University of Pretoria Yearbook 2021

BEng Electrical Engineering (12130003)

Department	Electrical, Electronic and Computer Engineering
Minimum duration of study	4 years
Total credits	568
NQF level	08

Programme information

All fields of study of the BEng degree have been accredited by the Engineering Council of South Africa (ECSA), and comply with the academic requirements for registration as a professional engineer. The programmes are designed in accordance with the outcomes-based model as required by the South African Qualifications Authority (SAQA). The learning outcomes and contents of the programmes have been compiled in accordance with the latest accreditation standards (PE-60 and PE-61) of ECSA, which also comply with the SAQA requirements, and which are summarised as follows:

Learning outcomes of the BEng degree:
A graduate in engineering should be able to apply the following skills on an advanced level:

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

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%).

Admission requirements

- The closing date is an administrative admission guideline for non-selection programmes. Once a non-selection programme is full and has reached the institutional targets, then that programme will be closed for further admissions, irrespective of the closing date. However, if the institutional targets have not been met by the closing date, then that programme will remain open for admissions until the institutional targets are met.
- The following persons will be considered for admission: Candidates who are in possession of a certificate that is deemed by the University to be equivalent to the required National Senior Certificate (NSC) with university endorsement; candidates who are graduates from another tertiary institution or have been granted the status of a graduate of such an institution, and candidates who are graduates of another faculty at the University of Pretoria.
- Life Orientation is excluded when calculating the APS.
- Grade 11 results are used for the conditional admission of prospective students.
- A valid qualification with admission to degree studies is required.
- Minimum subject and achievement requirements, as set out below, are required.
- Conditional admission to the four-year programmes in the School of Engineering is guaranteed only if a prospective student complies with ALL the requirements as indicated in the table.
- Admission to ENGAGE in the School of Engineering will be determined by the NSC results, achievement levels of 5 for Mathematics and 5 for Physical Sciences, and an achievement level of 5 for English, together with an APS of 30.
- Students may apply directly to be considered for the ENGAGE programme.
- All lectures at the University of Pretoria are presented in English only.

Note: The Engineering Council of South Africa (ECSA) accredits our programmes and our degrees meet the requirements for Professional Engineers in SA.

Transferring students

Candidates previously registered for the BSc – Extended programme

The Admissions Committee of the faculty considers applications of candidates who were previously registered for the BSc – Extended programme, on grounds of their NSC results as well as academic merit. Such students will only be considered for the four-year programme if they have passed all the prescribed modules and obtained a minimum of 65% in the Mathematics, Physics and Chemistry modules, respectively.

Candidates previously registered at UP or at another university

The faculty's Admissions Committee considers applications of candidates who have already completed the final NSC examination and/or were previously registered at UP or at another university, on grounds of their NSC results as well as academic merit. Candidates who were dismissed from other faculties or universities will not be considered.

Candidates previously registered at a teacher's college or university of technology

The faculty's Admissions Committee considers the application of these candidates on the grounds of their NSC results as well as academic merit.

Qualifications from countries other than South Africa

- Citizens from countries other than South Africa and South African citizens with foreign qualifications must comply with all the other admission requirements and the prerequisites for subjects/modules.
- In addition to meeting the admission requirements, it may be expected from candidates to write the **TOEFL, IELTS or SAT,** if required.
- Candidates must have completed the National Senior Certificate with admission to degree studies or a certificate of conditional exemption on the basis of a candidate's foreign qualifications, the so-called "Immigrant" or "Foreign Conditional Exemption". The only condition for the "Foreign Conditional Exemption" that is accepted is: 'completion of the degree course'. The exemption certificate is obtainable from Universities South Africa (USAf). Detailed information is available on the website at click here.

University of Pretoria website: click here

Minimum requirements Achievement level English Home Language or English First Additional Language		**Mathematics**		**Physical Sciences**		**APS**
NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
5	C	>65%	C	>65%	C	**33**

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. Students in the Cambridge system must offer both Physics AND Chemistry with performance at the level specified for NSC Physical Sciences in the table above.

