection. True lengths of lines in space, projections and intersections. Practical applications of these techniques. Introduction to computer-aided drawings, including dimensioning, crosshatching and detailing. Introduction to basic machine components like bearings, clutches, brakes etc.

(BIE 310) **ENGINEERING ECONOMICS 310, (8), 2-1-0, (S2, B3, M3, N3, P3)**
Money – Time relationships and equivalence (Interest formulae , effective interest rate , bonds and loans) , Bases for comparison of alternatives (present worth , annual worth , Internal rate of return , external rate of return , investment balance diagrams , economic value added {EVA} . Decision making among alternatives (useful lives equal to study period , useful lives different among alternatives , mutually exclusive alternatives in terms of combinations of proposals). The influence of inflation on engineering economic calculations . Decision making among alternatives on an after tax basis. Replacement analysis (the economic life of an asset, retirement without replacement). Evaluating projects with the Benefit/Cost Ratio method.

(EGA 110) **ENGINEERING GRAPHICS 110, (8), 1-0-2, (E1, R1, Z1)**
Free-hand sketches, Computer-Aided Design (CAD), presentation graphics, elementary descriptive geometry, isometric, perspective and 3D drawings.
Mechanical assembly drawings: packaging, containers, heatsinks, physical component packages, tolerances, pylon support structures, connectors.
Electrical and electronic drawings: symbols vs physical components, electrical and electronic circuit symbols, drawing standards, PCB layouts, wiring diagrams.
Computer drawings: computer network symbols and drawings, drawing standards, flow diagrams.

(BES 210) **ENGINEERING STATISTICS 210, (8), 2-1-0, (B2, N2, P2, S2, C3, M3)**
Engineering systems are often subjected to variation, uncertainty and incomplete information. Mathematical statistics provides the basis for effectively handling and quantifying the effect of these factors. This module provides an introduction to the concepts of mathematical statistics and will include the following syllabus themes: data analysis, probability theory, stochastic modelling, statistical inference, regression analysis and an introduction to experimental design.

(BIS 210) **ENGINEERING STATISTICS 210, (16), 4-2-0, (E2, R2, Z2)**
Engineering systems are often subjected to variation, uncertainty and incomplete information. Mathematical Statistics provides the basis for effectively handling and quantifying the effect of these factors. The first module will provide an introduction to the concepts of Mathematical Statistics and will include the following syllabus themes: data analysis, probability theory, stochastic modelling, statistical inference and regression analysis.
Mathematical Statistics provides the basis for a number of important applications in the engineering environment. The second module will provide an introduction to the most important of these applications, and includes the following syllabus themes: multi-variate data

analysis, Monte Carlo simulation, decision analysis, experimental design, forecasting, data-dependent modelling and an introduction to reliability engineering.

(COI 321) **ENVIRONMENTAL ENGINEERING 321, (16), 4-2-0, (C3)**
(COI 420) **ENVIRONMENTAL ENGINEERING 420, (17), 4-2-0, (C4)**
The influence of pollution on the natural environment. Dispersion of air pollution. Water utilization. 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.

(GLY 162) **ENVIRONMENTAL GEOLOGY 162, (8), 2-0-2, (P3)**
See Faculty of Natural and Agricultural Sciences Yearbook

(COM 420) **ENVIRONMENTAL MANAGEMENT 420 , (8), 2-1-0, (M3)**
Introduction and environmental awareness. Integrated environmental management processes. Responsible care in industry. Environmental auditing. Environmental law in South Africa. Environmental impact and risk assessments. ISO 14000: the what and why. Environmental economics and public participation.

(NEX 310) **EXCURSIONS 310, (8), 1-0-2, (N3)**
Attendance of and participation in industrial excursions organised during the year, including a four day excursion tour at the end of the first semester. Submission of reports and assignments as required.

(BFB 310) **FACILITIES PLANNING 310, (8), 2-1-0, (B3)**
Facilities planning process. Facilities location. Product development. Process planning, requirements and selection of equipment and labour. Production systems – process choice, group technology, manufacturing cells, flexible manufacturing and automation. Assembly line balancing, yield and cost models and machine coupling. Personnel requirements. Manufacturing support activity requirements. Materials handling and control - principles, equipment, system design, unit loads, flow lines, grouping and packaging. Storage and warehousing operations. Space requirements and layout planning. Visual management. Industry visits and facilities planning project.

(FBS 110) **FINANCIAL MANAGEMENT 110, (10) 3-0-0, (B3)**
Purpose and functioning of financial management. Basic financial management concepts. Accounting concepts and the use of the basic accounting equation to describe the financial position of a business. Recording of financial transactions. Relationship between cash and accounting profit. Internal control and the management of cash. Debtors and short-term investments. Stock valuation models. Depreciation. Financial statements of a business. Distinguishing characteristics of the different forms of businesses. Overview of financial markets and the role of financial institutions. Risk and return characteristics of various financial instruments. Issuing ordinary shares and debt instruments.

(FBS 120) **FINANCIAL MANAGEMENT 120, (10) 3-0-0, (B3)**
Analysis of financial statements. Budgeting and budgetary control. Tax principles and normal income tax for individuals. Time value of money and its use for financial and investment decisions. Calculating the cost of capital and the financing of a business to maintain the optimal capital structure. Capital investment decision and a study of the

financial Selection criteria in the evaluation of capital investment projects. The dividend decision and an overview on financial risk management.

(NHS 400) **FIRST-AID CERTIFICATE 400 (2), (B1, C1, L1, M1, N1, S1)**
Level 1 first-aid training at the end of the first year.

(MVM 410) **FLUID MACHINES 410, (13), 3-0-1, (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.

(MSX 310) **FLUID MECHANICS 310, (16), 3-0-1, (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. Experimental technique in fluid mechanics.

(MVK 410) **FLUID MECHANICS AND THERMODYNAMICS 410, (16), 3-0-1, (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 machnies, heat pumps. Theory of fluid mechanics: Hydrostatics, fluid dynamics, fluid properties, pipe friction, energy loss calculations.

(EXF 400) **FORUM 400, (2+2) 1-0-0, (E4, R4, Z4)**
Debating of professional and social aspects in relation to the engineering profession. Leaders in the South African industrial environment and evaluation of company strategies in the South African context. Examples of entrepreneurship, technological innovation, creativity management and the establishment of small businesses in South Africa. Introduction to research fields in electrical, electronic and computer engineering.

(CHM 171) **GENERAL CHEMISTRY 171, (16), 4-2-2, (B1, C1, E1, M1, N1, P1, S1, Z1)**
General introduction to inorganic and analytical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical reactions, redox reactions, solubilities, atomic structure, periodicity.
Inorganic and physical chemistry. Molecular structure and chemical bonding using the VSEPR and hybridisation models. Principles of reactivity, electrochemistry, energy and chemical reactions, entropy and free energy. Appropriate tutorial classes and practicals.

(CHM 181) **GENERAL CHEMISTRY 181, (16), 4-2-2, (C1, N1)**
General physical-analytical chemistry: Physical behaviour of gases, liquids and solids, intermolecular forces, solutions, chemical equilibrium, acids and bases, buffers, precipitation. Descriptive inorganic chemistry: Main group and transition elements.
Organic chemistry: Structure (bonding), nomenclature, isomerism, introductory stereo-chemistry, introduction to chemical reactions and chemical properties of organic compounds.
Appropriate tutorial classes and practicals.

(GIS 310) **GEOGRAPHIC INFORMATION SYSTEMS 310, (8), 2-1-1, (S3)**
The utilisation of information technology with special reference to geographic information systems, in the field of municipal infrastructure.

(SGM 210) **GEOMATERIALS AND PROCESSES 210, (16), 4-0-3, (S2)**
Introduction to basic geology and engineering geology, including geological stratigraphy, structural geology, rock identification, core logging and soil profiling. Basic rock mechanics including strength envelopes, slope stability and joint surveys.

(SMK 110) **GRAPHICS 110, (16), 4-0-3, (S1)**
Preparation of technical dawing of buildings, bridges and civil engineering structures. This includes freehand sketching, isometric dawings and basic plans which lead into Computer Aided Draughting and graphical techniques. Introduction to ortographic projections. True lengths and inclination angles. Analytical geometry. Application of these techniques in Engineering such as: Perspective drawings, shades, contours, projection and intersection planes and graphical solutions

(SGM 323) **GEOTECHNICAL ENGINEERING 323, (16), 3-1-2, (S3)**
Stresses at and stability of retaining walls. Bearing capacity of in situ soil. Stability of slopes and excavations. Pressure and buried structures. Piles. Ground anchors. Foundation investigation and design.

(CHO 321) **HEAT TRANSFER 321, (8), 2-2-0, (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, (13), 3-0-1, 4-0-1**
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.

(SVC 324) **HIGHWAY DESIGN 324, (8), 2-1-0, (S3)**
Vehicle characteristics; geometric road design, cross-section, horizontal and vertical alignment; road quantities and mass haul diagrams; urban streets; layout considerations and intersection design, traffic safety.

