
University of Pretoria Yearbook 2016

BEng Chemical Engineering Engage (12136021)

Duration of study 5 years

Total credits 610

Programme information

Please note: The Engineering Augmented Degree Programme (ENGAGE) is an extended degree programme with a five-year curriculum. It is designed to enable students who show academic potential but who do not meet the normal entry requirements for the four-year degree programme, to obtain an Engineering degree. ENGAGE students spend the first three years of the programme covering the content of the first two years of the four-year degree programme. They also take compulsory augmented modules in each of the Level 1 subjects. These augmented modules provide students with background knowledge and skills needed to succeed in an engineering degree. The curriculum for years four and five of the ENGAGE programme are identical to the curriculum for years 3 and 4 of the 4-year programme, respectively. Students may apply directly for admission to the programme.

- Students must register for the entire programme, not components of it. The curriculum is fixed; there are no electives.
 - Attendance at all components of years 1 to 3 of the programme is compulsory. Non-attendance will only be condoned in the case of illness (sick note required) or family crisis (e.g. a death in the family), in which case students must inform the programme administration immediately.
 - Students who fail to meet the attendance requirement for any module in any semester of years 1 to 3 of the programme will be excluded from the programme.
 - No augmented module may be repeated more than once.
 - Selection into the programme will be based on a combination of performance in the National Senior Certificate examinations or equivalent and other selection tests approved by the faculty.
 - A student who fails a mainstream module (e.g. Chemistry) but passes the associated augmented module (e.g. Additional chemistry) does not need to repeat the augmented module.
 - A student who fails an augmented module (e.g. Additional chemistry) but passes the associated mainstream module (e.g. Chemistry) does not need to repeat the mainstream module.
 - A student must meet the attendance requirement and obtain at least 40% for both the continuous assessment and test components as well as a final mark of 50% in order to pass an augmented module.
- i. The 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 programme.
- ii. JPO 110 is a prerequisite for JPO 120. Credit for JPO is obtained with a final mark of more than 50%.
Conditional admission to JPO 120: If the final mark for JPO 110 is between 45% and 49%, a student can register for JPO 120 but credit for JPO 110 and JPO 120 will only be obtained if the final combined mark for JPO 110 and JPO 120 is above 50%.



Please note: All students will be 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.

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 personal computer.
- ii. Students who intend transferring to Mining Engineering, must familiarise themselves with the stipulations set out in the syllabi of PWP 121 Workshop practice 121.

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 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.

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: 128

Fundamental modules

Academic orientation 112 (UPO 112)

Module credits	0.00
Language of tuition	Double Medium
Academic organisation	EBIT Dean's Office
Period of presentation	Year

Core modules

General chemistry 171 (CHM 171)

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.

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	1 web-based period per week, 1 practical per week, 1 discussion class per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemistry
Period of presentation	Semester 1

Physics 176 (FSK 176)

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.



Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	4 lectures per week, 1 discussion class per week, 1 practical per week
Language of tuition	Both Afr and Eng
Academic organisation	Physics
Period of presentation	Semester 2

Professional orientation 110 (JPO 110)

Module content:

A project-based approach is followed towards the development of skills needed for success in engineering. Skills include communication, information technology, technology, academic and life skills. The modules are presented in English.

Module credits	8.00
Prerequisites	Pass JPO 110. Conditional entry into JPO 120: JPO 110 mark between 45% and 49% . Pass JPO 110 and JPO 120: Final combined mark for JPO 110 and JPO 120 at least 50%.
Contact time	6 lectures per week, Foundation Course
Language of tuition	English
Academic organisation	EBIT Dean's Office
Period of presentation	Semester 1

Professional orientation 120 (JPO 120)

Module content:

A project-based approach is followed towards the development of skills needed for success in engineering. Skills include communication, information technology, technology, academic and life skills. The modules are presented in English.

Module credits	8.00
Prerequisites	Pass JPO 110. Conditional entry into JPO 120: JPO 110 mark between 45% and 49% . Pass JPO 110 and JPO 120: Final combined mark for JPO 110 and JPO 120 at least 50%.
Contact time	Foundation Course, 6 lectures per week
Language of tuition	English
Academic organisation	EBIT Dean's Office



Period of presentation Semester 2

Calculus 158 (WTW 158)

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.

