University of Pretoria Yearbook 2022

BEng (Mechanical Engineering) (12130004)

Department	Mechanical and Aeronautical Engineering
Minimum duration of study	4 years
Total credits	579
NQF level	08

Programme information

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

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

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

Learning contents of the BEng programmes:
Six essential knowledge areas are included in the syllabi of the programmes. The typical representation of each knowledge area as a percentage of the total contents of an undergraduate programme is given in brackets ( ) in the list below. This percentage varies for the different study directions, but conforms in all instances to the minimum knowledge area content as stipulated by ECSA.
Knowledge areas:

a. Mathematics, including numerical methods and statistics (13%)
b. Basic sciences: the natural sciences essential to the programme (15%)
c. Engineering sciences (40%)

d. Engineering design and synthesis (16%)
e. Computing and information technology (5%)
f. Complementary studies: communication, economy, management, innovation, environmental impact, ethics, engineering practice (11%).

Admission requirements

Important information for all prospective students for 2022

- The admission requirements apply to students who apply for admission to the University of Pretoria with a **National Senior Certificate (NSC) and Independent Examination Board (IEB) qualifications.**
- **Applicants with qualifications other than the abovementioned** should refer to:
  - **Brochure:** Undergraduate Programme Information 2022: Qualifications other than the NSC and IEB, available at click here.
- **Citizens from countries other than South Africa (applicants who are not South African citizens)** should also refer to:
  - **Brochure:** Newcomer's Guide 2021, available at click here.
  - **Website:** click here.
- **School of Tomorrow (SOT), Accelerated Christian Education (ACE) and General Education Development Test (GED):** The University of Pretoria no longer accepts qualifications awarded by these institutions.
- **National Certificate (Vocational) (NCV) Level 4:** The University of Pretoria may consider NCV candidates, provided they meet the exemption for bachelor's status criteria and the programme requirements.

Transferring students

A transferring student is a student who, at the time of application for a degree programme at the University of Pretoria (UP) –

- is a registered student at another tertiary institution, **or** was previously registered at another tertiary institution and did not complete the programme enrolled for at that institution, and is not currently enrolled at a tertiary institution, **or** has completed studies at another tertiary institution, but is not currently enrolled at a tertiary institution, **or** has started with tertiary studies at UP, then moved to another tertiary institution and wants to be readmitted at UP.

A transferring student will be considered for admission based on

- an NSC or equivalent qualification with exemption to bachelor's or diploma studies (whichever is applicable); **and** meeting the minimum faculty-specific subject requirements at NSC or tertiary level; **or** having completed a higher certificate at a tertiary institution with faculty-specific subjects/modules passed (equal to or more than 50%), as well as complying with faculty rules on admission;
- previous academic performance (must have passed all modules registered for up to the closing date of application) or as per faculty regulation/promotion requirements;
- a certificate of good conduct.

Note: Students who have been dismissed at the previous institution due to poor academic performance, will not be considered for admission to UP.

Returning students

A returning student is a student who, at the time of application for a degree programme –

- is a registered student at UP, and wants to transfer to another degree at UP, **or** was previously registered at UP and did not complete the programme enrolled for, and did not enrol at another tertiary institution in the

meantime (including students who applied for leave of absence), **or** has completed studies at UP, but is not currently enrolled or was not enrolled at another tertiary institution after graduation.

A returning student will be considered for admission based on

- an NSC or equivalent qualification with exemption to bachelor's or diploma studies (whichever is applicable); **and** meeting the minimum faculty-specific subject requirements at NSC or tertiary level; **or** previous academic performance (should have a cumulative weighted average of at least 50% for the programme enrolled for);
- having applied for and was granted leave of absence.

Note: Students who have been excluded/dismissed from a faculty due to poor academic performance may be considered for admission to another programme at UP. The Admissions Committee may consider such students if they were not dismissed more than twice. Only ONE transfer between UP faculties will be allowed, and a maximum of two (2) transfers within a faculty.