(GLY 161) **HISTORICAL GEOLOGY 161, (8), 2-0-2, (P3)**
See Faculty of Natural and Agricultural Sciences Yearbook

(SHC 310) **HYDRAULICS 310, (16), 4-1-1, (L3, S3)**
Fluid properties, hydrostatics, kinematics, measuring flow rate and velocity, potential flow, real fluids, pipe flow and municipal services.

(SHC 320) **HYDRAULICS 320, (8), 2-1-0, (S3)**
Pipe networks, pumps, water hammer analyses, free surface flows, introduction to water treatment and model analyses.

(SHC 410) **HYDRAULICS 410, (17), 2-3-2, (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, (15), 3-2-0, (L4)**
Dynamics of fluids in motion. Turbines, centrifugal and other pumps for agricultural use. Design of drainage schemes and canal systems.

(NHM 311) **HYDROMETALLURGY 311, (16), 3-0-4, (N3)**
Thermodynamics of hydrometallurgical and electrometallurgical processes. Introduction to kinetic principles of hydrometallurgical and electrometallurgical processes. Electrochemistry of leaching. Theory and practical examples of unit processes of leaching, concentration purification and reclamation. Practicals: Experimental characterisation of aspects of extraction processes.

(NHM 321) **HYDROMETALLURGY 321, (16), 3-0-1, (N3)**
Fundamentals of kinetics of hydrometallurgical operations, including chemical reaction control and mass transfer control. Extraction routes and metallurgy of gold, uranium, copper, nickel, cobalt, zinc, managanese and the platinum group metals. Practicals: Experimental characterisation of key aspects of extraction processes.

(NHM 410) **HYDROMETALLURGY 410, (20), 3-2-4, (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.

(BAN 222) **INDUSTRIAL ANALYSIS 222, (8), 2-1-0, (B2)**
Mathematical statistics provides the basis for a number of important applications in the engineering environment. This module provides an introduction to the most important of these applications, has Engineering statistics BES 210 as a prerequisite and will include the following syllabus themes : Multi-variate data analysis, Monte Carlo simulation, decision analysis, experimental design, forecasting, data-dependent modelling and an introduction to reliability engineering.

(BLK 320) **INDUSTRIAL LOGISTICS 320, (16), 4-2-0, (B3)**
Role of logistics in the economy and organisation. Customer service. Forecasting. Logistics information systems and electronic information flow. Inventory management. Managing materials flow. Distribution channels. Transportation. Warehousing. Packaging. Strategic purchasing. Global logistics. Organising and controlling logistics. Supply chain management. Implementing logistics strategy.

(CIC 311) **INDUSTRIAL CHEMISTRY 311, (8), 2-2-0, (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.

(PNB 310) **INDUSTRIAL EXCURSIONS 310, (8), 1-0-2, (P3)**
Attendance at and participation in an industrial excursion organised during the year, including a four-day tour at the end of the first semester. Submission of reports and assignments as required.

(LBC 320) **INDUSTRIAL PRINCIPLES 320, (11), 2-0-2, (L3)**
Laws. Engineering models for agricultural production. Mathematical modelling of implement systems. Project management and contracts.

(BID 320) **INFORMATION SYSTEMS DESIGN 320, (16), 4-2-0, (B3)**
System requirement analysis, structural analysis, system specification, structured designing of systems, data flow charts, database design and normalization, software design, the test plan, the control plan, implementation.

(EIT 111) **INFORMATION TECHNOLOGY 111, (16), 3-1-1, (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 organization: CPU, instruction sets, memory, storage devices, I/O devices and multimedia. Communication technologies: network topologies and protocols, WAN, LAN, routers and switches. Internet: WWW, e-mail, ftp, telnet, HTML: writing and publishing WWW pages and Java. System software: Operating systems, compilers, utility software. Applications software: Databases, spreadsheets, word processing, graphics software. Information literacy: Formulating search strategies, searching CD-ROMs and searching the Internet. Analysis, organizing and synthesis of information.

(CIL 110) **INFORMATION TECHNOLOGY 110, (8), 1-0-2, (B1, C1, M1, N1, P1, S1)**
Computer architecture and hardware: an overview of the different types of computers, information vs data, representation of data, computer architecture, and peripherals. System software: operating systems, compilers, utility software. Applications software: databases, spreadsheets, word processing, graphics software. Information literacy: formulating search strategies, searching CD-ROMs and searching the Internet. Analysis, organizing and synthesis of information.

(EIW 121) **INFORMATION TECHNOLOGY PRACTICE 121, (6), (R1)**
(EIW 221/320) **INFORMATION TECHNOLOGY PRACTICE 221/320, (8/8), (R2, R3)**
These modules are offered at the end of the first, second, third and fourth year of study. The duration is at least two weeks during which the students receive practical training in computers and computer networks. The modules may for practical reasons be offered in a different time slot (e.g. at the beginning of the next year of study).

(JNV 100) **INNOVATION 100, (4 + 4), 2-0-0,** (all first-year students who failed the language proficiency test)
The development of basic language proficiency in the context of and by means of examples from the engineering and technology environment.

(BNV 110) **INNOVATION 110, (8) 1-2-0, (B1)**
(CNV 110) **INNOVATION 110, (8) 1-2-0, (C1)**
(ENV 110) **INNOVATION 110, (8) 1-2-0, (E1, R1, Z1)**
(MNV 110) **INNOVATION 110, (8) 1-2-0, (M1)**
(NNV 110) **INNOVATION 110, (8) 1-2-0, (N1)**
(PNV 110) **INNOVATION 110, (8) 1-2-0, (P1)**
(SNV 110) **INNOVATION 110, (8) 1-2-0, (S1)**

This module introduces technological innovation via a historic perspective to create awareness and knowledge of landmark innovations in the various engineering disciplines. Knowledge of the roles of innovation in society, including the nature of work, environmental impact, legal and professional issues and ethical issues. Basic engineering skills, including observation, and interpretation of information, problem-solving skills (problem identification, idea generation, idea evaluation, implementation, assessment). A strong emphasis is placed on effective scientific and engineering communication skills (reading, interpretation of visual presentations, writing, listening and presenting in oral or printed format). Introduction to scientific integrity and engineering ethics. Management of engineering assignments (planning, time management and co-operation, and control) are practised in group assignments to foster creativity and innovation. A strong emphasis is placed on co-operative learning with support given to students regarding whole-brain thinking preferences and whole-brain group formation.

(EAI 310) **INTELLIGENT SYSTEMS 410, (16), 3-1-1, (R3)**
(EAI 410) **INTELLIGENT SYSTEMS 410, (16), 3-1-1, (R4)**
Practical application of neural networks, fuzzy logic, genetic algorithms and expert systems. Introduction to pattern recognition, optimization and problemsolving using intelligent systems techniques.

(EPE 111) **INTRODUCTION TO PROGRAMMING 111, (16), 3-1-1, (R1, E2, Z2)**
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.

(EPE 121) **INTRODUCTION TO PROGRAM DESIGN 121, (16), 3-1-1, (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 with respect to WWW- and computer network programming.

(PSC 321) **INTRODUCTION TO PROJECT 321, (8), 0-1-0, (P3)**
Identification of a suitable subject for Project 410. Detailed literature study with accompanying report. Planning of project execution.

(SIN 213) **INTRODUCTION TO STRUCTURAL DESIGN 213, (8), 2-1-0, (S2, L3)**
History and development of structures, structural failures, development of theory; environmental effects: loads (static and dynamic), temperature, load combinations; structural strength, stability, serviceability; structural safety, allowable stress design, limit states design; structural systems and load paths; structural elements and connections; material models; building construction; foundations; buildings and Bridges.

(GLY 151) **INTRODUCTORY GEOLOGY 151, (8), 2-0-2, (P3)**
See Faculty of Natural and Agricultural Sciences Yearbook

(MEG 123) **INTRODUCTORY MECHANICS 123, (16), 4-2-0, (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.

(LBP 420) **IRRIGATION 420, (17), 3-0-3, (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,(17), 3-0-3, (L3)**
Presented in the Faculty of Natural 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, (8), 2-1-0, (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 321) **LABORATORY 321, (8), 0-0-4, (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.

(ABV 320) **LABOUR RELATIONS 320, (11), 3-0-0, (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 161) **LINEAR ALGEBRA 161, (8), 2-2-0, (B1, C1, E1, M1, N1, P1, R1, S1, Z1)**
Vector algebra with applications, matrix algebra, systems of linear equations, the vector space R^n, bases, determinants. Mathematical induction. Complex numbers and factorisation of polynomials. Conic sections. This module also includes a formal technique-mastering programme. This module is designed for first-year engineering students as well as students who require Mathematics at 100 level only.

(ELI 220) **LINEAR SYSTEMS 220, (16), 3-1-1, (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.

(MOW 122) **MACHINE DESIGN 122, (16), 2-0-5, (B1, M1)**
Introduction to design and innovation. Engineering aspects of components, basic size calculations and the assembly of components by using functional sketches. Introduction

to workshop manufacturing processes, including sizes, fits and tolerances. Computer-aided solid modelling.

