University of Pretoria Yearbook 2016

BSc Environmental and Engineering Geology (02133042)

Duration of study	3 years
Total credits	432

Admission requirements

- In order to register NSC/IEB/Cambridge candidates must comply with the minimum requirements for degree studies as well as the minimum requirements for the relevant study programme.
- Life Orientation is excluded in the calculation of the Admission Point Score (APS).
- Grade 11 results are used for the provisional admission of prospective students.
- Final admission is based on the Grade 12 results.

Minimum requirements for 2016												
Achievement level												
Afrikaans or English				**Mathematics**				**Physical Sciences**				**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	5	3	C	C	5	3	C	C	32

Candidates who do not comply with the minimum admission requirements may be considered for admission to the BSc or the BSc (Four-year Programme) based on the results of the NBT.

Other programme-specific information

Students may enrol for AIM 111 and AIM 121 instead of AIM 102 (the same content presented over 2 semesters).

Students will be informed timeously of compulsory excursions that could take place during the vacations. The attendance of excursions for first-year students is compulsory, while excursions of longer duration are compulsory for senior students.

Electives can be chosen from the following departments: Geography, Geoinformatics and Meteorology, Plant Production and Soil Science, Chemistry, Mathematics and Applied Mathematics and Physics.

Electives are chosen as follows:

Second year – 36 credits

Third year – 28 credits

A student must pass all the minimum prescribed and elective module credits as set out at the end of each year within a programme as well as the total required credits to comply with the particular degree programme. Please refer to the curricula of the respective programmes. At least 144 credits must be obtained at 300-/400-level, or otherwise as indicated by curriculum. The minimum module credits needed to comply with degree requirements is set out at the end of each study programme. Subject to the programmes as indicated a maximum of 150 credits will be recognised at 100-level. A student may, in consultation with the Head of Department and subject to the permission by the Dean, select or replace prescribed module credits not indicated in BSc three-year study programmes to the equivalent of a maximum of 36 module credits.

It is important that the total number of prescribed module credits is completed during the course of the study programme. The Dean may, on the recommendation of the Head of Department, approve deviations in this regard. Subject to the programmes as indicated in the respective curricula, a student may not register for more than 75 module credits per semester at first-year level subject to permission by the Dean. A student may be permitted to register for up to 80 module credits in a the first semester during the first year provided that he or she obtained a final mark of no less than 70% for grade 12 Mathematics and achieved an APS of 34 or more in the NSC.

Students who are already in possession of a bachelor's degree, will not receive credit for modules of which the content overlap with modules from the degree that was already conferred. Credits will not be considered for more than half the credits passed previously for an uncompleted degree. No credits at the final-year or 300- and 400-level will be granted.

The Dean may, on the recommendation of the programme manager, approve deviations with regard to the composition of the study programme.

Please note: Where elective modules are not specified, these may be chosen from any modules appearing in the list of modules.

It remains the student's responsibility to acertain, prior to registration, whether they comply with the prerequisites of the modules they want to register for.

The prerequisites are listed in the Alphabetical list of modules.

Transitional measures

Transitional measures for Mathematics modules for 2016

- Students who would have registered for any of the degrees BSc in Environmental Sciences, Geography, Geoinformatics, BCom, BCom in Economics/Statistics or BScIT Information and Knowledge Systems prior to 2016, and not successfully completed WTW 114, WTW 126 or WTW 128 will be allowed to register for WTW 134, WTW 146 and WTW 148, respectively.
- Students who would have registered for BSc in Geology prior to 2016, and not successfully completed WTW 114, WTW 126 or WTW 128 will be allowed to register for WTW 158, WTW 164 or WTW 124 or WTW 148, respectively.
- Students who registered prior to 2016, and who failed both WTW 126 and WTW 128 will register for WTW 124 in 2016 if they wish to continue with mathematics at 200 level, or if WTW 126 and WTW 128 are required for their respective degree programmes.
- Students who do not qualify for WTW 146 and WTW 148 in terms of their degree programmes, and failed one of WTW 126 or WTW 128, will be allowed to register for the respective module in 2016, and will attend the

relevant lectures and tutorials of WTW 124. They will write separate semester tests and exams, covering just the relevant material from WTW 124.
- Students who registered prior to 2016 and passed WTW 126 but not WTW 128, will be allowed to continue with WTW 211 and COS 344 in 2016.
- Students who registered prior to 2016 and passed WTW 128 but not WTW 126, will be allowed to continue with the modules WTW 220, IAS 211 and GLY 265 in 2016, if they also meet the additional entry requirements.
- Students who registered prior to 2016, and who failed both WTW 161 and WTW 168 will register for WTW 164 in 2016.
- Students who failed one of WTW 161 or WTW 168, will be allowed to register for the respective module in 2016, and will attend the relevant lectures and tutorials of WTW 164. They will write separate semester tests and exams, covering just the relevant material from WTW 164.