Important faculty-specific information on undergraduate programmes for 2022

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

Note: Our programmes are accredited by the Engineering Council of South Africa (ECSA), and our degrees meet the requirements for Professional Engineers in SA.

University of Pretoria website: click here

Minimum requirements			
Achievement level			
English Home Language or English First Additional Language	**Mathematics**	**Physical Sciences**	**APS**
NSC/IEB	NSC/IEB	NSC/IEB	
5	6	6	**35**

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

Other programme-specific information

Please note: For the Aeronautical Option, the themes of both the Design and the Project must be aeronautical-related.

With a few exceptions, most modules offered at the School of Engineering are semester modules having credit values of either 8 or 16.
A student may be permitted by the Dean, on recommendation of the relevant head of department, to register for an equivalent module in an alternate semester, although the module is normally offered to the student's group in another semester, and providing that no timetable clashes occur.

Please note:

1. All students are required to successfully complete JCP 203, Community-based project 203, as part of the requirements for the BEng degree. A student may register for the module during any of the years of study of the programme, but preferably not during the first or the final year of study.
2. Students registered for Chemical Engineering who have passed CBI 311 or CBI 410, receive credit for CBI 310.
3. Mechanical Engineering: For the Aeronautical Option, the themes of both the Design and the Project must be aeronautical-related.
4. Offering of electives depends on the availability of resources and industry support.

Promotion to next study year

Promotion to the second semester of the first year and to the second year of study

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 enrol for modules of the second-year of study in addition to the first-year modules which he or she failed, providing that he or she complies with the prerequisites for the second-year modules and no timetable clashes occur. Students on the ENGAGE programme may, following the same procedure, be permitted to enrol for level-200 modules in addition to the level-100 modules which he/she failed providing that he/she complies with the prerequisites for the modules at 200-level and no timetable clashes occur. On recommendation of the relevant head of department and with special permission from the Dean, permission may be granted to exceed the prescribed number of credits. The total number of credits which may be approved may not exceed the normal number of credits per semester by more than 16 credits.
f. Students in Computer, Electrical and Electronic Engineering, who fail a first-year module for the second time, forfeit the privilege of registering for any modules of an advanced year of study.

Please note:

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

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

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 enrol for modules of the third year of study in addition to the second-year modules which he or she failed, providing that he or she complies with the prerequisites for the third-year modules and no timetable clashes occur. 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.

a. A student who complies with all the requirements of the third year of study is promoted to the fourth year of study. A student who does not comply with all the requirements but who is able to register for all outstanding modules in order to complete the degree programme, may at registration be promoted to the fourth year of study.
b. A student must pass all the prescribed modules of the second year of study, before he or she is admitted to any module of the fourth year of study.
c. A student who has not passed all the prescribed modules of the third year of study, must register for the outstanding modules. A student may be admitted by the Dean, on the recommendation of the relevant head of department, to modules of the fourth year of study, in addition to the outstanding third-year modules, provided that he or she complies with the prerequisites of the fourth-year modules and no timetable clashes occur. The total number of credits per semester for which a student registers may not exceed the normal number of credits per semester by more than 16 credits. In exceptional cases, the Dean may, on recommendation of the relevant head of department, permit a student to exceed the above limit.
d. Students in Computer, Electrical and Electronic Engineering who fail a third-year module for the second time, forfeit the privilege of registering for any modules of the fourth year of study.