Module credits 16.00

Service modules Faculty of Engineering, Built Environment and Information Technology

Prerequisites Refer to Regulation 1.2: A candidate must have passed Mathematics with at least 60% in the Grade 12 examination

Contact time 4 lectures per week, 1 tutorial per week

Language of tuition Both Afr and Eng

Academic organisation Mathematics and Applied Maths

Period of presentation Semester 1

Workshop practice 121 (WWP 121)

Module content:

*Attendance module only

The module is offered at the end of the first year of study and lasts at least eight days, during which training is given in the following workshops: electronic projects, panel wiring, electrical motors and switch gear, general machines, welding, turning and sheet metal work. Each student's progress is assessed after each workshop.

Module credits 6.00

Prerequisites No prerequisites.

Contact time 1 other contact session per week

Language of tuition Both Afr and Eng

Academic organisation Mechanical and Aeronautical En

Period of presentation Semester 2

Additional Chemistry 1 111 (JPO 111)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and chemical reasoning skills required by CHM 171/172.

Module credits 8.00



Prerequisites	No prerequisites.
Contact time	1 lecture per week, Foundation Course, 3 tutorials per week
Language of tuition	Both Afr and Eng
Academic organisation	EBIT Dean's Office
Period of presentation	Semester 1

Additional Physics 122 (JPO 122)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and physical reasoning skills required by FSK 116/176.

Module credits 8.00

Prerequisites No prerequisites.

Contact time 3 tutorials per week, 1 lecture per week, Foundation Course

Language of tuition English

Academic organisation EBIT Dean's Office

Period of presentation Semester 2

Additional Mathematics 1 116 (JPO 116)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and mathematical reasoning skills required by WTW 158.

Module credits 8.00

Prerequisites No prerequisites.

Contact time Foundation Course, 3 tutorials per week, 1 lecture per week

Language of tuition English

Academic organisation EBIT Dean's Office

Period of presentation Semester 1

Additional Mathematics 2 126 (JPO 126)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and mathematical reasoning skills required by WTW 161 and WTW 168.

Module credits 8.00

Prerequisites No prerequisites.



Contact time	1 lecture per week, Foundation Course, 3 tutorials per week
Language of tuition	English
Academic organisation	EBIT Dean's Office
Period of presentation	Semester 2

Humanities and social sciences 110 (HAS 110)

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.

Module credits	8.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Anthropology and Archaeology
Period of presentation	Semester 1

Humanities and social sciences 120 (HAS 120)

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.

Module credits	8.00
Service modules	Faculty of Engineering, Built Environment and Information Technology



Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Afrikaans
Period of presentation	Semester 2

Mathematics 164 (WTW 164)

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.

Module credits	16.00
Prerequisites	WTW 114 GS or WTW 158 GS
Contact time	4 lectures per week, 1 tutorial per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2



Curriculum: Year 2

Minimum credits: 136

Core modules

General chemistry 181 (CHM 181)

Module content:

General physical-analytical chemistry: Physical behaviour of gases, liquids and solids, intermolecular forces, solutions, chemical equilibrium, acids and bases, buffers, precipitation. Organic chemistry: Structure (bonding) and functional groups, nomenclature, isomerism, introductory stereo-chemistry, introduction to chemical reactions and chemical properties of organic compounds.

Appropriate tutorial classes and practicals.

Module credits 16.00

Service modules Faculty of Engineering, Built Environment and Information Technology

Prerequisites No prerequisites.

Contact time 1 web-based period per week, 1 practical per week, 4 lectures per week, 1 discussion class per week

Language of tuition Both Afr and Eng

Academic organisation Chemistry

Period of presentation Semester 2

Chemical engineering 113 (CIR 113)

Module content:

Dimensions, units and their conversion. The mol unit, density, concentration. Specific volume, bulk density, density of ideal mixtures. Temperatures and conversions. Pressure, absolute and gauge. Expression of concentration. Empirical formulae. Introduction to material balances: strategy for solving problems. Material balances without chemical reaction. Combinations of equipment.

Module credits 8.00

Prerequisites No prerequisites.