(MOW 212) **MACHINE DESIGN 212, (8), 1-0-4, (M2)**
Systems and safety factors, specification, life cycle, economic implications, choice of material, friction, wear and thin-film lubrication, journal bearings, rolling element bearings, bearing mounting and applications, design of a system, shaft calculations, stress concentrations and fatigue.

(MOW 216) **MACHINE DESIGN 216, (8), 1-0-4, (B2)**
Introduction to design, bearings and lubrication, bending and shear force diagrams, stress calculations, stress concentrations, fatigue, bolted connections and welds.

(MOW 222) **MACHINE DESIGN 222, (8), 1-0-4, (M2)**
System design and mechanism competition, mechanisms, belt and chain drives, clutches, brakes and shaft couplings, bolted connections – static and fatigue, welding design, casting design.

(MOW 312) **MACHINE DESIGN 312, (16), 3-0-3, (M3)**
Occupational safety act and codes, pressure vessels, design of ropes and lifting systems, design of gears and gear systems, springs, cams, material and material selection, tribology, lubrication and hydrodynamic bearings, contact stresses, ergonomics, costing, testing as part of the design process.

(MOW 323) **MACHINE DESIGN 323, (16), 3-0-5, (M3)**
Systems engineering applied within design like functional analysis, maintenance concept. Development of a small product. This part of the course is done in group context and the deliverable is a prototype of the product as well as a complete report.
Steel structures, applications and codes also incorporating finite element analysis

(MII 420) **MAINTENANCE ENGINEERING 420, (16), 3-0-1, (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, management approach, modelling.

(BSR 850) **MANAGEMENT ACCOUNTING 850, (11), 3-0-0, (B4)**
(BSR 860) **MANAGEMENT ACCOUNTING 860, (11), 3-0-0, (B4)**
Accounting and management accounting as an aid in management. Accounting principles, policy factors and uses. Alternative approaches in generally accepted accounting principles and their influence. Interpretation of published and other financial reports, assessment of amalgamation and pooling plans. Accounting data as a basis for control, policy 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 221) **MANUFACTURING SYSTEMS 221, (16), 3-1-1, (B2)**
Introduction to manufacturing, basic process knowledge, conventional manufacturing processes, modern manufacturing processes, manufacturing aids, safety and loss control.

(BVS 310) **MANUFACTURING SYSTEMS 310, (17), 3-3-1, (B3)**
Evaluation of product designs for manufacturability, choice of material, generic development methodology, design of manufacturing processes, process planning, specification of production facilities.

(BVS 410) **MANUFACTURING SYSTEMS 410, (15), 3-1-1, (B4)**
Logic circuits of process control. Microprocessors for measurement and control. PLC-control. Introduction to robotics.

(CMO 320) **MASS TRANSFER 320, (16) 4-2-0, (C3)**
Separation by means of equilibrium stages. Degrees of freedom. Graphical and algebraic solutions of binary single-stage, multi-stage and batch distillation problems. Azeotropic distillation. Design of plate columns. Graphical and algebraic analysis of absorption, stripping and extraction stage processes.

(NMC 122) **MATERIALS SCIENCE 122, (16), 4-1-1, (B1, E1, M1, N1, P1, Z1, C2)**
Introduction to materials: the family of materials, atomic structure and types of bonding, crystal types and space arrangement of atoms, directions and planes in crystals, defects in crystals, diffusion in solids. Mechanical properties of materials: stress and strain, mechanical testing (strength, ductility, hardness, toughness, fatigue, creep), plastic deformation, solid-solution hardening, recrystallisation. Electrical properties of materials: electrical conduction and the energy-band model, intrinsic and extrinsic semiconductors, the electrical properties of ceramics. Magnetic properties of materials: magnetic fields and quantities, types of magnetism, the nature and properties of ferrimagnetic and ferromagnetic materials. Polymeric materials: polymerisation and industrial methods, types of polymeric materials and their properties. Corrosion of metals: mechanisms and types of corrosion, corrosion rates, corrosion control.

(NMC 211) **MATERIALS SCIENCE 211, (8), 2-1-0, (M2)**
Introduction to materials selection. Phase diagrams, alloying and heat treatment of ferrous and non-ferrous metals. Classification of steel, aluminium and selected other engineering materials. Mechanical testing of metal components and compilation of test procedures. Principles of welding metallurgy and aspects of welding design.

(NMC 222) **MATERIALS SCIENCE 222, (16), 3-0-4, (N2)**
Materials selection and strengthening mechanisms. The analysis of binary and ternary phase diagrams. The heat treatment and classification of steel (the Fe-C phase diagram, the diffusion controlled transformation of austenite, hardening and tempering, hardenability, the application of IT and CCT diagrams). The heat treatment and classification of aluminium and its alloys. The metallurgy of cast iron and stainless steel. Metallographic and analytical techniques (electron microscopy, X-ray diffraction and surface analysis).

(NMC 320) **MATERIALS SCIENCE 320, (16), 3-1-2, (N3)**
The thermodynamics of binary and ternary phase diagrams. The kinetics of phase transformations (diffusion processes, nucleation and growth mechanisms). The solidification of pure metal and alloys. The transformation of austenite in ferrous metals

(the pearlite, bainite and martensite reactions). The metallurgy of non-ferrous metals (aluminium, copper, nickel and titanium alloys).

(CMK 410) **MATERIALS SCIENCE 410, (15), 4-0-0, (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, (20), 4-2-2, (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 methods such as rolling, forging and drawing).

(WTW 338) **MATHEMATICS 338, (16), 4-2-0, (C3, E3, M3, S3)**
Linear algebra, eigenvalues and eigenvectors, partial differential equations and numerical methods (finite difference) for the solving of practical problems.

(EMR100) **MEASUREMENT TECHNIQUES AND COMPUTER MODELLING 100, (2), (E1, R1, Z1)**
This module is presented at the end of the first semester. It lasts for one week. During this time Electrical, Electronic and Computer Engineering students receive training in Instrumentation and Measurement Techniques in the Department's electronics laboratories, as well as in the use of computer simulation programs (such as Matlab) in the computer laboratories.

(NMM 310) **MECHANICAL METALLURGY 310, (16), 3-0-4, (N3)**
The behaviour and response of materials to applied loads form the basis of the module. Structural aspects of plastic deformation and fracture, at room temperature and elevated temperatures. Dislocation mechanisms as a basis for interpreting mechanical properties. Engineering aspects of testing materials. Influence of metallurgical variables on the mechanical behaviour of materials. Introduction to fracture mechanics, fatigue and failure analysis.

(SWK 122) **MECHANICS 122, (16), 4-2-0, (B1, C1, E1, M1, N1, P1, S1, Z1)**
Equivalent force systems, resultants. Newton's laws, units. Forces acting on particles. Rigid bodies: principle of transmissibility, resultant of parallel forces. Vector moments and scalar moments. Relationship between scalar- and vector moments. Couples. Equivalent force systems on rigid bodies. Resultants of forces on rigid bodies. Equilibrium in two and three dimensions. Hooke's law. Trusses and frameworks. Centroids and second moments of area. Hydrostatics: Pressure at a point, resultant forces on submerged plane areas. Beams: Distributed forces, shear force, bending moment, method of sections, relationship between load, shear force and bending moment. Friction law: Dry friction. Potential energy: Stability.

(EMK 310) **MICROPROCESSORS 310, (16), 3-1-1, (E3, R3, 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).

(PKB410) **MINE CLIMATE CONTROL 410, (15), 3-0-2, (P4)**
The module is subdivided into 9 syllabus themes, briefly outlined as follows:
1. Mine ventilation air provision methods – Primary and secondary mine ventilation methods. 2. Mine air control – Fans, speed, performance, fan types. 3. Cooling – Basic principles of cooling, single-phase cooling plants, pressure enthalpy diagrams, two-phase cooling plants, plant components and calculations. 4. Mine ventilation planning – Basic planning principles, principles of network analysis, use of computers in ventilation planning and optimization of lay-outs. 5. Economics of mine ventilation – Basic economic principles. 6. Occupational hygiene – Principles, anatomy, pathology and physiology, heat stress, lighting, noise. 7. Dangers of gas and dust explosions – Mine gasses and their occurrences 8. Mine dust and associated ionized radiation – Mine dust and associated dangers, gravimetric sampling, ionized radiation. 9. Mine Health and Safety Act.

(PMZ 420) **MINE DESIGN 420, (30), 4-4-4, (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.