Pass with distinction

a. A student graduates with distinction if:

i. no module of the third or fourth year of study of the four-year programme or of the fourth or fifth year of the ENGAGE programme was repeated and a weighted average of at least 75% (not rounded) 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: 145

Fundamental modules

Academic orientation 112 (UPO 112)

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

Core modules

General chemistry 172 (CHM 172)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	Admission to relevant programme.
Contact time	1 discussion class per week, 1 practical per week, 1 web-based period per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 2

Module content

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

Electricity and electronics 111 (EBN 111)

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

Period of presentation	Semester 1

Module content

The general objective of this module is to develop expertise in solving electric and electronic circuits. The topics covered in the course are Ohm's law, Kirchoff's current and voltage laws, voltage and current division, mesh current and node voltage methods, linearity, Thevenin and Norton equivalent circuits, source transformation, power transfer, energy storage elements in circuits (inductors and capacitors), and operational amplifiers and applications. Although circuits will mostly be solved using direct current (DC) sources, the final part of the course will consider methods to solve circuits using alternating current sources (AC).

Physics 116 (FSK 116)

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

Module content

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

Humanities and social sciences 110 (HAS 110)

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

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

Humanities and social sciences 120 (HAS 120)

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

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

Graphical communication 110 (MGC 110)

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

Module content

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

Materials science 123 (NMC 123)

Module credits	16.00
NQF Level	07
Prerequisites	Admission to relevant programme.
Contact time	1 practical per week, 1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Materials Science and Metallurgical Engineering
Period of presentation	Semester 2

Module content

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

Statics 122 (SWK 122)

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

Module content

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

Calculus 158 (WTW 158)

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

Module content

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

Mathematics 164 (WTW 164)

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

Module content

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

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

Workshop practice 121 (WWP 121)

Module credits	1.00
NQF Level	05
Prerequisites	No prerequisites.
Contact time	1 other contact session per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

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.

Curriculum: Year 2

Minimum credits: 144

Core modules

Engineering statistics 220 (BES 220)

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

Module content

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

Community-based project 203 (JCP 203)

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

Module content

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

Professional and technical communication 210 (MJJ 210)

Module credits	8.00
NQF Level	06
Prerequisites	No prerequisites.

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

Module content

Effective communication by engineers. Verbal, written and visual communication are all covered, with a focus on presentations and technical reports as the medium of communication. Effective communication in all three aspects is achieved with an understanding of the audience influence, the structure of information, the structuring of an argument and the effective use of language. Topics covered: Plagiarism, paraphrasing, correct referencing practices and distinguishing between information sources. Business emails and meetings. Body language. Graphical display of data in graphs and slides.

Manufacturing and design 217 (MOW 217)

Module credits	16.00
NQF Level	06
Prerequisites	MGC 110
Contact time	3 lectures per week, 4 tutorials per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Conceptual consideration of the phases in mechanical design acknowledging the many feedbacks & iterations. Detailed exposure to machine elements, including fasteners, gears, belts, chains and bearings. Selection of standard mechanical components. Detailed exposure to machining processes used to manufacture components for mechanical machines. Detailed exposure to GD&T (Geometric Dimensioning & Tolerancing) needed for manufacturing drawings.

Structural design 227 (MOW 227)

Module credits	16.00
NQF Level	06
Prerequisites	SWK 122
Contact time	3 lectures per week, 4 tutorials per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Analyse statically determinate structures to obtain section forces and moments and stress distributions. Axial loading, pure shear, torsion and bending. Stress and strain transformations. Derivation of stress transformation equations. Mohr's circle. Failure criteria. Fatigue strength design. Introduction to code design, safety factors. All analysis techniques are applied to the open-ended design of hoisting systems and ropes, symmetric beams, shafts, springs, bolts and welds.

Programming and information technology 213 (MPR 213)

Module credits	16.00
NQF Level	06
Prerequisites	No prerequisites.
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Spreadsheet applications: Formulas and calculations, named ranges, plotting and trend lines, goal seek, linear programming, importing and exporting data, data navigation and filtering. Programming fundamentals: Names and objects, conditional and unconditional looping, branching, functions, modules, packages, reading and writing data files, graphical output (plotting). Solving simple problems using a high level programming language to develop, code and debug programs. Solving complex problems by breaking it down into a number of simple problems using concepts such as functions, modules and available packages. Programming principles are developed through solving mathematics and physics problems.