Contact time 2 tutorials per week, 2 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 1

Chemical engineering 123 (CIR 123)

Module content:

Chemical reaction and stoichiometry, excess reactant, conversion, yield, selectivity. Material balances with



recycle streams, bypass streams and purge streams. Gases, vapours and liquids: ideal gas law, SG and density of gases, Nm³. Material balances where gases are involved. Fuels and combustion: coal analysis, combustion calculations.

Module credits	8.00
Prerequisites	CIR 113, CHM 171 GS
Contact time	2 tutorials per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 2

Electricity and electronics 111 (EBN 111)

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.

Module credits	16.00
Prerequisites	No prerequisites.
Contact time	1 tutorial per week, 1 practical per week, 3 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Electrical, Electronic and Com
Period of presentation	Semester 1

Community-based project 203 (JCP 203)

Module content:

This module is integrated into all undergraduate academic programmes offered by the Faculty. Main objectives: execution of a community project aimed at achieving a beneficial impact on a section of society; awareness of personal, social and cultural values and an understanding of social issues; and development of life skills. Assessment: project proposal, written progress reports, peer assessment, assessment by community, presentation, report presented in the form of a blog.

Module credits	8.00
Prerequisites	No prerequisites.
Contact time	1 lecture per week



Language of tuition Both Afr and Eng

Academic organisation Informatics

Period of presentation Year

Graphical communication 110 (MGC 110)

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.

Module credits 16.00

Service modules Faculty of Education

Prerequisites No prerequisites.

Contact time 3 tutorials per week, 3 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Mechanical and Aeronautical En

Period of presentation Semester 1

Mechanics 122 (SWK 122)

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.

Module credits 16.00

Service modules Faculty of Natural and Agricultural Sciences

Prerequisites WTW 158

Contact time 2 tutorials per week, 4 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Civil Eng

Period of presentation Semester 1 or Semester 2



Calculus 258 (WTW 258)

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.

Module credits	8.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 158 and WTW 164
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Numerical methods 263 (WTW 263)

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.

Module credits	8.00
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	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Additional Chemistry 2 121 (JPO 121)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and chemical reasoning skills required by CHM 181.

Module credits	8.00
Prerequisites	No prerequisites.
Contact time	Foundation Course, 3 tutorials per week, 1 lecture per week
Language of tuition	English
Academic organisation	School of Engineering



Period of presentation Semester 2

Additional Electricity and electronics 112 (JPO 112)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by EBN 111/122.

Module credits 8.00

Prerequisites No prerequisites.

Contact time Foundation Course, 1 lecture per week, 3 tutorials per week

Language of tuition English

Academic organisation EBIT Dean's Office

Period of presentation Semester 1

Additional Graphical communication 113 (JPO 113)

Module content:

Background knowledge, conceptual understanding, drawing skills and reasoning skills required by MGC 110.

Module credits 8.00

Prerequisites No prerequisites.

Contact time 1 lecture per week, Foundation Course, 3 tutorials per week

Language of tuition English

Academic organisation School of Engineering

Period of presentation Semester 1

Additional Mechanics 125 (JPO 125)

Module content:

Background knowledge, problem-solving skills, conceptual understanding and reasoning skills required by SWK 122.

Module credits 8.00

Prerequisites No prerequisites.

Contact time 3 tutorials per week, 1 lecture per week, Foundation Course

Language of tuition English

Academic organisation EBIT Dean's Office

Period of presentation Semester 2





Curriculum: Year 3

Minimum credits: 138

Core modules

Engineering statistics 220 (BES 220)

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.

Module credits 8.00

Prerequisites No prerequisites.

Contact time 1 tutorial per week, 2 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Industrial and Systems Eng

Period of presentation Semester 2

Chemistry 215 (CHM 215)

Module content:

Organic chemistry. Chemical properties of organic (including aromatic) compounds. Functional group transformation and synthesis.

Module credits 12.00

Service modules Faculty of Engineering, Built Environment and Information Technology

Prerequisites CHM 171 or CHM 172 and CHM 181

Contact time 3 lectures per week, 1 practical per week

Language of tuition Double Medium

Academic organisation Chemistry

Period of presentation Semester 1

Chemistry 226 (CHM 226)

Module content:

Theory: Introduction to instrumental chemical analysis. Integration of electronic, chemical, optical and computer principles for the construction of analytical instrumentation. Detail discussion of principles and some instrumental methods from three disciplines within analytical chemistry, namely electrochemistry, spectroscopy and chromatography. This includes potentiometry, (AA) atomic absorption-, (ICP) atomic emission-, ultraviolet (UV)-, and infrared (IR) spectroscopy, potentiometric and photometric titrations, gas chromatography, liquid



chromatography as well as combinations of these techniques. Practical: IR spectroscopy, UV spectroscopy, AA spectroscopy, potentiometric titration, gas chromatography.

