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# University of Pretoria Yearbook 2017

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## BEng Industrial Engineering (12130001)

**Duration of study** 4 years

**Total credits** 586

### 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.

#### 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 following persons will be considered for admission: a candidate who is in possession of a certificate that is deemed by the University to be equivalent to the required Grade 12 certificate with university endorsement; a candidate who is a graduate from another tertiary institution or has been granted the status of a graduate of such an institution; and a candidate who is a graduate of another faculty at the University of Pretoria.
- Life Orientation is excluded when calculating the APS.
- Grade 11 results are used in the provisional 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. On first-year level a student has a choice between Afrikaans and English as language medium. In certain cases, tuition may be presented in English only, for example in electives, where the lecturer may not speak Afrikaans or in cases where it is not economically or practically viable.
- Provisional admission to the four-year programmes in the School of Engineering is only guaranteed if a prospective student complies with ALL the requirements below.  
**Note:** Candidates who do not comply with the minimum requirements, set out above, but who have obtained a minimum APS of 30, an achievement level of 5 for English or Afrikaans, 6 for Mathematics and 5 for Physical Science, will be considered for provisional admission to either the four-year programme or the ENGAGE programme based on the results of the NBT.
- Admission to ENGAGE in the School of Engineering will be determined by the results of the NBT, NSC results, an achievement level of 5 in Mathematics and 4 in Physical Science, as well as an achievement level of 4 in Afrikaans or English, together with an APS of 25. Students may apply directly to be considered for the ENGAGE programme.

Minimum requirements												
Achievement level												
Afrikaans or English				Mathematics				Physical Science				APS
NSC/IEB	HIGCSE	AS-Level	A-Level	NSC/IEB	HIGCSE	AS-Level	A-Level	NSC/IEB	HIGCSE	AS-Level	A-Level	
5	3	C	C	6	2	B	B*	6	2	B	B*	35

\* A-Level: C symbols for Mathematics Physics and Chemistry will be considered for admission providing the required APS has been obtained.

## 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 the department, to register for an equivalent module in an alternate semester, although the module is normally offered to the student's group in another semester, and providing that no timetable clashes occur.

### Please note:

1. Students who did not pass SWK 122 Mechanics 122 in their first year of study can take the module in the first semester of the following year.



2. All students are required to successfully complete JCP 2013, 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.
3. Students registered for Chemical Engineering who have passed CBI 311, receive credit for CBI 410.
4. Mechanical Engineering: For the Aeronautical Option, the themes of both the Design and the Project must be aeronautical-related.
5. 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 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: 144

### Fundamental modules

#### Academic orientation 112 (UPO 112)

<b>Module credits</b>	0.00
<b>Language of tuition</b>	Afrikaans and English is used in one class
<b>Academic organisation</b>	EBIT Dean's Office
<b>Period of presentation</b>	Year

### Core modules

#### General chemistry 172 (CHM 172)

##### 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.

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 practical per week, 1 web-based period per week, 4 lectures per week, 1 discussion class per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Chemistry
<b>Period of presentation</b>	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.



<b>Module credits</b>	16.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 tutorial per week, 1 practical per week, 3 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1

## Physics 116 (FSK 116)

### 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.

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 discussion class per week, 4 lectures per week, 1 practical per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Physics
<b>Period of presentation</b>	Semester 1

## 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.

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Education
<b>Prerequisites</b>	No prerequisites.



<b>Contact time</b>	3 tutorials per week, 3 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mechanical and Aeronautical En
<b>Period of presentation</b>	Semester 1

## Materials science 123 (NMC 123)

### 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.

<b>Module credits</b>	16.00
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<b>Prerequisites</b>	No prerequisites.
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<b>Contact time</b>	1 tutorial per week, 1 practical per week, 4 lectures per week
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<b>Language of tuition</b>	Separate classes for Afrikaans and English
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<b>Academic organisation</b>	Materials Science and Metallur
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<b>Period of presentation</b>	Semester 2
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## 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.

<b>Module credits</b>	16.00
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<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
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<b>Prerequisites</b>	WTW 158
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<b>Contact time</b>	2 tutorials per week, 4 lectures per week
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<b>Language of tuition</b>	Separate classes for Afrikaans and English
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<b>Academic organisation</b>	Civil Eng
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**Period of presentation** Semester 1 or 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** Separate classes for Afrikaans and English

**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** Separate classes for Afrikaans and English

**Academic organisation** Mechanical and Aeronautical En

**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.

<b>Module credits</b>	8.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Anthropology and Archaeology
<b>Period of presentation</b>	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.