Promotion to next study year

A student will be promoted to the following year of study if he or she passed 100 credits of the prescribed credits for a year of study, unless the Dean on the recommendation of the head of department decides otherwise. A student who does not comply with the requirements for promotion to the following year of study, retains the credit for the modules already passed and may be admitted by the Dean, on recommendation of the head of department, to modules of the following year of study to a maximum of 48 credits, provided that it will fit in with both the lecture and examination timetable.

General promotion requirements in the faculty

All students whose academic progress is not acceptable can be suspended from further studies.

- A student who is excluded from further studies in terms of the stipulations of the abovementioned regulations, will be notified in writing by the Dean or Admissions Committee at the end of the relevant semester.
- A student who has been excluded from further studies may apply in writing to the Admissions Committee of the Faculty of Natural and Agricultural Sciences for re-admission.
- Should the student be re-admitted by the Admissions Committee, strict conditions will be set which the student must comply with in order to proceed with his/her studies.
- Should the student not be re-admitted to further studies by the Admissions Committee, he/she will be informed in writing.
- Students who are not re-admitted by the Admissions Committee have the right to appeal to the Senior Appeals Committee.
- Any decision taken by the Senior Appeals Committee is final.

Pass with distinction

A student obtains his or her degree with distinction if all prescribed modules at 300-level (or higher) are passed in one academic year with a weighted average of at least 75%, and obtain at least a subminimum of 65% in each of the relevant modules.

Curriculum: Year 1

Minimum credits: 140

Fundamental modules

Academic information management 111 (AIM 111)

Module credits	4.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities Faculty of Law Faculty of Health Sciences Faculty of Natural and Agricultural Sciences Faculty of Theology
Prerequisites	No prerequisites.
Contact time	MAMELODI, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Information Science
Period of presentation	Semester 1

Module content

Find, evaluate, process, manage and present information resources for academic purposes using appropriate technology.

Academic information management 121 (AIM 121)

Module credits	4.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities Faculty of Law Faculty of Health Sciences Faculty of Natural and Agricultural Sciences Faculty of Theology Faculty of Veterinary Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week, MAMELODI
Language of tuition	Both Afr and Eng
Academic organisation	Information Science
Period of presentation	Semester 2

Module content
Apply effective search strategies in different technological environments. Demonstrate the ethical and fair use of information resources. Integrate 21st-century communications into the management of academic information.

Language and study skills 110 (LST 110)

Module credits	6.00
Service modules	Faculty of Natural and Agricultural Sciences Faculty of Veterinary Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	English
Academic organisation	Unit for Academic Literacy
Period of presentation	Semester 1

Module content
The module aims to equip students with the ability to cope with the reading and writing demands of scientific disciplines.

Academic orientation 102 (UPO 102)

Module credits	0.00
Language of tuition	Double Medium
Academic organisation	Natural + Agric Sciences Dean
Period of presentation	Year

Academic information management 102 (AIM 102)

Module credits	6.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities Faculty of Law Faculty of Health Sciences Faculty of Natural and Agricultural Sciences Faculty of Theology Faculty of Veterinary Science
Contact time	2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Information Science
Period of presentation	Semester 2

Module content

Find, evaluate, process, manage and present information resources for academic purposes using appropriate technology. Apply effective search strategies in different technological environments. Demonstrate the ethical and fair use of information resources. Integrate 21st-century communications into the management of academic information.

Core modules

General chemistry 117 (CMY 117)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Health Sciences Faculty of Veterinary Science
Prerequisites	Final Grade 12 marks of at least 60% for Mathematics and 60% for Physical Sciences.
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemistry
Period of presentation	Semester 1

Module content

General introduction to inorganic, analytical and physical chemistry. Atomic structure and periodicity. Molecular structure and chemical bonding using the VSEOR model. Nomenclature of iorganic ions and compounds. Classification of reactions: precipitation, acid-base, redox reactions and gas-forming reactions. Mole concept and stoichiometric calculations concerning chemical formulas and chemical reactions. Principles of reactivity: energy and chemical reactions. Physical behaviour gases, liquids, solids and solutions and the role of intermolecular forces. Rate of reactions: Introduction to chemical kinetics.