(PEE 320) **MINE ENVIRONMENT ENGINEERING 320, (16), 3-1-2, (P3)**
This module is subdivided into 6 study themes. 1. Flow analysis: Basic mine flood flow, theory (air and water flow), ideal fluids, pressure aspects, Bernouilli, laminar and turbulent flow. 2. Psychrometry: Psychrometric characteristics. 3. Thermodynamic aspects of mine air: Changing and constant moisture content, pressure measurements, mechanical influence/effect of air. 4. Heat Sources: Different sources of heat, conduction, convection, and radiative heat flow, overall heat transference coefficients. 5. Compressed air: various aspects related to compressed air. 6. Water flow: Laminar and turbulent flow, water flow measuring, techniques, water flow and energy considerations, water reticulation underground (supply and removal)

(PME 320) **MINERAL ECONOMICS 320, (16), 4-0-2, (P3)**
Technical mine valuation: Sampling, mass and mineral content of ore, mine call and block factors, pay limits, SAMREC code. Financial mine valuation: Mining projects with a view to investment decisions and mining cost structures through cash flow analysis, investment analysis through net present value, internal rate of return, pay back period, mining taxation, inflation, uncertainty, risks, sensitivity analysis

(PME 410) **MINERAL ECONOMICS 410, (17), 3-2-2, (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, (16), 3-0-4, (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, metamorphica 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 322) **MINERALS PROCESSING 322, (16), 3-0-4, (P3)**
Main factors affecting the economic nature of an ore deposit. Analytical techniques which can be used to assess the deposit properties. Mass balancing; introduction to data reconciliation. Mineral properties on which concentration processes are based. Comminution: Overview of different types of crushers and mills, basic theory and mechanisms. Classification and screening, hydrocyclones and screens. Separation processes: Gravity concentration, theory and functioning of spirals. Dense medium separation, theory of separation and properties of the medium. Chemical and physical aspects of froth flotation. Typical flowsheets of platinum, gold, heavy minerals and coal industries.

(NMP 323) **MINERALS PROCESSING 323, (16), 3-0-4, (N3)**
Main factors affecting the economic nature of an ore deposit. Analytical techniques which can be used to assess the deposit properties. Mass balancing; introduction to data reconciliation. Mineral properties on which concentration processes are based. Comminution: Overview of different types of crushers and mills, basic theory and mechanisms. Classification and screening, hydrocyclones and screens. Separation processes: Gravity concentration, theory and functioning of spirals. Dense medium separation, theory of separation and properties of the medium. Chemical and physical aspects of froth flotation. Typical flowsheets of platinum, gold, heavy minerals and coal industries. Introduction to process simulation.

(PMW 410) **MINE VALUATION 410, (15), 3-0-2, (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 121) **MINING 121, (16), 4-2-2, (P1)**
Introduction: Mining in South Africa: Overview and history of mining in South Africa, Minerals and mining. Surface mining: Surface mining methods, Surface mining planning, Rock breaking, Rock loading and transport. Underground hard rock mining: A mine in outline, explanations of underground mining terms, basic mine layouts, shafts, development, stoping methods, compressed air, water and electrical reticulation. Underground coal mining: planning and development, rock breaking: stoping and tunneling. Mine environmental engineering: ventilation practice, airflow, fans, gases, heat, psychrometry. Mine strata control: strata control in deep and shallow underground mines, strata control in coal mines.

(PMY 220) **MINING 210, (16), 4-2-2, (P2)**
Underground mining methods in coal, massive ore bodies, wide-seam and narrow seam ore deposits. Room-and-pillar, rib pillar stooping, longwall mining, stooping in coal

deposits. Cut-and-fill, stooping, sub-level caving, block caving, crater retreat in massive ore bodies. Shrinkage methods, scraper methods and trackless mining in narrow seam deposits. Mine surveying: Legal aspects, measurement and plan specifications. Problem solving, faulting, excavations, surfaces and volumes. Services: Electricity and water. Electrical: provision, transformers, distribution and costs for surface mining as well as, hard rock and underground coal mining. Water management systems for underground mines: Water supply and drainage: - the role of water in the mining industry, methods to remove water, water pumps, corrosion and erosion in pumps and water pipes, clearing and purifying of mine water, chilled service water. Mine flooding: - Sources of water, types of flooding, flooding in sinking shafts, flooding of tunnels, prevention of flooding, development through water bearing strata, handling of flooded areas. Mine Fires: flammable materials, causes of fires underground, initiation mechanisms, protection against open fires, spontaneous combustion, detection of fires, extinguishing of fires, results of mine fires, fire prevention manual. Handling of materials such as liquids, solids and explosives. Rock handling: Systems and equipment for underground trains, cables, shafts, conveyor belts.

(PMY 421) **MINING 421, (16), 2-2-2, (P4)**
Selected topics in mine management: Human resources management in the minerals environment: HIV/AIDS, technology, employment equity, contracting, change management. Risk and safety management: Risk assessment and analysis, mitigation of high risks. Systems engineering: hard and soft systems, theory of constraints, value chain analysis. Valuation of mineral properties: SAMREC code, specific valuation techniques (e.g. Rand per hectare, DCF), weighted average cost of capital, risk finance.

(EMS 310) **MODULATION SYSTEMS 310, (16), 3-1-1, (Z3)**
Spectral analysis using the Fourier and Z-transforms. Transform identities. Convolution and correlation. Linear System Theory. Analog and hybrid modulation systems: AM, PM, FM, PAM, PCM, Delta-modulation, PWM. Carrier synchronisation. Communication channels and transmission effects. Sampled Systems. Source digitization (D/A conversion), quantisation noise. Introduction to Information Theory and Source Coding. Formatting and line codes. Spectral characteristics of random data signals. Introduction to digital modulation. Binary modulation techniques: PSK, FSK and ASK. Symbol synchronization. PLL theory. Matched filter concepts. Analysis of digital modulation systems in AWGN. Simulation and practical implementation of simple digital communication building blocks and subsystems. The focus will be on analog modulation techniques as applied to radio communication systems.

(WTW 263) **NUMERICAL METODS 263, (8), 2-2-0, (B2, C2, E2, M2, N2, P2, R2, S2, Z2)**
Solution of non-linear equations, direct and iterative methods of solving systems of equations (linear and non-linear). Solution of differential equations and systems of differential equations. Numerical integration. Curve fitting.

(ERB 210) **OPERATING SYSTEMS 210, (16), 3-1-1, (R2)**
Considerations in design and implementation of the following broad functional areas of a UNIX-operating system: Process management; importing and exporting of data; memory and file management.

(BOB 310) **OPERATIONS MANAGEMENT 310, (16), 4-2-0, (B3)**
Introduction to operations management, operations strategy and competitiveness. World Class and Agile Manufacturing. Operations planning in the service industries. The manufacturing management environment. Manufacturing planning and control systems.

Sales and operations planning. Capacity planning and control. Demand management. Master production scheduling. Materials requirements planning. Distribution requirements planning. Just-in-time (JIT) manufacturing. Synchronous manufacturing (Theory of Constraints). Comparing MRP, JIT and TOC. Shop floor scheduling and control. Integration and implementation of manufacturing planning and control systems. Enterprise Resource Planning (ERP) systems. Business process transformation.

(BOZ 311) **OPERATIONS RESEARCH 311, (16), 4-2-0, (B3)**
Introduction to Operations Research. Introduction to linear programming, linear algebra, classical linear programming applications, solution algorithms, sensitivity analysis, duality. Computer programming packages.

(BOZ 321) **OPERATIONS RESEARCH 321, (16), 4-2-0, (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, (13), 3-1-0, (B4)**
Formulation of prototype problems. Analysis of algorithm orders. Complexity theory. Improved search procedures. Constructive heuristics. Independence systems. Relaxations. Improved heuristic applications of exact solution techniques. Non-linear programming. Routing models.

(EOK 320) **OPTICAL COMMUNICATION NETWORKS 320, (16), 3-1-1, (R3, Z3)**
Technology of optical networks: Optical fibre theory, optical fibre types, couplers, switches, multiplexers, light sources and detectors, receivers and receiver amplifiers, optical amplifiers (SOA and fibre amplifiers). Modulation and demodulation. TDM and WDM principles. Transmission systems (amplification, crosstalk, dispersion, fibre non-linearities, wavelength stabilisation). Design principles for WDM and DWDM systems. Optical networks: SDH. ITU-T. Broadcast and select networks (topologies): Wavelength routed networks. Virtual topology design. Control and management of networks. Protection and restoration. Optical network simulation tools. Design of optical communication networks: Performance criteria (S/N, BER, Eye diagrams). Measurement techniques and instrumentation (OTDR).

(EFC 410) **OPTICAL COMMUNICATION NETWORKS 410, (16), 3-1-1, (Z4)**
Introduction to optical communication networks: Building blocks. Optical fbres (single mode, multimode), transmitters (sources, drives and modulators), receivers (detectors, detector amplifiers, filters, demodulators, optical amplifiers (EDFA), solitons, joints (splices and couplers), optical connectors and multiplexers (OXC, WADM). Optical network configurations. Performance criteria: Bitrate, BER, SNR, eye pattern, timing jitter. Physical restrictions: Scattering, adsorption, dispersion, non-linear effects. Measuring instruments and techniques (power meter, optical spectrum analyser, OTDR, BER meter). Power budget. Optical network simulation packages (PTDS).

(NEB 410) **ORE-DRESSING 410, (15), 3-0-2, (N4)**
Laws and theory of comminution. 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.