<b>Module credits</b>	8.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Afrikaans
<b>Period of presentation</b>	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.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	WTW 114 GS or WTW 158 GS
<b>Contact time</b>	4 lectures per week, 1 tutorial per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	Semester 2



## Curriculum: Year 2

**Minimum credits: 146**

### 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** WTW 158 GS, WTW 164 GS

**Contact time** 1 tutorial per week, 2 lectures per week

**Language of tuition** Separate classes for Afrikaans and English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 2

#### Productivity 220 (BPZ 220)

**Module content:**

Qualifying and quantifying productivity: efficiency, effectiveness, utilisation, profitability and competitiveness. Method study: critical examination and process flow charts and diagrams. Work measurement: time study and activity sampling. Organisational behaviour: motivation, incentive schemes, group forming, work teams, job design and change management. Ergonomics.

**Module credits** 16.00

**Prerequisites** No prerequisites.

**Contact time** 1 tutorial per week, 3 lectures per week, 2 practicals per week

**Language of tuition** Separate classes for Afrikaans and English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 2

#### 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.

<b>Module credits</b>	8.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 lecture per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Informatics
<b>Period of presentation</b>	Year

## Manufacturing and design 217 (MOW 217)

### Module content:

Detailed exposure to manufacturing processes including heat treatment. Detailed exposure to machine elements. Conceptual framework for design process including life cycle, ergonomics, material selection, manufacturing and safety factor considerations.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	MGC 110
<b>Contact time</b>	3 lectures per week, 4 tutorials per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mechanical and Aeronautical En
<b>Period of presentation</b>	Semester 1

## Dynamics 210 (MSD 210)

### 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.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	FSK 116 or FSK 176 and SWK 122 and WTW 256 #
<b>Contact time</b>	2 tutorials per week, 3 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mechanical and Aeronautical En
<b>Period of presentation</b>	Semester 1



## Thermodynamics 221 (MTX 221)

### Module content:

Application overview. Concepts: system, control volume, property, state, process, cycles, mass, volume, density, pressure, pure substances, property tables, ideal gases. Work and heat. Internal energy, enthalpy, specific heat capacity. First Law of Thermodynamics for system and control volume. Conservation of mass. Processes: Adiabatic, isentropic, compressible and incompressible gases. Second Law of Thermodynamics for system and control volume. Entropy and enthalpy. Third Law of Thermodynamics. Introduction to vapour power, cooling and gas cycles. Experimental techniques in thermodynamics.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	FSK 116 or FSK 176
<b>Contact time</b>	1 tutorial per week, 1 practical per week, 3 lectures per week
<b>Language of tuition</b>	Afrikaans and English is used in one class
<b>Academic organisation</b>	Mechanical and Aeronautical En
<b>Period of presentation</b>	Semester 2

## 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.

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	WTW 256 and WTW 258 GS
<b>Contact time</b>	4 lectures per week, 2 tutorials per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	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.

<b>Module credits</b>	8.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology



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<b>Prerequisites</b>	WTW 158 and WTW 164
<b>Contact time</b>	1 discussion class per week, 2 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	Semester 1

## 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.

<b>Module credits</b>	8.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	WTW 158 and WTW 164
<b>Contact time</b>	2 lectures per week, 1 tutorial per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	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.

<b>Module credits</b>	8.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	WTW 164
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	Semester 2

## Professional and technical communication 210 (BJJ 210)

### 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.

<b>Module credits</b>	8.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 lectures per week, 2 other contact sessions per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	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.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 practicals per week, 4 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Mechanical and Aeronautical En
<b>Period of presentation</b>	Semester 1





## Curriculum: Year 3

**Minimum credits: 154**

### Core modules

#### Business law 310 (BER 310)

**Module content:**

Introduction to law. General principles of the law of contract. Specific contracts: purchase contracts; letting and hiring of work; employment contracts. Agency. General aspects of entrepreneurial law. Dispute resolution – mediation and arbitration.

**Module credits** 16.00

**Service modules** Faculty of Engineering, Built Environment and Information Technology

**Prerequisites** No prerequisites.

**Contact time** 4 lectures per week

**Language of tuition** Separate classes for Afrikaans and English

**Academic organisation** Mercantile Law

**Period of presentation** Semester 1

#### Information systems design 320 (BID 320)

**Module content:**

Systems development planning, system requirement analysis, different approaches towards structured analysis and design of systems, process design, database design and normalization, object-oriented design and modelling, information system application building and testing.

**Module credits** 16.00

**Prerequisites** No prerequisites.

**Contact time** 2 practicals per week, 1 tutorial per week, 3 lectures per week

**Language of tuition** Module is presented in English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 2

#### Industrial logistics 320 (BLK 320)

**Module content:**

Role of logistics in the economy and organisation. Customer service. Forecasting. Logistics information systems and electronic information flow. Inventory management. Managing materials flow. Distribution channels. Transportation. Warehousing. Packaging. Strategic purchasing. Global logistics. Organising and controlling logistics. Supply chain management. Supply chain finance and performance measurement. SCOR reference models. Implementing logistics strategy.