* International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission. Students in the IB system must offer both Physics AND Chemistry with performance at the level specified for NSC Physical Sciences in the table above.

ENGAGE Programme minimum requirements Achievement level English Home Language or English First Additional Language		**Mathematics**		**Physical Sciences**		**APS**
NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
5	C	5	C	5	C	**30**

Other programme-specific information

With a few exceptions, most modules offered at the School of Engineering are semester modules having credit values of either 8 or 16.
A student may be permitted by the Dean, on recommendation of the relevant head of 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.

Please note:

1. All students are required to successfully complete JCP 203, Community-based project 203, as part of the

requirements for the BEng degree. A student may register for the module during any of the years of study of the programme, but preferably not during the first or the final year of study.
2. Students registered for Chemical Engineering who have passed CBI 311 or CBI 410, receive credit for CBI 310.
3. Mechanical Engineering: For the Aeronautical Option, the themes of both the Design and the Project must be aeronautical-related.
4. Offering of electives depends on the availability of resources and industry support.

Promotion to next study year

Promotion to the second semester of the first year and to the second year of study (Eng. 14)

a. A new first-year student who has failed in all the prescribed modules of the programme at the end of the first semester, is excluded from studies in the School of Engineering. A student who is registered for the Engineering Augmented Degree Programme and has passed only 8 credits will also be excluded.
b. A student who complies with all the requirements of the first year of study, is promoted to the second year of study.
c. A student who has not passed at least 70% of the credits of the first year of study after the November examinations, must reapply for admission should he/she intend to proceed with his/her studies. Application on the prescribed form must be submitted to the Student Administration of the School of Engineering not later than 11 January. Late applications will be accepted only in exceptional circumstances after approval by the Dean. Should first-year students be readmitted, conditions of readmission will be determined by the Admissions Committee.
d. Students who have not passed all the prescribed modules at first year level (level 100), as well as students who are readmitted in terms of Faculty Regulations must register for the outstanding first-year level (level-100) modules.
e. A student who is repeating his or her first year, may, on recommendation of the relevant heads of department and with the approval of the Dean, be permitted to enroll for modules of the second-year of study in addition to the first-year modules which he or she failed, providing that he or she complies with the prerequisites for the second-year modules and no timetable clashes occur. Students on the ENGAGE programme may, following the same procedure, be permitted to enrol for level-200 modules in addition to the level-100 modules which he/she failed providing that he/she complies with the prerequisites for the modules at 200-level and no timetable clashes occur. On recommendation of the relevant head of department and with special permission from the Dean, permission may be granted to exceed the prescribed number of credits. The total number of credits which may be approved may not exceed the normal number of credits per semester by more than 16 credits.
f. Students in Computer, Electrical and Electronic Engineering, who fail a first-year module for the second time, forfeit the privilege of registering for any modules of an advanced year of study.

Please note:

i. From the second year of study each student should be in possession of an approved calculator. It is assumed that each student will have easy access to a laptop computer.
ii. Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out in the syllabi of PWP 121 Workshop practice 121.

Promotion to the third year of study of the Four-year Programme, as well as to the third and the

fourth years of study of the ENGAGE Programme. In case of the fourth year of study of the ENGAGE Programme, the words "first", "second" and "third" must be substituted with the words "second", "third" and "fourth" respectively. (Eng. 15)

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

Promotion to the fourth year of study of the Four-year Programme, as well as to the fifth year of study of the ENGAGE Programme. In case of the fifth year of study of the ENGAGE Programme, the words "second", "third" and "fourth" must be substituted with the words "third", "fourth" and "fifth" respectively. (Eng. 16)

a. A student who complies with all the requirements of the third year of study is promoted to the fourth year of study. A student who does not comply with all the requirements but who is able to register for all outstanding modules in order to complete the degree programme, may at registration be promoted to the fourth year of study.
b. A student must pass all the prescribed modules of the second year of study, before he or she is admitted to any module of the fourth year of study.
c. A student who has not passed all the prescribed modules of the third year of study, must register for the outstanding modules. A student may be admitted by the Dean, on the recommendation of the relevant head of department, 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.