(GLY 152) **PHYSICAL GEOLOGY 152, (8), 2-0-2, (P3)**
See Faculty of Natural and Agricultural Sciences Yearbook

(FSK 116) **PHYSICS 116, (16), 4-2-2, (B1, C1, E1, M1, N1, P1, R1, S1, Z1)**
Introductory mathematics: Units, length, time, mass. Motion along a straight line: position and displacement, acceleration. Vectors: adding vectors, components, multyplying vectors. Motion in two and three dimensions: projectile motion, circular motion. Force and motion: Newton's Law, force, friction. Kinetic energy and work: work, power. Potential energy: Centre of mass, linear momentum. Collisions: impulse and linear momentum, elastic collisions, inelastic collisions. Rotation: kinetic energy of rotation, torque. Oscillations and waves: Simple harmonic motion, types of waves, wavelength and frequency, interference of waves, standing waves, the Doppler effect.

(FSK 126) **PHYSICS 126, (16), 4-2-2, (B1, C1, E1, M1, N1, P1, R1, S1, Z1)**
Electrostatic charge: Conductors and insulators, Coulomb's Law. Electric fields: Field lines, point charge, electric dipole, line of charge, charged disk. Gauss' law: Fux. Electric potential: Potential due to point charges, continuous charge distribution. Capacitance: Capacitors in parallel and in series, capacitor with a dielectric insert. Current and resistance: Resistance and resistivity. Circuits: Single- and multiloop circuits, RC circuits. Magnetic fields: Magnetic dipole, Ampere's Law, solenoids and torroids. Induction and inductance: Inductors and inductance, self-induction, RL circuits, mutual induction. Alternating current: Transformers. Electromagnetic waves. Images: Plane mirrors, spherical mirrors, thin lenses, optical instruments,. Interference and diffraction: Single slit.

(CPS 311) **PIPING SYSTEMS DESIGN 311, (8), 2-2-0, (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.

(EDF 320) **POWER ELECTRONICS 320, (16), 3-1-1, (E3)**
Semiconductor components: Power diodes, silicon-controlled-rectifiers, bipolar transistors, power mosfets, IGBTs, emerging devices. Passive components: Inductors, capacitors and transformers for power electronic applications. Ancillary issues: Heat sinks, snubbers, drive circuits. Converter topologies: AC-DC converters, DC-DC converters, DC-AC converters and AC-AC converters. Dynamics and control of power electronic converters. Applications: AC voltage controllers, Isolated high-frequency power supplies.

(EKR 320) **POWER SYSTEMS 320, (16), 3-1-1, (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, (16), 3-1-1, (E4)**
Per-unit calculations. Power systems composition and operation: Typical lay-outs, reliability (qualitative), costs, load factor, maximum 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.

(BPY 210, CPY 211, MPY 215, NPY 216) **PRACTICAL TRAINING 210, 211, 214, 215, 216, (2), (B2, C2, M2, N2)**
A satisfactory report on workshop practice must be submitted to the Faculty Administration within one week of registration.

(BPY 310) **PRACTICAL TRAINING 310, (16), (B3)**
During or at the end of the second year of study, students in Industrial Engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(BPY 410) **PRACTICAL TRAINING 410, (16), (B4)**
During or at the end of the third year of study, students in Industrial Engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(CPY 311) **PRACTICAL TRAINING 311, (16), (C3)**
At the end of the second year of study, students in Chemical Engineering undergo at least six weeks of prescribed practical training in the industry. The student must also attend all excursions organised during the year by the department. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(CPY 411) **PRACTICAL TRAINING 411, (16), (C4)**
At the end of the third year of study, students in Chemical Engineering undergo at least six weeks of prescribed practical training in the industry. The student must also attend all excursions organised during the year by the department. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(EPY 421) **PRACTICAL TRAINING 421, (12), (R4)**
Four weeks practice-orientated experience at any institution of the student's choice in computer engineering. The student must acquire experience in the working environment and more specifically in work ethics, economy, punctuality, knowledge of human nature, etc. Students who do succeed in doing work related to computer engineering, will be exempted from the requirement to submit a report. However, such students MUST render proof of their employment, and the completion of 4 weeks full-time employment, or at least 160 hours. Students who do not succeed in obtaining the prescribed type of work, must apply for permission to do other types of work. These students will be expected to submit the prescribed report within one week of the start of the second semester.

(EPY 422) **PRACTICAL TRAINING 422, (12), (E4, Z4)**
Four 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/her work experience as determined by the Head of the Department.

(LPY 314) **PRACTICAL TRAINING 314, (16), (L3)**
During or at the end of the second year of study, students in Agricultural Engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(LPY 414) **PRACTICAL TRAINING 414, (16), (L4)**
During or at the end of the third year of study, students in Agricultural Engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(MPY 315) **PRACTICAL TRAINING 315, (16), (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 six 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. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(MPY 415) **PRACTICAL TRAINING 415, (16), (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 six 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. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(NPY 316) **PRACTICAL TRAINING 316, (16), (N3)**
During or at the end of the second year of study, students in Metallurgical Engineering undergo at least six weeks of prescribed training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(NPY 416) **PRACTICAL TRAINING 416, (16), (N4)**
During or at the end of the third year of study, students in Metallurgical Engineering undergo at least six weeks of prescribed training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the Chairman of the School of Engineering.

(PPY 218) **PRACTICAL TRAINING 218, (16), (P2)**
At the end of the first year of study, students in Mining Engineering undergo at least six weeks of prescribed practical training at a mine. A satisfactory report on the practical training must be submitted to the Department within one week after registration for the following year. Arrangements must be made for a further prescribed training period of at least six weeks at the end of the second year of study.

(PPY 317) **PRACTICAL TRAINING 317, (16), (P3)**
Mining students must undergo at least six 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 Department within one week after registration. Arrangements must be made for a further prescribed training period of at least six weeks at the end of the third year of study.

(PPY 418) **PRACTICAL TRAINING 418, (16), (P4)**
Mining students must undergo at least six weeks prescribed practical training at a mine at the end of the third year of study. A satisfactory report on such work, must be submitted to the Department within one week after registration.

(CPR 420) **PRACTICE 420, (15), 4-0-0, (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.

(AGR 313) **PRIMARY FOOD CROPS 313, (11), 2-0-2, (L3)**
Presented in the Faculty of Natural and Agricultural Sciences.
The cultivation and utilization 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 become acquainted with grading regulations and topical practical problems.

(CPB 410) **PROCESS CONTROL 410, (17), 4-2-0, (C4)**
Dynamic properties of equipment, instruments and processes. Mathematical modelling and computer simulation of processes in the time, Laplaace 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, (8), 2-1-0, (C3)**
Process dynamics: Time dependent behavior of linear systems, linearisation. Transfer functions. Elements of a control loop. Control principles and mechanisms.

(NPL 410) **PROCESS METALLURGY 410, (20), 4-0-4, (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.

(NPT 220) **PROCESS THERMODYNAMICS 220, (16), 4-2-0, (N2)**
The first, second and third laws of thermodynamics, enthalpy and heat capacity. The criteria for equilibrium, Gibbs free energy, chemical potential, partial molar Gibbs free energy, activity, activity coefficient and the equilibrium constant. Solution thermodynamics of ideal and non-ideal solutions, as well as solution models. Gibbs free energy – composition diagrams, the Ellingham diagram and other applicable diagrams. The thermodynamic principles are applied to metallurgical processes. Applications also include stoichiometry and mass balance problems, as well as the calculation of energy balances.

(LPR 410) **PROCESSING 410, (17), 4-1-1, (L4)**
Psychometrics. Mechanised cooling systems. Drying of agricultural products. Principles of biochemical engineering.

(BPZ 410) **PRODUCTION 410, (15), 4-0-0, (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, (15), 4-0-0, (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.

(BPZ 210) **PRODUCTIVITY 210, (16), 3-1-2, (B2)**
Qualifying and quantifying productivity: Efficiency, effectiveness, utilization, profitability and competitiveness. Method study: Critical examination and process flow charts and diagrams. Work measurement: Time study and activity sampling. Organizational behaviour: Motivation, incentive schemes, group forming, work teams, job design and change management. Ergonomics.

(JPO 110) **PROFESSIONAL ORIENTATION 110, (8), 0-4-4, (Five-year programme)**
(JPO 120) **PROFESSIONAL ORIENTATION 120, (8), 0-4-4, (Five-year programme)**
Academic support and development within the wider engineering context. Technological skills: Skills of observation (analyse and interpret information), planning, designing, component estimates, problem-solving and computer skills (word processing, computations, graphics, Internet). Communication skills: Listen, read, write and presentation. Social and personal skills: Goal-setting and time management, stress management, creativity, career planning, study strategies, decision making, budgeting, ethics and values. Fundamental mathematical concepts

(EPP 410) **PROFESSIONAL PRACTICE 410, (16), 3-1-1, (E4, R4, 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.