Dynamics 210 (MSD 210)

Module credits	16.00
NQF Level	06
Prerequisites	FSK 116 or FSK 176 and SWK 122 and WTW 256 #
Contact time	2 tutorials per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

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

Thermodynamics 221 (MTX 221)

Module credits	16.00
NQF Level	06
Prerequisites	FSK 116 or FSK 176
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Application overview. Concepts: system, control mass, 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 control masses and control volumes. Conservation of mass. Processes: isothermal, polytropic, adiabatic, isentropic. Second law of thermodynamics and entropy for control masses and control volumes. Introduction to power cycles . Experimental techniques in thermodynamics.

Mathematics 238 (WTW 238)

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

Module content

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

Differential equations 256 (WTW 256)

Module credits	8.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 158 and WTW 164
Contact time	1 tutorial per week, 2 lectures per week

Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

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

Calculus 258 (WTW 258)

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

Module content

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

Numerical methods 263 (WTW 263)

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

Module content

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

Curriculum: Year 3

Minimum credits: 145

Core modules

Engineering management 310 (BSS 310)

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

Module content

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

Electrical engineering 221 (EIR 221)

Module credits	16.00
NQF Level	06
Prerequisites	EBN 111 or EBN 122 and WTW 161/164
Contact time	1 practical per week, 1 tutorial per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Electrical, Electronic and Computer Engineering
Period of presentation	Semester 2

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.

Engineering activity and group work 320 (MIA 320)

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

Module content

Two exit-level Graduate Attributes (GAs) of ECSA are addressed and each must be passed in the same semester. GA7: 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. GA8: 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 teamwork: 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-worker’s 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-worker’s discipline. Students communicate between disciplinary boundaries.

Solid mechanics 321 (MKM 321)

Module credits	16.00
NQF Level	07
Prerequisites	MOW 227
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Computational solid mechanics using a high-level programming language, macroscopic equilibrium equations, continuum mechanics, infinitesimal equilibrium equations, strong and weak form of the solid mechanics Boundary Value Problem (BVP), linear elastic FEM, FEM modelling principles. Data-driven modelling and inverse problems, structural sensing. Verification and validation.

Machine design 312 (MOW 312)

Module credits	16.00
NQF Level	07
Prerequisites	MOW 217, (MOW 227)
Contact time	3 lectures per week, 3 tutorials per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Within the framework of system engineering the following themes are integrated into the design process: Ergonomics, pressure vessels, structural design, welding and bonding, heat treatment, non-destructive testing, gears, contact stresses and lubrication. Energy systems, safety factors and load factors are considered throughout all themes. Assignments involve open-ended subsystem designs involving pressure vessels and gear systems.

Simulation-based design 323 (MOW 323)

Module credits	16.00
NQF Level	07
Prerequisites	(MSD 210), MOW 227
Contact time	3 lectures per week, 5 tutorials per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Design of static and dynamic mechanical systems. Computational models for mechanical design. Model fidelity and additional modelling considerations. Systems engineering and functional analysis. Open-ended multidisciplinary design and design improvement of products and systems using engineering software.

Practical training 315 (MPY 315)

Module credits	1.00
NQF Level	07
Prerequisites	No prerequisites.
Contact time	1 other contact session per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Prescribed practical training in the industry during or at the end of the second year. The aim is exposure to engineering equipment and processes, working environment of craftsmen and personnel relations. Duration at least 240 hours of work. Perform case study on personnel management and submit together with a satisfactory report on the practical training, to the Faculty Administration.

Structural mechanics 310 (MSY 310)

Module credits	16.00
NQF Level	07
Prerequisites	MOW 227, (WTW 256)
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Introduction of stress tensor. 3D stress and strain transformation. Eigenvalue/vector analysis for principal stresses and strains. Experimental strain measurements. Stress-strain relations. Strain energy. Thin-walled cylinders. Statically indeterminate stress systems. Bending stress, slope and deflection of beams, shear center, non-symmetric beams, composite beams, Castigliano’s theorem. Statically indeterminate beams. Buckling instability. Yield criteria. Elementary plasticity. Structural streel design SANS code. Fracture mechanics. Fatigue.