Module credits	8.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	CHM 171 or CHM 172 and CHM 181
Contact time	6 ppw, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Chemistry
Period of presentation	Semester 2

Chemical engineering 211 (CIR 211)

Module content:

Vapour pressure, phase changes, equilibrium. Vapour/gas equilibrium; Henry's law. Enthalpy and enthalpy balances. Heat of reaction. Data and data sources, steam tables. Enthalpy and combustion; flame temperature. Heats of solution and mixing. Miscible and immiscible liquid mixtures; dew point, bubble point. Simultaneous mass and enthalpy balances. PVT properties of real gases, PVT-diagrams of pure compounds. Vapour liquid equilibrium for ideal mixtures (Raoult's law).

Module credits	12.00
Prerequisites	CIR 123
Contact time	3 lectures per week, 3 tutorials per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1

Thermodynamics 223 (CTD 223)

Module content:

Simple applications of the first and second laws of thermodynamics. The concepts of work, heat, enthalpy and entropy. The calculation of internal energy, enthalpy and entropy using the equations of state. Simple heat engine cycles. Refrigeration and gas liquefaction. Process efficiency by means of energy. Introduction to non-ideality in VLE and mixing behaviour.

Module credits	16.00
Prerequisites	CIR 211, MPR 212/213, (WTW 258)
Contact time	3 tutorials per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering



Period of presentation Semester 2

Electrical engineering 221 (EIR 221)

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 induction motors: basic principles of induction motors, equivalent circuit and analysis thereof, calculation of power and torque through application of Thevenin's theorem. Synoptic introduction to other types of motors.

Module credits 16.00

Prerequisites EBN 111 or EBN 122 and WTW 161

Contact time 1 tutorial per week, 1 practical per week, 3 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Electrical, Electronic and Com

Period of presentation Semester 2

Strength of materials 210 (SWK 210)

Module content:

Stresses, strains and the mechanical properties of materials: Normal stress and shear stress, tension and compression, equilibrium in shear, factor of safety, design, shear strain, stress/strain diagram, Hooke's Law, Poisson's Ratio and the shear stress/strain diagram. Axial loads: Elastic deformation, displacements, statically determinate and indeterminate structures and thermal effects. Torsion: Torsion of circular bars and power transmission bending of straight members and composite beams. Transverse shear: Shear in straight members and shear flow. Combined loads: Thin walled pressure vessels and stresses as a result of combined loads. Stress transformation: Plane stress transformation, principle stresses, maximum values and stress variation in prismatic beams. Strain transformation: Plane strain transformation, principle strains, maximum values, strain gauges and rosettes and the relationship between E, G and ν . Design of beams from section characteristics. Deflection of beams: The elastic curve, integration method, Macaulay's method and superposition.

Module credits 16.00

Service modules Faculty of Natural and Agricultural Sciences

Prerequisites SWK 122, WTW 164/WTW 124

Contact time 4 lectures per week, 2 tutorials per week

Language of tuition Both Afr and Eng

Academic organisation Civil Eng



Period of presentation Semester 1

Mathematics 238 (WTW 238)

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.

Module credits 16.00

Service modules Faculty of Engineering, Built Environment and Information Technology

Prerequisites WTW 256 and WTW 258 GS

Contact time 4 lectures per week, 2 tutorials per week

Language of tuition Both Afr and Eng

Academic organisation Mathematics and Applied Maths

Period of presentation Semester 2

Differential equations 256 (WTW 256)

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.