(MPR 210) **PROGRAMMING 210, (16), 3-2-0, (B2, M2)**
Software engineering programme principles: functional specification by means of flow charts, programme specification by means of structure chart or pseudo-code, programming by means of structured programming principles, unit testing by means of test specifications. Basic structured programming: loops, branches, subroutines, reading and writing of text files. Development, translation and debugging of simple programmes. Use of MATLAB as computational aid. Introduction to MATLAB toolboxes. Object-orientated programming: An introduction to object-orientated modelling and design. Introduction to and the use of a low-level programming language (C++): Defining of classes, formation of relationships. Application of principles through practical assignments.

(BPJ 410) **PROJECT 410, (7), 0-0-4, (B4)**
Choice of a project topic. Appointment 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, (35), 0-0-16, (B4)**
Detailed solution of chosen alternative. Writing of final project report and presentation of project.

(EPR 400/402) **PROJECT 400/402, (8), 1-0-2** (1st semester), **(64), 2-0-24** (2nd semester), **(E4, R4, 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; 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, (15), 0-0-8, (C4)**
The execution of a complete literature study and research project on a chosen subject.

(CSC 420) **PROJECT 420, (9), 0-0-5, (C4)**
Interpretation of the research results of CSC 410. The writing of a project report and scientific article.

(LSC 320) **PROJECT PREPARATION 320, (2), 0-1-0, (L3)**
Identification of a suitable subject for Project 402. Detailed literature study with accompanying report. Planning of project execution.

(LSC 402) **PROJECT 402, (8), 0-0-4,** (1st semester)**, (22), 0-0-10,** (2nd semester), **(L4)**
Execution of the research project on chosen subject. Detailed project report. Oral presentation of project.

(MSC 400) **PROJECT 400, (8), 0-0-4** (1st semester), **(16), 0-0-10** (2nd semester), **(M4)**
(MSC 401) **AERONAUTICAL PROJECT 401, (8), 0-0-4** (1st semester), **(16), 0-0-10** (2nd semester), **(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, (8), 0-0-4** (1st semester), **(48), 0-0-20** (2nd semester), **(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 programme 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, (8), 0-2-0, (P4)**
The project involves the execution of an analytical and/or experimental research project under guidance of a lecturer. During the second semester of the third year of study students must select a suitable research topic, to be approved by the head of department. Information for the approved 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.

(IPB 320) **PROJECT MANAGEMENT 320, (8) 2-1-0, (B2, L3, S3)**
Project management concepts: Application of project management, systems thinking, systems approach, project life cycles, project phases. Organisation: Project team, project manager, teamwork and performance, support services, organisation structure for projects. Planning and scheduling: Task definition, duration estimates, Gantt charts, network diagrams, PERT and CPM, resource allocation, resource levelling, Critical Chain. Costs and budgets: Cost estimates, project life cycle costs, escalation, work authorisation. Control: Control process, control of costs and schedules, buffer management, control of technical performance, project value, project management information systems. Case studies.

(NPM 321) **PYROMETALLURGY 321, (16), 3-2-0, (N3)**
Fundamentals governing pyrometallurgical processes; Gibbs free energy, equilibrium constants, Henrian and Raoultian activities; slag basicity and viscosity; energy sources and reductants used in pyrometallurgical processing; equilibrium of iron and steelmaking reactions; equilibrium reactions in non-ferrous pyrometallurgy; analysing and proposing processing conditions for ferrous and nonferrous production.

(BGC 410) **QUALITY ASSURANCE 410, (13), 3-1-0, (B4)**
Introduction to quality assurance and quality management systems. Background of statistics. Statistical process control. Statistical acceptance control.

(CRO 410) **REACTOR DESIGN 410, (17), 4-2-0, (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 reactors. Reactor stability, dynamic reactor behaviour and non-ideal flow in reactors.

(NVM 321) **REFRACTORY MATERIALS 321, (8), 2-2-0, (N3)**
Classification, requirements and properties of refractory materials. Manufacturing principles. Specification and testing of refractory materials. The main refractory systems, i.e silica, aluminosilicates, alumina, magnesia, magnesia-chrome, magnesia-carbon,

doloma, zircon, zirconia, silicon carbide and graphite, and their applications. Principles of ternary phase diagrams and their application in refractory systems, and interactions between slag, metal and refractory materials.

(SIN 324) **REINFORCED CONCRETE DESIGN 324, (8), 2-1-1, (L3, S3)**
Properties of reinforced concrete. Principles of limit states design. Analysis and design of sections in flexure and in compression combined with flexure. Design for shear and torsion. Bond and anchorage. Serviceability requirements: Detailing and span-effective depth ratios. Calculation of deflection and crack width.

(SGM 221) **ROAD BUILDING MATERIALS AND DESIGN 221, (16), 2-1-2, (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.

(PRX 311) **ROCK BREAKING 311, (16), 3-1-2, (P3)**
Rock breaking: Specific energy of rock breaking. Energy transfer from drill to rock. Performance of hammer, rotary, diamond and drag-bit drills. Economic aspects and drill selection criteria. Mechanical tunnelling and equipment. Novel rock breaking methods. 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. Blast design for tunnelling, shaft construction, stoping and coal mining. Importance of safety during blasting operations.

(PSZ 311) **ROCK MECHANICS 311, (16), 3-1-2, (P3)**
Stress and strain in solid materials. Elasticity. Strength and failure modes of rock material 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. Rock failure due to gravity. Slope stability, joint failure, wedge failure, circular and non-circular failure in surface mines.

(LLI 420) **RURAL ENGINEERING 420, (9), 2-1-0, (L4)**
The planning, utilisation and management of natural resources in rural areas on a sustainable basis, planning and management of irrigation systems, surface and subsurface drainage, soil and water conservation and structures, waste control and environmental planning.

(BUY 321) **SIMULATION MODELLING 321, (16), 4-2-0, (B3)**
Introduction to simulation as technique. Simulation methodology. Formulation of problem situations by means of simulation models with the emphasis on discrete models. Input and output analysis. Introduction to simulation software.

(EPE 321) **SOFTWARE ENGINEERING 321, (16), 3-1-1, (R3)**
Software Engineering deals with the application of engineering principles to the development and maintenance of high-quality software, with these goals in mind: functionality, timely delivery and budget concerns. The module will expose the students to various methodologies in the different stages of the software life cycle, the problems of group work, and software configuration management with CVS. Advanced programming skills including C++, Unix and TeX. Exposure to advanced programming and debugging techniques.

(LGH 420) **SOIL CONSERVATION AND HYDROLOGY 420, (15), 3-2-0, (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-sized catchment areas. Determination of dam capacities for small catchment areas.

(LGD 410) **SOIL DYNAMICS 410, (11), 2-1-1, (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 322) **SOIL MECHANICS 322, (16), 3-1-2, (S3)**
Introduction to soil mechanics. Introduction to clay mineralogy. Mass- volume relationships and phases of soil. Groundwater flow and permeability. Effective stress principle. Suction pressures in saturated as well as partially saturated soil. The Mohr circle and stresses at a point. The Mohr-Coulomb strength theory and the stress-strain properties of soil. The Boussinesq theory. Consolidation theory and soil settlement.

(SGM 411) **SOIL MECHANICS 411, (17), 2-3-2, (S4)**

(GKD 215) **SOIL SCIENCE 215, (11), 2-0-2, (L3)**
Appearance and properties of soil. Soil fertility and classification. Aspects of soil conservation and pollution.

(EES 420) **SPECIALISATION 420, (16), 3-1-1, (E4, R4, Z4)**
Specific niche areas from practice are addressed. The specific choice of content will be done in consultation with the head of department.

(SIN 323) **STEEL DESIGN 323, (8), 2-1-1, (L3, S3)**
Stability of beams. Material properties. Analysis and limit states design of tension, compression and flexural members, and beam-columns. Design of trusses, simple framed structures and connections.

(ESC 320) **STOCHASTIC COMMUNICATIONS SYSTEMS 320, (16), 3-1-1, (Z3)**
Review of signal theory. Introduction to stochastic processes: Stationarity and Ergodicity. Noise models. Stationarity and ergodicity. Channel models and transmission effects. Comparison of analogue and digital modulation systems in noise. Signal space concepts and geometric representation of signals. Statistical Communication Theory: Channel Capacity Theorem. Design and realization of binary and multi-level digital modulation systems. Spectral efficiency. Optimal receiver design: Matched Filter (MF) and Correlation-type Receiver structures. Nyquist and Partial-Response (PR) systems. Digital transmission through bandlimited AWGN channels: Inter-Symbol-Interference (ISI). Introduction to linear estimation: Equaliser algorithms and design. Introduction to channel (error correction) coding: Symbol-by-symbol versus maximum likelihood sequence estimation (MLSE) techniques. Block and convolutional codes. The focus will be on applications in the cellular and mobile communication fields where stochastic processes such as noise and channel effects are of prime importance.

(WTW 342) **STOCHASTIC PROCESSES 342, (16), 4-2-0, (R3, Z3)**
Mathematical formulations of a number of probability models, properties of random variables, theory of Poisson and Markov processes with engineering applications.

(PSZ 410) **STRATA CONTROL 410, (15), 3-0-2, (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.