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<b>Module credits</b>	16.00
<b>Prerequisites</b>	(BOB 310)
<b>Contact time</b>	4 lectures per week, 2 tutorials per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 2

## Operational management 310 (BOB 310)

### Module content:

Introduction to operations management, operations strategy and competitiveness. World-class and agile manufacturing. Operations planning in the service industries. The manufacturing management environment. Batching principles (EOQ and DEL). Manufacturing planning and control systems. Sales and operations planning. Capacity planning and control. Demand management. Master production scheduling. Materials requirements planning (MRP). Distribution requirements planning. Just-in-time (JIT) manufacturing. Synchronous manufacturing (Theory of constraints). Comparing MRP, JIT and TOC. Shop-floor scheduling and control. Integration and implementation of manufacturing planning and control systems. Enterprise Resource Planning (ERP) systems. Business process transformation.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 lectures per week, 1 practical per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 1

## Practical training 310 (BPY 310)

### Module content:

\*Attendance module only

During or at the end of the second year of study, students in industrial engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the Faculty Administration within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 other contact session per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Industrial and Systems Eng



**Period of presentation** Semester 1 or Semester 2

## Simulation modelling 321 (BUY 321)

### Module content:

Introduction to simulation as technique. Simulation methodology. Formulation of problem situations by means of simulation models with the emphasis on discrete models. Input and output analysis. Introduction to simulation software.

**Module credits** 16.00

**Prerequisites** (BAN 313)

**Contact time** 4 lectures per week, 2 tutorials per week

**Language of tuition** Module is presented in English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 2

## Financial management 110 (FBS 110)

### Module content:

\*Only for BSc (Mathematical Statistics. Construction Management, Real Estate and Quantity Surveying) and BEng (Industrial Engineering) students.

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

**Module credits** 10.00

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Natural and Agricultural Sciences

**Prerequisites** No prerequisites.

**Contact time** 3 lectures per week

**Language of tuition** Module is presented in English

**Academic organisation** Financial Management

**Period of presentation** Semester 1

## Industrial analysis 313 (BAN 313)

### Module content:



Mathematical statistics provides the basis for a number of important applications in the engineering environment. This module provides an introduction to the most important of these applications and will include the following syllabus themes: Monte Carlo simulation, decision analysis, forecasting and data-dependent modelling.

<b>Module credits</b>	8.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	BES 220
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 1

### Manufacturing systems 311 (MVS 311)

#### Module content:

Basic knowledge of conventional manufacturing processes like casting, forming, machining and joining. Modern manufacturing of plastic products, powder metallurgy, micro-electronic manufacturing and non-traditional machining. Quality control by work-holding devices, measurement, inspection and testing and determination of process capability. Manufacturing automation, rapid prototyping and free form fabrication. Manufacturing systems design concepts like Jobshop, Flowshop, Leanshop with linked cells, Projectshop and continuous processing.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	3 lectures per week, 1 practical per week, 3 tutorials per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Mechanical and Aeronautical En
<b>Period of presentation</b>	Semester 1

### Facilities planning 320 (BFB 320)

#### Module content:

This module introduces the principles, approaches, methods, techniques and tools to systematically determine facility requirements, determine the required space of and relationships between activities, develop and evaluate alternative plans and layouts and present the results. Aspects such as facilities location, manufacturing and service process design, capacity planning, materials handling, personnel facilities, storage and warehousing are also addressed. A structured facility design project forms an integral part of the course.

<b>Module credits</b>	8.00
<b>Prerequisites</b>	No prerequisites.



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<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 2

### Operational research 312 (BOZ 312)

#### Module content:

Introduction to Operations Research, and more specifically the branch of optimisation and its application to industrial problems. In the module the topics of linear and integer linear programming are introduced. The focus is on identifying and scoping appropriate problems, the subsequent formulation of problems, solution algorithms, and post-optimisation sensitivity analysis. Students are exposed to solving problems using optimisation software.

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	3 lectures per week, 1 tutorial per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 1

### 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).

<b>Module credits</b>	8.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 other contact session per week, 2 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English



**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** (BSS 310), (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

**Academic organisation** Mechanical and Aeronautical En

**Period of presentation** Semester 2



## Curriculum: Final year

**Minimum credits: 144**

### Core modules

#### Labour relations 320 (ABV 320)

**Module content:**

The theoretical basis of Labour Relations

In this section the basic concepts, historical context and theoretical approaches to the field of labour relations will be discussed. The institutional framework in which labour relations operates, will be addressed with particular emphasis on the structural mechanisms and institutional processes. The service relationship that forms the basis of labour relations practices, will also be analysed.