Module credits 8.00

Service modules Faculty of Engineering, Built Environment and Information Technology

Prerequisites WTW 158 and WTW 164

Contact time 2 lectures per week, 1 discussion class per week

Language of tuition Both Afr and Eng

Academic organisation Mathematics and Applied Maths

Period of presentation Semester 1

Programming and information technology 213 (MPR 213)

Module content:

Advanced spreadsheet applications: Named ranges, linear algebra, solution of systems of equations, regression, interpolation, optimisation and table manipulation. Basic structured programming: Looping, branching, subroutines, iteration, reading and writing data files. Development, coding and debugging of simple programs in a high level programming language. Programming principles are illustrated via mathematical concepts such as limits, differentiation, integration and linear algebra. Structured programming by making use of functions and



available toolboxes. Basic graphical output (plotting is also covered). Different information resources, searching and management of information. Use of databases. Development of webpages. Hardware interaction and control of equipment and systems.

Module credits	18.00
Prerequisites	No prerequisites.
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Mechanical and Aeronautical En
Period of presentation	Semester 1

Chemical engineering materials 210 (CIM 210)

Module content:

Introduction to the synthesis, processing, structure, physical properties, and technical performance of important engineering materials: metals, ceramics, polymers and composites. Structural, mechanical, thermodynamic, and design related issues important to chemical engineering applications. Materials specification with emphasis on the corrosion of metals and life time estimation for polymer components.

Module credits	8.00
Prerequisites	CHM 181
Contact time	2 lectures per week, 2 tutorials per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1



Curriculum: Year 4

Minimum credits: 144

Core modules

Biotechnology 310 (CBI 310)

Module content:

Characterisation and taxonomy of biological material. Biochemistry and the chemistry of life. Biological growth requirements, metabolism, growth kinetics and product formation. Enzyme chemistry and kinetics, basic stoichiometry of biological reactions as well as mass - and energy balances for these processes using a chemical engineering approach. Biological reactor, operation and downstream processing.

Module credits 16.00

Prerequisites (CIR 211), (CHM 215)

Contact time 1 practical per week, 2 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 1

Laboratory 321 (CLB 321)

Module content:

Laboratory safety and general industrial safety practices. Techniques for planning of experiments. Experimental work illustrating: Analysis: Composition of coal and gas, heat of combustion, viscosity. Mass transfer: Gas absorption, batch distillation, azeotropic distillation, fractional distillation and liquid-liquid extraction. Heat transfer: Condenser, shell and tube heat exchanger, heat loss from insulated pipes. Piping system design: Frictional energy loss through pipes and fittings. Measuring equipment: Rate of flow, temperature. Reporting of laboratory results.

Module credits 16.00

Prerequisites CJJ 310/CJJ 210, CHM 226, CPN 321#, CKN 321#, (CMO 310), CIO 320#

Contact time 8 practicals per week, 2 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 2

Transfer processes 311 (COP 311)

Module content:

Momentum transfer. Fluid statics. Control volume approach for conservation of mass, energy, and momentum. Application to pumps and turbines. Navier-Stokes equations, derivation and applications. Laminar and turbulent



boundary layer theory. Heat transfer: fundamentals of heat transfer. Differential equations of heat transfer. Steady state conduction. Introduction to unsteady state conduction. Convection heat transfer and the thermal boundary layer. Radiation heat transfer. Mass transfer: fundamentals of mass transfer. Diffusion and the diffusion coefficient. Differential equations of mass transfer. Steady state molecular diffusion in one or more dimensions.

Module credits	16.00
Prerequisites	WTW 238, (WTW 263)
Contact time	3 tutorials per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1

Practical training 311 (CPY 311)

Module content:

*Attendance module only

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

Module credits	16.00
Prerequisites	(CIR 211)
Contact time	1 other contact session per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1

Chemical engineering 310 (CIR 310)

Module content:

Fundamentals of phase and chemical equilibrium with emphasis on vapour/liquid systems leading to the study of separations and reacting systems. Concepts and formalism of thermodynamics. Postulates and laws of thermodynamics. Thermodynamic functions (enthalpy, entropy, Gibbs free energy). Thermochemistry and Ellingham diagrams. Phase Equilibria: Phase diagrams of single substances, phase boundaries, the Phase Rule. Phase diagrams of mixtures, steam distillation, eutectic mixtures. Solution thermodynamics: Ideal and non-ideal solutions, excess properties and activity coefficient models. The equations of state of ideal and real gases, residual properties and fugacity. Vapour-liquid equilibrium from equations of state and the γ - ϕ approach. Application of thermodynamics to equilibrium between fluid- (gas and liquid) and condensed (liquid and solid) phases. Chemical reaction equilibrium.