(SWK 210) **STRENGTH OF MATERIALS 210, (16), 4-1-0, (M2, N2, P2, S2)**
Stresses, strains and material behaviour: Normal and shear stresses, factors of safety. Bar structures with axial loads: Displacements and stresses of statically derminate 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, v, 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.

(SWK 213) **STRENGTH OF MATERIALS 213, (8,) 2-1-0, (C2)**
Internal forces: shear forces, bending moments. Normal stress, shear stress, plane stress. Transformation of stress: Mohr's circle. Linear strain, material properties, Hooke's law, Poisson's ratio. Shear modulus. Allowable stresses, safety factors. Statically indeterminate uni-axial structures, temperature effects. Torsion. Pure bending of beams: bending stress, maximum bending stress at a section, shear stress. Cylindrical pressure vessels.

(SIN 223) **STRUCTURAL ANALYSIS 223, (16), 3-1-2, (S2)**
Statically indeterminate beams. Euler buckling of columns with different boundary conditions. Virtual work. Analysis of statically indeterminate structures using the methods of super-position, slope-deflection and moment distribution (with sway and support displacement).

(SIN 311) **STRUCTURAL ANALYSIS 311, (8), 2-1-1, (S3)**
Analysis of symmetrical structures using slope-deflection equations or moment-distribution; three dimensional structures and grillages; plastic analysis of frames; matrix methods; influence lines.

(SIN 412) **STRUCTURAL ENGINEERING 412, (17), 3-2-2, (S4)**

(GLY 414) **STRUCTURAL GEOLOGY 414, (12), 2-0-3, (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, (16), 3-0-1, (M3)**
Section A : Introduction to structural analysis using the finite element method: FEA process. Direct stiffness method. Spring, bar and beam elements. Slope deflection equations. Co-ordinate transformations. Analysis of statically indeterminate trusses and frames. Internal hinges. Continuous loads. Continuous beams with normal loads. Computer assignments.

Section 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 elastic 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, (13), 3-0-1, (M4)**
Section 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.
Section B: The finite element method in structural 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 311) **SURFACE MINING 311, (16), 3-1-2, (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 crushers. Bucket wheel excavators. Economic cut-off limits with regards to waste stripping and ore grade. Basic computerized mine planning.

(SUR 220) **SURVEYING 220, (16), 3-0-4, (S1, P2, L3)**
Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and leveling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

(ITI 220) **TECHNOLOGICAL ENTREPRENEURSHIP 220, (8), 2-1-0, (B2, C2, E2, M2, N2, P2, R2, S2, Z2)**
Elements of Technological Entrepreneurship: technology and the engineer, evolution and impact of technology, relationship between technology, innovation and entrepre-neurship. Technology: dynamics of technology, technology and product development, technology and manufacturing, acquisition of technology. Innovation: concept of innovation, process of innovation, innovation patterns, idea generation, intellectual property. Entrepreneurship: technology-based enterprises, enterprise models, business plans, characteristics of entrepreneurs, incubators and techno parks. Case studies of technological entrepreneurship.

(ETK 410) **TELECOMMUNICATION SYSTEMS 410, (16), 3-1-1, (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 fiber 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, (8), 2-0-0, (M2)**
Theory of mechanisms: couplings, brakes, flywheels, drive belts and screws.

(MSK 321) **THEORY OF MACHINES AND STRENGTH OF MATERIALS 321, (16), 3-0-1, (E3)**
Theory of machines: drives, balancing, vibration, isolation, hoists, couplings and clutches, gears, cams and eccentrics. Velocity, acceleration and inertia forces in machines.
Strength of materials: failure properties of materials. Shear forces and bending moments, stress, strain, torsion and elasticity in shafts and beams, deformation energy and pillar theory. Design applications.

(MTC 420) **THERMAL MACHINES 420, (16), 3-0-1, (M4)**
(i) Thermodynamics: introductory thermodynamics with reference to power cycles. Energy systems and views, transformation of energy. Nuclear power. (ii) Steam gene-rators: 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.

(CTD 222) **THERMODYNAMICS 222, (8), 2-2-0), (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 311) **THERMODYNAMICS 311, (16), 4-2-0, (C3)**
The first and second laws of thermodynamics. Generalized correlation's for physical and thermodynamic properties. Refrigeration 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 220) **THERMODYNAMICS 220, (16), 3-1-1, (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. Conservation of mass. Second law of thermodynamics for system and control volume. Entropy. Introduction to vapor power, cooling and gas cycles. Experimental techniques in thermodynamics.

(MTX 321) **THERMODYNAMICS 321, (16), 3-0-1, (M3)**
Ideal and real gases. Supersonic flow through nozzles. Irreversibility and availability. Refrigeration cycles. Mixtures of gases. Combustion. Combustion in internal combustion engines. Engine analysis using engine cycles. Experimental techniques in thermodynamics.

(SIB 310) **TIMBER DESIGN 310, (8), 2-1-0, (S3)**
Self-weight, imposed and wind loads. Principles of limit-states design. Timber as a structural material, design of tension, compression and bending members (laterally braced and unbraced), beam columns, trusses and bracing.

(TRP 311) **TOWN AND REGIONAL PLANNING 311, (8), 2-0-0, (S2)**
Introduction to the basic concepts of urban and regional planning. The planning process, policy and institutional framework in which planning functions in SA. The interaction and co-operation of land and space, economy, politics and social aspects related to space in decision making and the support thereof. Interventions with regard to normative principles for sustainable development planning and design, definitions and rationale with land-use management and the strategic integrated development planning process.

(COP 311) **TRANSFER PROCESSES 311, (16), 4-2-0, (C3, N3)**
Momentum transfer: Fluid statics. Control volume approach for conservation of mass, energy, and momentum. Application to pumps and turbines. Navier-Stokes equations, derivation and applications. Laminar and turbulent boundary layer theory. Heat transfer: Fundamentals of heat transfer. Differential equations of heat transfer. Steady state conduction. Introduction to unsteady state conduction. Convection heat transfer and the thermal boundary layer. Radiation heat transfer. Mass transfer: Fundamentals of mass transfer. Diffusion and the diffusion coefficient. Differential equations of mass transfer. Steady state molecular diffusion in one or more dimensions.

(SVC 310) **TRANSPORTATION ENGINEERING 310, (8), 2-1-0, (S3)**
Introduction to transportation engineering; institutional, social, economic and environmental aspects of transport; public transport; design of pedestrian facilities; railway engineering; airport engineering, introduction to the transportation planning process.

(MVR 320) **VIBRATION AND NOISE 320, (16), 3-0-1, (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.

(SHC 220) **WATER TREATMENT 220, (8), 2-0-1, (S2)**
Water treatment and purification.

(NSW 410) **WELDING ENGINEERING 410, (17), 3-0-4, (N4)**
Welding processes (process with gas shielding and/or slag 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.

(B/C/N/S/WP 121 and WPM 121) **WORKSHOP PRACTICE 121, (4), (B1, C1, M1, N1, S1)**
The module is offered at the end of the first year of study and lasts at least two weeks during which the students receive training in the following workshops, depending on the field of study: 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, and the application of formwork, scaffolding, masonry and structural steel. A satisfactory report must be

submitted within two weeks after the commencement of lectures of the following semester.

(PWP 121) **WORKSHOP PRACTICE 121, (3), (P1)**
(PYL 120) **PRACTICAL TRAINING 120, (3), (P1)**
The modules are presented during the first year of study and, subject to departmental arrangements, can be attended either during July or December holiday periods. The duration will be a minimum of two weeks, during which time the student will receive training in a mine as well as a mine workshop. Training will include the following maintenance aspects: rotary and percussion drills, transport equipment, hoists and hoist ropes, electrical motors, conveyor belts and pumps. A satisfactory report must be submitted within two weeks after the commencement of lectures of the following semester.

PRIZES AND MEDALS IN THE SCHOOL OF ENGINEERING

Name	Donor	Award
General		
Medal of the Vice-Chancellor and Principal	University of Pretoria	The award consists of a silver medal as well as a cash prize and is awarded to candidates for outstanding academic achievement during the undergraduate years of study for any first Bachelor's degree in a faculty.
Medal of the Engineering Council of SA	Engineering Council of SA	For the most outstanding achievement in the final year in the School of Engineering.
Minerals Education Trust Fund Prize	Minerals Education Trust Fund	Bursary for postgraduate studies and medal for the best final year student in the Departments of Chemical Engineering, Materials Science and Metallurgical Engineering and Mining Engineering.
S_2A_3 Bronze Medal	The South African Society for the Promotion of Science	The medal is awarded to a student who has completed an exceptionally meritorious Master's study in a field traditionally linked to the activity of the South African Society for the Promotion of Science (S_2A_3).
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 School	For the first-year students registered for the JPO module who: i. Achieved the highest average mark in all the prescribed modules 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	As above	For the first-year student registered for the JPO module who showed leadership potential and was actively involved in promoting a positive image of the Five Year Programme
Department of Chemical Engineering		
Medal of the SA Institute for Chemical Engineers	SA Institution for Chemical Engineers	For the best final-year student in Chemical Engineering.
Department of Civil and Biosystems Engineering		
Agricultural Engineering		
Bronze Medal of the SA Institute of Agricultural Engineers	SA Institute of Agricultural Engineers	For the best achievement in the final year.
Bigen Africa Prize	Bigen Africa	For the best achievement in the final year.