Pass with distinction

a. A student graduates with distinction if:

i. no module of the third or fourth year of study of the four year programme or of the fourth or fifth year of the

ENGAGE programme was repeated and a weighted average of at least 75% was obtained in one year in all the modules of the final year of study; and

ii. the degree programme was completed within the prescribed four years for the four year programme and within the prescribed five years of the ENGAGE programme.

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

Curriculum: Year 1

Minimum credits: 144

Fundamental modules

Academic orientation 112 (UPO 112)

Module credits	0.00
NQF Level	00
Language of tuition	Module is presented in English
Department	EBIT Deans Office
Period of presentation	Year

Core modules

General chemistry 171 (CHM 171)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	1 discussion class per week, 1 practical per week, 1 web-based period per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 1

Module content

General introduction to inorganic, analytical and physical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical reactions, redox reactions, solubilities and solutions, atomic structure, periodicity. Molecular structure and chemical bonding using the VSEPR model. Principles of reactivity, electrochemistry, energy and chemical reactions, entropy and free energy. Appropriate tutorial classes and practicals.

Electricity and electronics 122 (EBN 122)

Module credits	16.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering

Period of presentation	Semester 2

Module content

Electrical quantities, units, definitions, conventions. Electrical symbols, ideal and practical current and voltage sources, controlled sources. Ohm's law in resistive circuits, Kirchoff's current and voltage laws, resistors in series and parallel circuits, voltage and current division, mesh current and node voltage methods. Circuit theorems: linearity, superposition, Thevenin and Norton equivalent circuits, sources transformation, power calculation, maximum power transfer. Energy storage elements: current, voltage, power and energy in inductors and capacitors, inductors and capacitors in series and parallel. Ideal operational amplifiers and applications: inverting and noninverting amplifiers, summing amplifiers, current sources, integrators.

Physics 176 (FSK 176)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	1 discussion class per week, 1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 2

Module content

Introductory mathematics: Symbols, exponents, logarithms, angles in degrees, radial measure, goniometry, differentiation, and integration. Motion along a straight line: position and displacement, acceleration. Vectors: adding vectors, components, multiplying vectors. Motion in two and three dimensions: projectile motion, circular motion. Force and motion: Newton's Law, force, friction. Kinetic energy and work: work, power. Potential energy: Centre of mass, linear momentum. Collisions: impulse and linear momentum, elastic collisions, inelastic collisions. Rotation: kinetic energy of rotation, torque. Oscillations and waves: Simple harmonic motion, types of waves, wavelength and frequency, interference of waves, standing waves, the Doppler effect. Temperature, heat and the first law of thermodynamics.

Humanities and social sciences 110 (HAS 110)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Anthropology and Archaeology
Period of presentation	Semester 1

Module content

Social sciences: Perspectives on contemporary society
An introduction to long-standing questions about the nature of human societies and contemporary challenges. Topics to be discussed include globalisation and increasing connectedness; rising unemployment, inequality and poverty; rapid urbanisation and the modern city form; transformations in the nature of work; environmental degradation and tensions between sustainability and growth; shifts in global power relations; the future of the nation-state and supra-national governance structures; and possibilities for extending human rights and democracy. Critical questions are posed about modern selfhood, sociality, culture and identity against the background of new communications technologies, ever more multicultural societies, enduring gender, class and race inequities, and the emergence of new and the resurgence of older forms of social and political identity. These issues are approached from the vantage of our location in southern Africa and the continent, drawing on social science perspectives.

Humanities and social sciences 120 (HAS 120)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Afrikaans
Period of presentation	Semester 2

Module content

Humanities: Text, culture and communication
Successful communication of ideas, values and traditions depends on understanding both the literal and implied meanings of texts. In this module students are introduced to a variety of texts, including original literary and visual texts, with a view to developing an understanding of how textual meanings have been constructed and negotiated over time. Students are encouraged to understand themselves as products of – and participants in – these traditions, ideas and values. Appropriate examples will be drawn from, among others, the Enlightenment, Modernism, Existentialism, Postmodernism and Post-colonialism.