Module credits	8.00
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Prerequisites	(CTD 223), SWK 210, CHM 215, CIM 210#
Contact time	2 lectures per week, 2 tutorials per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1

Kinetics 321 (CKN 321)

Module content:

Batch reactors; basic reaction kinetics; fitting of experimental reaction data; flow reactor basics.

Module credits 16.00

Prerequisites (CTD 223)

Contact time 3 tutorials per week, 4 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 2

Process dynamics 321 (CPN 321)

Module content:

Application of the continuity equations, transport equations and phase relationships to describe time-dependent behaviour of processes. Linearisation and use of transfer functions. Stability analysis, effect of dead time and inverse response. Elements of a control loop. Control principles and mechanisms.

Module credits 16.00

Prerequisites CIO 310#, CKN 321#

Contact time 4 lectures per week, 3 tutorials per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 2

Engineering management 310 (BSS 310)

Module content:

Programme and systems engineering Concepts: Application of project management, systems thinking, systems approach, product, system and project life cycles, project phases and specification practices. Development models: stage-gate development, project charter, systems engineering models, systems engineering management and life cycle characteristics. Planning and Scheduling: task definition, work breakdown structures, duration estimation, Gantt charts, critical path, resource handling. Costs and



Budgets: cost estimates, project life cycle costs, work authorisation. Control: project organisation. Legal: contracts, intellectual property. Case studies and semester project Engineering Economics Decision making in an engineering environment. Allocation of cost. Money-time relationships (discreet interest formulae, tables, financial calculator, Excel). Bases for comparison of alternatives (present worth, annual worth,). Decision making among alternatives before and after tax (useful lives equal to study period, useful lives different among alternatives).

Module credits	8.00
Prerequisites	No prerequisites.
Contact time	1 other contact session per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Industrial and Systems Eng
Period of presentation	Semester 1

Engineering activity and group work 320 (MIA 320)

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.

Module credits	8.00
Prerequisites	No prerequisites.
Contact time	1 other contact session per week, 2 lectures per week
Language of tuition	English
Academic organisation	Mechanical and Aeronautical En
Period of presentation	Semester 2



Chemical engineering design 320 (CIO 320)

Module content:

Steady and unsteady state conductive heat transfer in one to three dimensions. Temperature distributions. Convective heat transfer. Application of boundary layer theory. Determination of film coefficients. Design of heat transfer equipment. Radiant heat transfer. Application of the mechanical energy balance to single phase Newtonian fluids in steady state systems. Adjustment for multiphase, non-Newtonian as well as pulsating systems. Orifice design. Optimal economic choice of pipe diameters, pumps and control valves.

Module credits	16.00
Prerequisites	(CTD 223), (COP 311)
Contact time	3 tutorials per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 2

Mass transfer 310 (CMO 310)

Module content:

Separation by means of equilibrium stages. Design of flash distillation systems, distillation columns, absorbers and strippers by hand and computer calculations. Design of membrane separation systems.

Module credits	16.00
Prerequisites	(CTD 223), COP 311#
Contact time	4 lectures per week, 3 tutorials per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1

Professional and technical communication 310 (CJJ 310)

Module content:

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

Module credits	8.00
Prerequisites	CIR 123



Contact time 2 lectures per week

Language of tuition English

Academic organisation Chemical Engineering

Period of presentation Semester 1



Curriculum: Final year

Minimum credits: 144

Core modules

Process control 410 (CPB 410)

Module content:

Dynamic properties of equipment, instruments and processes. Mathematical modelling and computer simulation of processes in the time, Laplace and frequency domains. Linearisation and non-linear processes. Stability of control systems. Controller tuning. Methods for process identification. Digital process control. Z-transforms. Use of computers and microprocessors. Introduction to modern control theory: state-space approach. Applied process control. Choice of control instrumentation. Plantwide control strategy. Development of P and ID's.

Module credits 16.00

Prerequisites CPN 321 GS

Contact time 3 tutorials per week, 4 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 1

Design project 421 (CPJ 421)

Module content:

Application of chemical engineering principles for the complete design of a chemical plant.