Name	Donor	Award
MBB Merit Prize	Murray, 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.
Civil Engineering - Fourth-year Prizes		
BKS-DW de Vos Medal	BKS Incorporated	For the student with the best achievement in the final year of study in Civil Engineering (R4 000).
Final-year project prizes		**For the best final-year Civil Engineering Project in:**
Joint Structural Division of SAICE and ISE Prize	The Joint Structural Division of SAISI and IStructE	Structural Analysis (R1 200)
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 (R1 000)
Africon Engineering International Prize	Africon Engineering International (Pty) Ltd	Geotechnics (R750)
Third-year Prizes	**Awards for the best third-year students in:**	
BKS-G P R von Willich Prize	BKS Incorporated	Best student in the third year of study (R1 000).
Grinaker-LTA Prize	Grinaker-LTA	Geotechnical Engineering 323 (R1 000)
VGI Prize	Venter and Grobler Consulting Engineers	Transportation Engineering 310 (R500)
Vibro Bricks Prize	Vibro Bricks (Pty) Ltd	Road Design 324 (R1 000)
Vibro Bricks Prize	Vibro Bricks (Pty) Ltd	Civil Building Materials 321 (R1 000)
Raubex Prize	Raubex Construction (Pty) Ltd	Civil Construction Economy 310(R1 000)
Second-year Prize		
BKS-G P R von Willich Prize	BKS Incorporated	For the best student in the second year of study (R600)
First-year Prize		
Departmental Prize	DW de Vos Training Fund	For the best first-year student (R500).

Name	Donor	Award
Department of Electrical, Electronic and Computer Engineering		
Louis van Biljon Prize and Gold Medal	Firms and institutions in the field of Electronic Engineering	For outstanding achievement in the third and fourth years of study in Electronic Engineering (R10 000 plus gold medal).
Louis van Biljon Prize and Silver Medal	Firms and institutions in the field of Electronic Engineering	For outstanding achievement in the third and fourth years of study in Electronic Engineering (R6 000 plus silver medal).
Louis van Biljon Prize and Bronze Medal	Firms and institutions in the field of Electronic Engineering	For outstanding achievement in the third and fourth years of study in Electronic Engineering (R4 000 plus bronze medal).
Gustav Heyman Prize and Gold Medal	Firms and institutions in the field of Electrical Eng	For outstanding achievement in the third and fourth years of study in Electrical Engineering (degree wth distinction) (R10 000 plus gold medal).
Gustav Heyman Prize and Silver Medal	Firms and institutions in the field of Electrical Eng	For outstanding achievement in the third and fourth years of study in Electrical Engineering (degree with distinction) (R6 000 plus silver medal).
Gustav Heyman Prize and Bronze Medal	Firms and institutions in the field of Electrical Engineering	For outstanding achievement in the third and fourth years of study in Electrical Engineering (degree with distinction) (R4 000 plus bronze medal).
Wilhelm Leuschner Prize and Gold Medal	Firms and institutions in the field of Computer Engineering	For outstanding achievement in the third and fourth years of study in Electrical Engineering (degree with distinction) (R10 000 plus gold medal).
Wilhelm Leuschner Prize and Silver Medal	Firms and institutions in the field of Computer Engineering	For outstanding achievement in the third and fourth years of study in Electrical Engineering (degree with distinction) (R6 000 plus silver medal).
Wilhelm Leuschner Prize and Bronze Medal	Firms and institutions in the field of Computer Engineering	For outstanding achievement in the third and fourth years of study in Electrical Engineering (degree with distinction) (R4 000 plus bronze medal).
SA Institute of Measure and Control /Schneider Automation Prize	WSP Group	R1 100 and a gold medal for the best final-year project in Measurement and Control.

Name	Donor	Award
SAMES Prize	South African Micro-electro-nic Systems	For the best final year project in Electronic Engineering in the specialist field of Micro-electronics (R2 000). *(The donor has the prerogative to award the prize of R2 000 each to two students should their achievement be of equal standard.)*
ABB Powertech Transformers Prizes	ABB Powertech Transformers (Pty) Ltd	For the best student in the module Electrical Drives in the third year of study in Electrical Engineering (R1 000). For the best final year student in the module Electrical Design (R1 000).
Siemens Prize	Siemens (Pty)(Ltd)	For the best final-year project in Electronic Engineering (R2 000).
Mintek Prize	Mintek	For the best final-year student in the module Automation (R1 000).
Parsec VHDL Prize	Parsec Design Solutions (Pty) Ltd	For the final-year student with the best VHDL based design project.(R1 000 plus a voucher of R3000 to attend the VHDL course the following year)
Parsec DSP Prize	Parsec Design Solutions (Pty) Ltd	For the final-year student with the best digital signal processing project (R1 000 plus a voucher of R3000 to attend the VHDL course the following year). *(Parsec prizes are mutually exclusive.)*
SAIEI Prize	South African Institute of Electrical Engineers	For the best third-year student in Electronic Engineering (R500).
SAIEI Prize	South African Institute of Electrical Engineers	For the best third-year student in Electrical Engineering (R500).
SAIEI Prize	South African Institute of Electrical Engineers	For the best third year student in Computer Engineering (R500).
IST Prize	IST	For the best third-year student in the module Control Systems (R1 000).
Department of Industrial and Systems Engineering		
Medal of the SA Institute of Industrial Engineering	SA Institute of Industrial Engineering	For the best final-year student in Industrial Engineering.
e-Logics Prize	e-Logics	For the best final-year project in Industrial and Systems Engineering (R1 500).
Procon-Fischer Prize	Procon-Fischer and Associates	For the best first-year student in Industrial and Systems Engineering (R1 000)

Name	Donor	Award
Fourier Approach Prize	Fourier Approach	For the best second-year student in Industrial and Systems Engineering (Personal Computer)
Xcel Prize	Xcel	For the best third-year student in Industrial and Systems Engineering (R2 000 plus plaque).
Sasol Prize	Sasol Ltd	For the most outstanding consistent academic achievement for the duration of the degree programme (R1 500).
Department of Mechanical and Aeronautical Engineering		
C A du Toit Medal and Prize	C A du Toit and Partners	Awarded in the final year for excellence in the subject of Heat Transfer.
MMD Prize in Maintenance Engineering (Not necessarily awarded every year.)	Mines Machinery Division	Awarded in the final year of study for excellence in Maintenance Engineering.
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	Awarded for excellence in Design in the third year of study (R1 000).
Sasol Merit Medal	Sasol Ltd	Awarded for excellence in Design in the final-year of study (R1 500).
Sasol Merit Medal	Sasol Ltd	For the best Master's student in Mechanical Engineering (R2 000).
Prizes in the Department of Mechanical and Aeronautical Engineering are awarded at the discretion of the Head of Department.		
Department of Materials Science and Metallurgical Engineering		
SA Iron and Steel Institute Prize (SAISI Prize)	SAISI	For the best finalist in Metallurgical Engineering over four years of study (R5 000)
Prestige Award of the SA Institute of Mining and Metallurgy	SA Institute of Mining and Metallurgy	For the best achievement in the final year in Metallurgical Engineering (R2 000).
Kumba Prize	Kumba Resources	For the best achievement in the third year in Metallurgical Engineering (R2 000).
Iscor Prize	Iscor	For the best achievement in the second year in Metallurgical Engineering (R2 000).
Department of Materials Science and Metallurgical Engineering Prize	UP Dept. of Materials Science and Metallurgical Engineering	For the best achievement in the first year in Metallurgical Engineering (R2 000).

Name	Donor	Award
Department of Materials Science and Metallurgical Engineering Project Prize	UP Dept. of Materials Science and Metallurgical Engineering	For the best achievement in the final year project in Metallurgical Engineering (R3 000).
Mintek Prize	Mintek	For the best second-year student in the module Process Thermodynamics (R1000).
Hernic Premier Prize	Hernic Premier	For the best third-year student in the module Refractory Materials (R500).
Department of Mining Engineering		
Prestige Award of the SA Institute of Mining and Metallurgy	SA Institute of Mining and Metallurgy	For the best achievement in the final year in Mining Engineering (R2000).
Medal and Prize of the UP Mining Alumni Society	UP Mining Alumni Society	Medal plus R1000 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 Climate Control 410 (R400).
SANIRE Prize for Rock Mechanics	The SA National Group on Rock Mechanics	For the most 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).
Sasol Prize	Sasol Ltd	Best academic student in the first year of study (floating trophy and cash prize).
Sasol Prize	Sasol Ltd	Best academic student in the second year of study (floating trophy and cash prize).
Sasol Prize	Sasol Ltd	Best academic student in the third year of study (floating trophy and cash prize)
MOVUP & De Villiers Prize	UP Mining Alumni Society	For the best student in Geology in the third year of study (Book Prize of R500).

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