Graphical communication 110 (MGC 110)

Module credits	16.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	3 lectures per week, 3 tutorials per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Freehand sketching covering the following: perspective, isometric and orthographic drawings. Drawing conventions, graphical techniques and assembly drawings. Evaluation of drawings and error detection. True lengths of lines, projections and intersections. Practical applications of these techniques. Introduction to computer-aided drawings, including dimensioning, crosshatching and detailing. Introduction to basic manufacturing processes including primary (casting, forging and extrusion) and secondary (drilling, turning, milling, grinding, broaching and sawing) manufacturing procedures.

Materials science 113 (NMC 113)

Module credits	16.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	1 practical per week, 1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Materials Science and Metallurgical Engineering
Period of presentation	Semester 1

Module content

Introduction to materials: the family of materials, atomic structure and types of bonding, crystal types and space arrangement of atoms, directions and planes in crystals, defects in crystals, diffusion in solids. Mechanical properties of materials: stress and strain, mechanical testing (strength, ductility, hardness, toughness, fatigue, creep), plastic deformation, solid-solution hardening, recrystallisation.
Polymeric materials: polymerisation and industrial methods, types of polymeric materials and their properties. Corrosion of metals: mechanisms and types of corrosion, corrosion rates, corrosion control. The heat treatment of steel: Fe-C phase diagram, equilibrium cooling, hardening and tempering of steel, stainless steel. Composite materials: Introduction, fibre reinforced polymeric composites, concrete, asphalt, wood.

Statics 122 (SWK 122)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	WTW 158
Contact time	2 tutorials per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Civil Engineering
Period of presentation	Semester 2

Module content

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

Calculus 158 (WTW 158)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	60% for Mathematics in Grade 12
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 158, WTW 114, WTW 134, WTW 165.
Introduction to vector algebra. Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, applications. The mean value theorem, the rule of L'Hospital. Indefinite integrals, integration.

Mathematics 164 (WTW 164)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 114 or WTW 158
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 146, WTW 148 and WTW 124,

Vector algebra with applications to lines and planes in space, matrix algebra, systems of linear equations, determinants, complex numbers, factorisation of polynomials and conic sections. Integration techniques, improper integrals. The definite integral, fundamental theorem of Calculus. Applications of integration. Elementary power series and Taylor’s theorem. Vector functions, space curves and arc lengths. Quadratic surfaces and multivariable functions.

Curriculum: Year 2

Minimum credits: 148

Core modules

Engineering statistics 220 (BES 220)

Module credits	8.00
NQF Level	06
Prerequisites	WTW 158 GS, WTW 164 GS
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Department	Industrial and Systems Engineering
Period of presentation	Semester 2

Module content

Engineering systems are often subjected to variation, uncertainty and incomplete information. Mathematical statistics provides the basis for effectively handling and quantifying the effect of these factors. This module provides an introduction to the concepts of mathematical statistics and will include the following syllabus themes: data analysis, probability theory, stochastic modelling, statistical inference and regression analysis.

Imperative programming 132 (COS 132)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	APS of 30 and level 5 (60-69%) Mathematics
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

This module introduces imperative computer programming, which is a fundamental building block of computer science. The process of constructing a program for solving a given problem, of editing it, compiling (both manually and automatically), running and debugging it, is covered from the beginning. The aim is to master the elements of a programming language and be able to put them together in order to construct programs using types, control structures, arrays, functions and libraries. An introduction to object orientation will be given. After completing this module, the student should understand the fundamental elements of a program, the importance of good program design and user-friendly interfaces. Students should be able to conduct basic program analysis and write complete elementary programs.