Fluid mechanics 310 (MTV 310)

Module credits	16.00
NQF Level	07
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Introduction: Liquids and gases, pressure, viscosity, temperature. Fluid statics and pressure measurement. Introduction to control volume method for mass, momentum and energy conservation. Bernoulli equation. Differential approach: Navier-Stokes and continuity equations. Similarity and dimensional analysis. Flow in pipes and channels: friction coefficients and Reynolds number, pressure drop; laminar, turbulent and transitional flow. Flow over bodies: drag and lift. Experimental techniques in fluid mechanics.

Thermodynamics 311 (MTX 311)

Module credits	16.00
NQF Level	07

Prerequisites	MTX 221
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Third Law of Thermodynamics, availability and useful work. Ideal and real gases. Compressible flow: conservation laws, characteristics of compressible flow, normal shock waves, nozzles and diffusers. Power cycles: classification, internal combustion engine cycles (Otto and Diesel), vapour power cycles (Brayton, Rankine), refrigeration cycles (Reversed Carnot cycle, Reversed Brayton cycle, ammonia absorption cycle) and heat pump cycles. Mixtures of gases: perfect gas mixture, water/air mixtures and processes (psychrometry). Heating and cooling load calculations, basic refrigeration and air-conditioning systems. Combustion: fuels, air-fuel ratios, heat of formation, combustion in internal combustion engines.

Vibration and noise 320 (MVR 320)

Module credits	16.00
NQF Level	07
Prerequisites	(MSD 210)
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Introduction to vibration: basic concepts, classification, modelling elements. Single degree of freedom systems: undamped and damped free vibration, undamped and damped harmonic motion, non-periodic excitation, numerical integration. Multidegree of freedom systems: discretisation, eigenproblem, co-ordinate coupling. Vibration control: balancing, isolation, absorbers. Vibration and sound measurement: signal analysis, modal testing, vibration monitoring. Continuum systems: string, bar, rod. Sound and noise: metrics, measurement, legislation.

Curriculum: Final year

Minimum credits: 145

Core modules: 129 credits
Elective modules: 16 credits

Core modules

Engineering professionalism 410 (IPI 410)

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

Module content

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

Mechatronics and control 410 (MBB 410)

Module credits	16.00
NQF Level	08
Prerequisites	MVR 320 GS
Contact time	2 practicals per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Sensors and Actuators: Basics behind the most common sensors and actuators. Signal conditioning: Basic understanding of the use of analogue electronic components and power supplies. Sampling theory: Analogue-to-digital conversion, the effect of aliasing and the design of anti-aliasing filters. Digital: Basic understanding of digital communication. Digital control: Programming a microcontroller, and the implementation of control in discrete time systems.

Computational fluid dynamics 411 (MKM 411)

Module credits	16.00
NQF Level	08
Prerequisites	(MTV 310), (MKM 321)
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

A fast review of partial differential equations, introduction to continuum mechanics, continuity equation, momentum equation, Navier- Stokes equation, energy equation, boundary conditions in thermal fluid systems, finite difference method, linear and non-linear partial differential equations, introduction to finite volume method (FVM), FVM for diffusion problems, FVM for convection-diffusion problems, introduction to pressure-velocity coupling in FVM, SIMPLE algorithm, introduction to computational fluid dynamics (CFD) software packages and their abilities, using CFD commercial software packages to solve thermal-fluid engineering problems.