Labour Relations practice

In this section students are taught the conceptual and practical skills related to practice aspects such as handling of grievances, disciplining, retrenchments, collective bargaining, industrial action and dispute resolution.

**Module credits** 20.00

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Humanities

**Prerequisites** No prerequisites.

**Contact time** 3 lectures per week

**Language of tuition** Separate classes for Afrikaans and English

**Academic organisation** Human Resource Management

**Period of presentation** Semester 2

#### Quality assurance 410 (BGC 410)

**Module content:**

Introduction to quality and quality management systems. Statistical process control. Acceptance control.

**Module credits** 16.00

**Prerequisites** No prerequisites.

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

**Language of tuition** Separate classes for Afrikaans and English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 1

#### Operational research 410 (BON 410)

**Module content:**

Review of basic probability, Markov chain models, Markov decision models. Queuing systems: M/M/1 queues



(both finite and infinite capacity), etc.; deterministic and stochastic inventory models. Competitive games: pure and mixed strategies, optimum strategy, two-person zero-sum games, graphical methods and applications, LP methods for games.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	(BES 220), (BOZ 312)
<b>Contact time</b>	1 tutorial per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 1

### Project 410 (BPJ 410)

#### Module content:

Choice of project topic. Appointment of project leader. Literature study, analysis and creation of alternatives.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	Finalists only
<b>Contact time</b>	1 other contact session per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 1

### Project 420 (BPJ 420)

#### Module content:

Narrowing of topic choice. Detailed solution of chosen alternative. Writing of final project report and presentation of project.

<b>Module credits</b>	24.00
<b>Prerequisites</b>	BPJ 410
<b>Contact time</b>	2 other contact sessions per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 2

### Practical training 410 (BPY 410)

#### Module content:





\*Attendance module only During or at the end of the third year of study, students in industrial engineering undergo at least six weeks of prescribed practical training in the industry. A satisfactory report on the practical training must be submitted to the department within one week of registration. In exceptional circumstances the prescribed minimum period can be reduced, as approved by the chairman of the School of Engineering.

<b>Module credits</b>	16.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 other contact session per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 1

### Business engineering 421 (BPZ 421)

#### Module content:

Integration of engineering functions; strategic planning; organisational structures; business management; systems engineering; work-flow management; process modelling; business architecture; change management and motivation; marketing management and industry exposure. Business management game project.

<b>Module credits</b>	16.00
<b>Contact time</b>	4 lectures per week, 2 tutorials per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 2

### Management accounting 410 (BSR 410)

#### Module content:

The work of management and the need for managerial accounting information. The changing business environment. Cost terms, concepts, and classification. Job order costing. Process costing. Activity-based costing and quality management. Cost-volume-profit relations. Variable and fixed costing. Budgeting and control. Standard costs and flexible budgets. Segment reporting and decentralisation. Relevant costs for decision-making. Allocations of service departments cost to operating departments.

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	FBS 110
<b>Contact time</b>	6 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Financial Management



**Period of presentation** Semester 1

## Systems engineering 410 (BSS 410)

### Module content:

A company's ability to remain competitive hinges increasingly on its ability to develop successful products. In practice this is often determined by how well the company performs systems engineering. Applying the principles of systems engineering allows designers to understand the big picture, i.e. how a product needs to perform technically as well as within its application domain, e.g. environmentally, human interfaces, and so on. This module equips the student with the relevant tools and process understanding to successfully apply systems engineering to product development. Some of these tools and processes include specification practices, requirements engineering, systems engineering management and verification and validation processes.

**Module credits** 16.00

**Prerequisites** No prerequisites.

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

**Language of tuition** Module is presented in English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 2

## Engineering professionalism 410 (IPI 410)

### 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.

**Module credits** 8.00

**Prerequisites** No prerequisites.

**Contact time** 2 lectures per week, 1 other contact session per week

**Language of tuition** Module is presented in English

**Academic organisation** Engineering and Technology Mgt

**Period of presentation** Semester 1

## Engineering economics 420 (BIE 420)



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**Module content:**

Money-time relationships and equivalence (interest formulae, effective interest rate, bonds and loans). Bases for comparison of alternatives (present worth, annual worth, Internal rate of return, external rate of return, investment balance diagrams, Decision making among alternatives (useful lives equal to study period, useful lives different among alternatives, mutually exclusive alternatives in terms of combinations of proposals). The influence of inflation on engineering economic calculations. Decision making among alternatives on an after-tax basis. Replacement analysis (the economic life of an asset, retirement without replacement). Risk analysis of cash flows.

<b>Module credits</b>	8.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Separate classes for Afrikaans and English
<b>Academic organisation</b>	Industrial and Systems Eng
<b>Period of presentation</b>	Semester 2

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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.