Electrical engineering 211 (EIR 211)

Module credits	16.00
NQF Level	06
Prerequisites	EBN 111 or EBN 122 and WTW 161/164
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Transient response phenomena in RC, RL and RLC circuits: Natural response and step response. Alternating current (AC) circuits: Phasors, impedances, and power in AC circuits. The application of Ohm’s law, Kirchoff’s circuit theorems, matrix methods and Thevenin and Norton equivalents to sinusoidal steady-state analysis. Three-phase circuits: Balanced three-phase circuits, star/delta configurations, and three-phase power transfer calculations. Magnetically coupled circuits: Mutual inductance, coupling factor, transformers, ideal transformers and autotransformers. Application of circuit theory to an induction machine: basic principles of induction machines, equivalent circuit and analysis thereof, calculation of power and torque through application of Thevenin's theorem. Synoptic introduction to other types of machines.

Professional and technical communication 210 (EJJ 210)

Module credits	8.00
NQF Level	06
Prerequisites	No prerequisites.
Contact time	2 lectures per week, 2 tutorials per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

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

Linear systems 220 (ELI 220)

Module credits	16.00
NQF Level	06
Prerequisites	EIR 211/221 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

Frequency domain analysis of linear time-invariant systems. Laplace, Fourier and Z-transforms applied to periodic, aperiodic and sampled signals; exponential and trigonometric Fourier series. Nyquist sampling theorem, transfer functions, poles and zeros, bandwidth and rise time, frequency response, impulse response, Bode diagrams, natural frequency, natural and forced response. Instability and oscillations. Computer simulation.

Introduction to programming and computer simulations 101 (EMR 101)

Module credits	4.00
NQF Level	05
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Year

Module content

This module is presented during the recess period at the end of the first semester. The module serves as an introduction to programming and computer simulations using a high-level industry-standard programming language to develop and support problem solving. Students will be informed by the Department if, for practical reasons, the module needs to be offered in a different time slot.

Practical wiring 200 (EPW 200)

Module credits	4.00
NQF Level	06
Prerequisites	No prerequisites.
Contact time	1 Week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Year

Module content
This module is presented during one of the recess periods during the second year of study. In this module the student will become acquainted with relevant regulations and legislation and basic aspects of wiring practice.Students will be informed by the Department if, for practical reasons, the module needs to be offered in a different time slot.

Digital systems 220 (ERS 220)

Module credits	16.00
NQF Level	06
Prerequisites	No prerequisites.
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content
Introduction to digital circuit design, digital representations of numbers, device electronics in digital circuits, representation and simplification of logic functions, components of combinational circuits, analysis and design of combinational circuits, components of sequential circuits, analysis and design of sequential circuits, programmable components for combinatorial and sequential logic.

Community-based project 203 (JCP 203)

Module credits	8.00
NQF Level	06
Prerequisites	No prerequisites.
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Year

Module content
This module is integrated into all undergraduate academic programmes offered by the Faculty. Main objectives: execution of a community project aimed at achieving a beneficial impact on a section of a socio-economically underprivileged community located in socio-economically deprived areas our society; awareness of personal, social and cultural values and an understanding of social issues; and development of life skills.

Dynamics 210 (MSD 210)

Module credits	16.00
NQF Level	06
Prerequisites	FSK 116 or FSK 176 and SWK 122 and WTW 256 #

Contact time	2 tutorials per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Kinetics of systems of particles, Newton's 2nd law generalised for a system of particles, rate of change of momentum and angular momentum relations, work-energy relations, conservation laws, steady mass flow. Plane kinematics of rigid bodies, rotation, translation, general 2D motion, relative motion analysis. Moments and products of inertia. Plane kinetics of rigid bodies, equations of motion, rotation, translation, general 2D motion, work-energy relations. Vibration and time response.

Mathematics 238 (WTW 238)

Module credits	16.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 256 and WTW 258 GS
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

Linear algebra, eigenvalues and eigenvectors with applications to first and second order systems of differential equations. Sequences and series, convergence tests. Power series with applications to ordinary differential equations with variable coefficients. Fourier series with applications to partial differential equations such as potential, heat and wave equations.