Design project 410 (MOX 410)

Module credits	16.00
NQF Level	08
Prerequisites	MOW 312 GS and MOW 323 GS
Contact time	8 tutorials per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Two exit-level Graduate Attributes (GAs) of ECSA are accessed and each must be passed in order to pass the module. GA3 Engineering Design & GA6 Professional & Technical Communication.
Engineering Design (GA3) is evaluated at the hand of (i) the definition and specification of the design problem, (ii) concept creation and concept selection, (iii) procedural & non-procedural calculations, analysis & optimisation, (iv) illustration and description of the complete design solution and (v) manufacturing & costing analysis and impacts & benefits of the design.
Professional and technical communication (GA6) is evaluated at the hand of (i) the written report, (ii) graphical communication (sketches, CAD images and detail & assembly drawings) for which there is a subminimum and (iii) oral communication.

Practical training 415 (MPY 415)

Module credits	1.00
NQF Level	08

Prerequisites	No prerequisites.
Contact time	1 other contact session per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

During or at the end of the third year of study, students in Mechanical Engineering undergo prescribed practical training in the industry. The purpose is the execution of small projects on engineering assistant level with exposure to the various relevant functions in the organisation. The duration is at least 240 hours of work. A case study on occupational health and safety must be done in this period and submitted to the department together with a satisfactory report on the practical training.

Research project 412 (MRN 412)

Module credits	16.00
NQF Level	08
Prerequisites	Finalists only
Contact time	8 other contact sessions per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

The module involves the management of the execution of a project that produces knowledge and understanding of a phenomenon, conclusions and a recommended course of action. The project is undertaken under the supervision of a staff member with the student ultimately taking responsibility for the management of and execution of the project. The student should be able to demonstrate competence in designing and conducting investigations and experiments and adherence to well defined time-lines and work breakdown structures. An acceptable process consists of but is not restricted to: (a) planning and conducting of investigations and experiments; (b) conducting of a literature search and critically evaluating material. The student should be able to demonstrate competence in engaging in independent learning through well-developed skills by: (a) reflecting on own learning and determining learning requirements and strategies; (b) sourcing and evaluating information; (c) determining learning requirements and strategies; (d) accessing, comprehending and applying knowledge acquired outside formal instruction; (e) critically challenging assumptions and embracing new thinking as well as communicating progress on a regular basis.

Research project 422 (MRN 422)

Module credits	24.00
NQF Level	08
Prerequisites	Finalist only, MRN 412
Contact time	12 other contact sessions per week

Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

The module involves the management of the execution of a project that produces knowledge and understanding of a phenomenon, conclusions and a recommended course of action. The project is undertaken under the supervision of a staff member with the student ultimately taking responsibility for the management of and execution of the project. This module follows onto MRN 412 and deals with the same topic in the same year. The student should be able to demonstrate competence in designing and conducting investigations and experiments and adherence to well-defined time-lines and work breakdown structures. An acceptable process consists of but is not restricted to: (a) understanding of the stated problem, (b) developing a work breakdown structure, (c) performing the necessary analyses; (d) selecting and using appropriate equipment or software; (e) construction and instrumentation of an experimental set-up; (f) taking measurements; (g) analysing, interpreting and deriving information from data; (h) drawing conclusions based on evidence; (i) communicating the purpose, process and outcomes in a technical report and presentation.

Heat transfer 410 (MTV 410)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 1

Module content

Introduction to basic thermodynamic heat transfer concepts. Conduction (steady state and transient), heat resistance networks. Conduction in two dimensions. Convective heat transfer: forced convection (external and internal), natural convection. Boiling and condensation. Thermal radiation. Heat exchangers: classification, Parallel flow and counterflow heat exchangers; double-pass, multi-pass and cross-flow heat exchangers; LMTD method, Effectiveness-NTU method, selection of heat exchangers. Experimental techniques in heat transfer.