Module credits 24.00

Prerequisites (CPB 410), (CRO 410); BIE 310/BSS 310, CPS 420#, CPR 420#

Contact time 1 tutorial per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 2

Chemical engineering practice 420 (CPR 420)

Module content:

Design economics and process evaluation. Cost estimation and time-value of money. Control applications, choice of instrumentation and development of a plantwide control strategy. Development of PandID's. Safety: Site plan and layout, area classification, hazard and operability analysis (HAZOP). Occupational Safety and Health Act, Engineering Profession of South Africa Act. Requirements to maintain continued competence and to keep abreast of up-to date tools and techniques. ECSA code of conduct, Continuing Professional Development, ECSA outcomes, ECSA process and reasons for



registration as PrEng. Displays understanding of the system of professional development. Accepts responsibility for own actions. Displays judgment in decision making during problem solving and design. Limits decision making to area of current competence. Reason about and make judgment on ethical aspects in case study context. Discerns boundaries of competence in problem solving and design. Case studies typical of engineering practice situations in which the graduate is likely to participate.

Module credits	8.00
Prerequisites	CLB 321
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 2

Process synthesis 410 (CPS 410)

Module content:

Development of new processing plants; Evaluating process alternatives; Developing a process flowsheet using a process synthesis approach. Applying thermodynamic principles to obtain an optimal synthesis route. Applications using computer packages.

Module credits	8.00
Prerequisites	CLB 321, CIR 310 GS
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemical Engineering
Period of presentation	Semester 1

Practical training 411 (CPY 411)

Module content:

*Attendance module only At the end of the third year of study, students in chemical engineering undergo at least six weeks of prescribed practical training in the industry. The student must also attend all excursions organised during the year by the department. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

Module credits	16.00
Prerequisites	(CMO 320), CPY 311
Contact time	1 other contact session per week
Language of tuition	Both Afr and Eng



Academic organisation Chemical Engineering

Period of presentation Semester 1

Reactor design 410 (CRO 410)

Module content:

Heterogeneous catalysis: diffusion in reaction for catalyst pores and different catalyst geometries. Inter and intraparticle heat and mass transfer processes. Reactor design: energy and continuity equation for different types of reactor: stirred tank, pipe, radial flow, slurry and fluidised. Modelling of non-ideal flow in reactors.

Module credits 16.00

Prerequisites CKN 321 GS

Contact time 4 lectures per week, 3 tutorials per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 1

Research project 411 (CSC 411)

Module content:

The execution of a complete literature study and research project on a chosen subject.

Module credits 16.00

Prerequisites CLB 321, CPB 410 # and CRO 410 #

Contact time 1 tutorial per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 1

Research project 421 (CSC 421)

Module content:

Interpretation of the research results of CSC 411. The writing of a project report and scientific article.

Module credits 16.00

Prerequisites CSC 411

Contact time 1 tutorial per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering



Period of presentation Semester 2

Specialisation 420 (CSS 420)

Module content:

A module to be selected from the list of available specialisation topics, including Process Control, Chemical Product Design, Environmental Engineering, Nuclear Engineering, Polymer Processing, Reactor Design, and Water Utilisation Engineering.

Module credits 16.00

Prerequisites CPJ 421#

Contact time 4 lectures per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 2

Process analysis 420 (CPS 420)

Module content:

Pinch analysis and exergy analysis. Optimisation techniques. Flowsheet optimisation. Economic evaluation of processes. Applications using computer packages.

Module credits 8.00

Prerequisites CPS 410

Contact time 2 lectures per week, 1 tutorial per week

Language of tuition Both Afr and Eng

Academic organisation Chemical Engineering

Period of presentation Semester 2

Particle technology 410 (CPA 410)

Module content:

Humidification and dehumidification of air. Water cooling, drying, crystallisation, ion exchange, particle technology, particle movement in a fluid, sedimentation. Hydrocyclones, flotation, filtration. Centrifuges. Fluidised bed technology. Mixing. Comminution. Pneumatic transport.

Module credits 16.00

Prerequisites COP 311

Contact time 3 tutorials per week, 4 lectures per week

Language of tuition Both Afr and Eng



Academic organisation Chemical Engineering

Period of presentation Semester 1

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 each student to familiarise himself or herself 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.