Differential equations 256 (WTW 256)

Module credits	8.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 158 and WTW 164
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

Theory and solution methods for linear differential equations as well as for systems of linear differential equations. Theory and solution methods for first order non-linear differential equations. The Laplace transform with application to differential equations. Application of differential equations to modelling problems.

Calculus 258 (WTW 258)

Module credits	8.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 158 and WTW 164
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

Calculus of multivariable functions, directional derivatives. Extrema. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green. Surface integrals and the theorems of Gauss and Stokes.

Numerical methods 263 (WTW 263)

Module credits	8.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 164
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

Numerical integration. Numerical methods to approximate the solution of non-linear equations, systems of equations (linear and non-linear), differential equations and systems of differential equations. Direct methods to solve linear systems of equations.

Curriculum: Year 3

Minimum credits: 148

Core modules

Engineering management 310 (BSS 310)

Module credits	8.00
NQF Level	07
Prerequisites	No prerequisites.
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Department	Industrial and Systems Engineering
Period of presentation	Semester 1

Module content

The purpose of this module is to develop knowledge and understanding of engineering management principles and economic decision-making so that students can design, manage, evaluate and participate in engineering projects in the workplace. As such elements from engineering economics, project management and systems engineering are combined.
This module develops and assesses the students' competence in terms of ECSA Exit Level Outcome 11 relating to Engineering Management.

Control systems 320 (EBB 320)

Module credits	16.00
NQF Level	07
Prerequisites	ELI 220 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

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

Power electronics 320 (EDF 320)

Module credits	16.00
NQF Level	07
Prerequisites	ELX 311 GS, ELI 220 GS

Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

Semiconductor components: Power diodes, silicon-controlled-rectifiers, bipolar transistors, power mosfets, IGBTs, emerging devices. Ancillary issues: Heat sinks, snubbers, gate drive circuits. Converter topologies: AC-DC converters, DC-DC converters; Applications: Sizing of converter components, isolated high-frequency power supplies.

Power system components 320 (EKK 320)

Module credits	16.00
NQF Level	07
Prerequisites	EIR 211, 221 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

Single and three-phase basic concepts, Transformers: the ideal transformer, equivalent circuit, single and three-phase transformers, auto-transformers, tap changing transformers. Synchronous machines: equivalent circuit, real and reactive power control, two-axis machine model. Transmission lines, Underground Cables, Capacitors, Reactors, Single and three-phase induction motors, Load modelling.

Electrical machines 311 (ELX 311)

Module credits	16.00
NQF Level	07
Prerequisites	EIR 211/221
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Magnetic circuits: flux, flux density, reluctance, hysteresis, MMF.Magnetic Energy, Conversion: Process, field energy, mechanical force in electromagnetic systems. Transformers: Types of transformers, per unit system, voltage regulation and efficiency, three phase circuit analysis. Principles of machines: Torque, speed, efficiency and heat loss, circuit models. Machines: Power transformers, DC motors, induction motors.

Microprocessors 310 (EMK 310)

Module credits	16.00
NQF Level	07
Prerequisites	ERS 220 GS, ELI 220 GS, ENE 310/ ENE 310#
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Hardware based introduction to system designing microprocessors. General microprocessor architecture assembly language and limited C embedded code development, with specific focus on a RISC (Microchip PIC 18) and MIPS (Microchip PIC 32) type processor, memory interfacing and address decoding, microprocessor input/output and interfacing, general programming concepts, general microprocessor system design principles, current trends and new processors exposure to development boards and integrated development environments.

Electromagnetism 310 (EMZ 310)

Module credits	16.00
NQF Level	07
Prerequisites	WTW 238 GS, WTW 263 GS, EIR 211/221 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Transmission line equations, wave propagation, input impedance, power flow; Electrostatics, charge and current, laws of Coulomb and Gauss, scalar potential, properties of materials, boundary conditions, capacitance, Magnetostatics, laws of Biot-Savart and Ampère, magnetic properties of materials, boundary conditions; Plane wave propagation, polarisation, power density; Wave reflection and transmission, normal and oblique incidence.