Thermal and fluid machines 420 (MTV 420)

Module credits	16.00
NQF Level	08
Prerequisites	MTV 310, (MTX 311)
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering

Period of presentation	Semester 1 or Semester 2

Module content

Rotary Turbomachines: Fundamental principles of fluid dynamics and thermodynamics applicable to the rotating turbomachinery components i.e. gas and steam turbines, compressors, hydraulic turbines, and pumps. Classifications and basic components in turbomachines. Euler equations for turbines, compressors, and pumps. Estimations of work and power, and thermal energy losses and efficiencies in turbomachinery components. Basic theory for wind turbine power and Betz's method.
Power Cycles: Fundamental principles of fluid dynamics and thermodynamics applicable to the steam and gas turbine power cycles, internal combustion engine cycles, and reciprocating compressor cycles. Basic components in steam and gas turbine power plants. Power estimations in conventional power cycles, combined cycles, binary cycles, cogeneration plants, and organic Rankine cycles. Thermal energy losses and efficiencies in power cycles. Air-flow duct network and fan selection curves for duct system

Elective modules

Heat and mass transfer 420 (MHM 420)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Fundamentals of Thermal Radiation; blackbody radiation, radiative properties, Kirchhoff’s law. Radiation Heat Transfer; the view factor, gray surfaces, radiation shields. Boiling and condensation; pool and film boiling, film condensation, dropwise condensation. Heat exchangers; types, analysis, design, and selection. Mass transfer: Fick’s Law, mass diffusion, mass convection, simultaneous heat and mass transfer, porous catalysts.

Maintenance engineering 420 (MII 420)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

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

Nuclear engineering 420 (MKI 420)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 discussion class per week, 1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Basic nuclear physics: definitions and concepts (nuclear reaction, binding energy, cross-sections, moderator, reflector, etc.). Basic reactor physics: diffusion equation and boundary equations, group-diffusion methods, reactor kinetics. Reactor types: pressurised water reactors, boiling water reactors, gas-cooled reactors. Nuclear fuel cycle (including waste disposal). Reactor materials: fuels, moderators, coolants, reflectors, structures, systems or components. Reactor safety: biological effects of radiation, radiation shielding, principles of nuclear plant safety, atmospheric dispersion of radioactive contamination, event-tree and fault-tree analyses of reactor systems.

Aeronautics 420 (MLV 420)

Module credits	16.00
NQF Level	08
Prerequisites	MTV 310
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Introduction to aerodynamics and aeronautics. Fundamental physical quantities of flowing gas. Equations of state. Anatomy of an airplane. Basic aerodynamics. Potential flow. Elementary incompressible flow. The Kutta-Joukowski Theorem. Introduction to viscous flow. Laminar and Turbulent Boundary Layers. Skin friction. Transition Flow Separation. Airfoil nomenclature. Lift, drag and moment coefficients. Pressure coefficients. Airfoil data. Thin airfoil theory. Biot-Savart Law, Prandtl's lifting line theory. Wing properties. Circulation, downwash, and induced drag. Span efficiency. Stall. High-lift devices. Drag. Elements of airplane and flight performance. Range, endurance and payload. Principles of static stability and control.

Optimum design 420 (MOO 420)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Elements of optimisation, optimization problem identification and classification, optimisation formulations for physics-based models, model identification, data-driven models, optimisation background mathematics, loss functions, regularisation, constrained and unconstrained real-parameter optimisation. Optimisation solution philosophies: minimisation, optimality criteria, non-negative gradient projection points. Optimisation algorithms: gradient-based, derivative-free, gradient-only. Compute using a high-level programming language.

Vehicle engineering 420 (MVE 420)

Module credits	16.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Mechanical and Aeronautical Engineering
Period of presentation	Semester 2

Module content

Tyres: Construction, forces and moments, side force generation, rolling resistance, dynamic characteristics, tractive effort, slip, soft soil characteristics. Vehicle performance: equations of motion, supply and demand, forces acting on the vehicle, prediction of top speed, acceleration, braking, gradient ability and fuel consumption. Vehicle suspension systems: suspension concepts, kinematics, dynamic characteristics. Ride comfort: springs, dampers, suspension models, human response to vibration. Handling: steering systems, low-speed handling, steady-state handling, dynamic handling, under/oversteer, handling tests.

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