Analogue electronics 310 (ENE 310)

Module credits	16.00
NQF Level	07
Prerequisites	ELI 220 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Amplifier concepts: gain, input impedance, output impedance, bandwidth, cascaded stages. Amplifier power dissipation and power efficiency. Operational amplifiers: non-ideal, limitations, low power, programmable. Diode operational circuits: Logarithmic amplifiers, peak detector, clamp, absolute value, voltage regulators. Feedback and stability in amplifiers. Operational circuits: Instrumentation amplifiers, multipliers, oscillators, filters, translinear circuits, and sampling electronics.

DSP programming 300 (ESP 300)

Module credits	4.00
NQF Level	07
Prerequisites	EPW 200, (ELI 220), (EMK 310)
Contact time	Three days
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Year

Module content

This module is presented during one of the recess periods in the third year of study. The module is an introduction to digital signal processors (DSPs) for electrical engineering students. The first of three days is dedicated to theory lectures introducing DSP and addressing quantisation, sampling theory, anti-aliasing filters, correlation, convolution, DFT, inverse DFT, Z- transforms, digital filters (low pass, anti-aliasing, FIR and IIR) and the design thereof. PCB layout techniques, decoupling and bypass capacitors relating to digital circuits are addressed. At the end of the theory sessions students need to design a filter. The practical work over the last two days consists of implementing the filter designed as well as coding DAC, FIR, IIR and PWM for a DSP. The DAC, FIR, IIR and PWM are implemented in hardware/firmware and the results displayed on an oscilloscope. At the end of the module each student will demonstrate a working system consisting of the developed firmware and hardware performing the required signal processing functions. Students will be informed by the Department if, for practical reasons, the module needs to be offered in a different time slot.

Electrical engineering design 320 (EWE 320)

Module credits	16.00
NQF Level	07
Prerequisites	EIR 211/221 GS, EMK 310 GS
Contact time	1 tutorial per week, 2 lectures per week, 2 practicals per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

In this module, students are required to generate a creative system design through synthesis and integration of components and subsystems. Students have to acquire technical knowledge through independent learning, and demonstrate a competency to work in a technical design team to realise and demonstrate a working product. This practical component is augmented by theoretical instruction in the fundamentals of system engineering, industry standards and practices, design for operational feasibility, power transformer design, power cable design, power capacitor design and protection system design.

Engineering activity and group work 320 (MIA 320)

Module credits	8.00
NQF Level	07
Prerequisites	(CJJ 310) or (EJJ 210) or (BJJ 210) or (MJJ 210) or (NJJ 210) or (PJJ 210)
Contact time	1 other contact session per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Two exit learning outcomes (ELO) of ECSA are addressed and each must be passed in the same semester. ELO7: Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment. The history of engineering globally and in South Africa. Most important engineering projects globally and in South Africa. The impact of technology on society. Occupational and public health and safety. Occupational Health and Safety Act. Impacts on the physical environment. The personal, social, cultural values and requirements of those affected by engineering activity. The combination of social, workplace (industrial) and physical environmental factors are appropriate to the discipline of the qualification. ELO8: Demonstrate competence to work effectively on a small project as an individual, in teams and in multidisciplinary environments. Identifies and focuses on objectives. Works strategically. Executes tasks effectively. Delivers completed work on time. Effective team work: Makes individual contribution to team activity; performs critical functions; enhances work of fellow team members; benefits from support of team members; communicates effectively with team members; delivers completed work on time. Multidisciplinary work by the following: Acquires a working knowledge of co-workers' discipline; uses a systems engineering approach; communicates across disciplinary boundaries. Report and presentation on team project. Tasks require co-operation across at least one disciplinary boundary. Students acquire a working knowledge of co-workers discipline. Students communicate between disciplinary boundaries.

Curriculum: Final year

Minimum credits: 152

Core modules

Electrical drives 410 (EAD 410)

Module credits	16.00
NQF Level	08
Prerequisites	ELX 311GS and EDF 320 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Single and three-phase DC-AC invertors, PWM, 4-quadrant conversion, DC and AC variable speed drives and high frequency transformer design.

Automation 410 (EBT 410)

Module credits	16.00
NQF Level	08
Prerequisites	EBB 320 GS
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Plant automation issues. The steps taken to establish controllers for industrial processes. Static and dynamic properties of sensors and actuators. Obtaining models from process data. Plant automation platforms. Model-bases PID and internal model control. Turning and troubleshoot control loops. Unconstrained single-input-single-output model predictive control. Economic evaluation of automation systems.

Power system analysis 410 (EKK 410)

Module credits	16.00
NQF Level	08
Prerequisites	EKK 320 GS
Contact time	1 practical per week, 1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English

Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 1

Module content

Power flow: bus admittance matrix, bus impedance matrix, Gauss Seidal and Newton Raphson methods. Fault analysis: balanced fault analysis, symmetrical components, unbalanced fault analysis. Power system protection: definite time, invese-definite-minimum-time (IDMT), introduction to over-current and earth fault protection, distribution system protection, transmission system protection, reticulation system protection. Sizing of protection devices. High voltage control: over-voltages, transients.

Research project 420 (ENR 420)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 tutorial per week, 2 lectures per week, 2 practicals per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

Specific niche areas from electrical engineering are addressed within the context of a research project. The student should be able to demonstrate competence in designing and conducting investigations and experiments; to analyse the results; to select and use appropriate engineering tools and software; to interpret and derive information from the data; to draw conclusions based on evidence and to communicate the purpose, process and outcomes in a report.

Project 400 (EPR 400)

Module credits	64.00
NQF Level	08
Prerequisites	EWE 320 (Electrical Engineering) ELO 320 (Electronic Engineering), Finalists only
Contact time	1 lecture per week
Language of tuition	Separate classes for Afrikaans and English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Year

Module content

This module entails the individual completion of an engineering project from concept to delivery. The student must demonstrate independent mastery of an engineering project. The module focuses on the formulation of an engineering problem, the development of appropriate technical specifications, project planning and management and then completion of a technical project of a given nature, scope and complexity. The nature of projects is either mainly design (design, synthesis and testing) with a smaller component of investigation (experimental work and data analysis), or, alternatively, mainly investigation with a smaller component of design. As final step in the project, the student evaluates the final outcome of the design or investigation against the specifications and he/she also evaluates the impact of the project (social, legal, safety and environmental). Oral and written technical communication is evaluated as an important part of the module.

Practical training and report 423 (EPY 423)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

Module content

Four weeks practice-orientated experience at any institution of the student’s choice (preferably in electrical, electronic or computer engineering). The student must acquire experience in the working environment and more specifically work ethics, ecology, economy, punctuality, knowledge of human nature, etc. One week after the commencement of the second semester the student must submit a report on the aspects of his/her work experience as determined by the Head of the Department.

Engineering professionalism 410 (IPI 410)

Module credits	8.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 other contact session per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Mining Engineering
Period of presentation	Semester 1

Module content

Requirements to maintain continued competence and to keep abreast of up-to date tools and techniques. ECSA code of conduct, Continuing Professional Development, ECSA outcomes, ECSA process and reasons for registration as CEng and PrEng. Displays understanding of the system of professional development. Accepts responsibility for own actions. Displays judgment in decision making during problem solving and design. Limits decision making to area of current competence. Reason about and make judgment on ethical aspects in case study context. Discerns boundaries of competence in problem solving and design. Case studies typical of engineering practice situations in which the graduate is likely to participate.

The information published here is subject to change and may be amended after the publication of this information. The General Regulations (G Regulations) apply to all faculties of the University of Pretoria. It is expected of students to familiarise themselves well with these regulations as well as with the information contained in the General Rules section. Ignorance concerning these regulations and rules will not be accepted as an excuse for any transgression.