General chemistry 127 (CMY 127)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Health Sciences Faculty of Veterinary Science
Prerequisites	Natural and Agricultural Sciences students: CMY 117 GS or CMY 154 GS Health Sciences students: none
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Chemistry
Period of presentation	Semester 2

Module content

Theory: General physical-analytical chemistry: Physical behaviour of gases, liquids and solids, intermolecular forces, solutions. Principles of reactivity: energy and chemical reactions, entropy and free energy, electrochemistry. Organic chemistry: Structure (bonding), nomenclature, isomerism, introductory stereochemistry, introduction to chemical reactions and chemical properties of organic compounds and biological compounds, i.e. carbohydrates and amino acids. Practical: Molecular structure (model building), synthesis and properties of simple organic compounds.

Historical geology 161 (GLY 161)

Module credits	8.00
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
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 4

Module content

Principles of stratigraphy and stratigraphic nomenclature; geological dating and international and South African time scales; Africa framework and tectonic elements of South Africa; introduction to depositional environments. Overview of the historical geology of South Africa, from the Archaean to the present: major stratigraphic units, intrusions and tectonicmetamorphic events - their rock types, fossil contents, genesis and economic commodities. Principles of palaeontology and short description of major fossil groups: fossil forms, ecology and geological meaning. Geological maps and profiles; rock samples.

Environmental and hazard geology 162 (GLY 162)

Module credits	8.00
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
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 3

Module content

Hazardous exogenic and endogenic geological processes and their influence on the human environment; impact of human activities on the geological environment; natural resource utilisation including materials for construction; natural and mine-induced seismicity; waste disposal; groundwater and environmental pollution. Geological maps; geological profiles; rock specimens; fossil specimens.

Mechanics 122 (SWK 122)

Module credits	16.00

Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	WTW 158
Contact time	2 tutorials per week, 4 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Civil Eng
Period of presentation	Semester 1 or Semester 2

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
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	Refer to Regulation 1.2: A candidate must have passed Mathematics with at least 60% in the Grade 12 examination
Contact time	4 lectures per week, 1 tutorial per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

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.

Introduction to geology 155 (GLY 155)

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	1 practical per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geology

Period of presentation	Semester 1

Module content

Solar system; structure of solid matter; minerals and rocks; introduction to symmetry and crystallography; important minerals and solid solutions; rock cycle; classification of rocks. External geological processes (gravity, water, wind, sea, ice) and their products (including geomorphology). Internal structure of the earth. The dynamic earth – volcanism, earthquakes, mountain building – the theory of plate tectonics. Geological processes (magmatism, metamorphism, sedimentology, structural geology) in a plate tectonic context. Geological maps and mineral and rock specimens.

First course in physics 114 (PHY 114)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	Refer to Regulation 1.2: A candidate must have passed Mathematics and Physical Science with at least 60% in the Grade 12 examination
Contact time	4 lectures per week, 1 discussion class per week, 1 practical per week
Language of tuition	Both Afr and Eng
Academic organisation	Physics
Period of presentation	Semester 1

Module content

SI-units. Significant figures. Waves: intensity, superposition, interference, standing waves, resonance, beats, Doppler. Geometrical optics: Reflection, refraction, mirrors, thin lenses, instruments. Physical optics: Young-interference, coherence, diffraction, polarisation. Hydrostatics and dynamics: density, pressure, Archimedes' principle, continuity, Bernoulli. Heat: temperature, specific heat, expansion, heat transfer. Vectors. Kinematics of a point: Relative, projectile, and circular motion. Dynamics: Newton's laws, friction. Work: point masses, gasses (ideal gas law), gravitation, spring, power. Kinetic energy: Conservative forces, gravitation, spring. Conservation of energy. Conservation of momentum. Impulse and collisions. System of particles: Centre of mass, Newton's laws. Rotation: torque, conservation of angular momentum, equilibrium, centre of gravity.

Mathematics 164 (WTW 164)

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

Module content

*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 146, WTW 148 and WTW 124,
Vector algebra with applications to lines and planes in space, matrix algebra, systems of linear equations, determinants, complex numbers, factorisation of polynomials and conic sections. Integration techniques, improper integrals. The definite integral, fundamental theorem of Calculus. Applications of integration. Elementary power series and Taylor's theorem. Vector functions, space curves and arc lengths. Quadratic surfaces and multivariable functions.

Curriculum: Year 2

Minimum credits: 148

Core modules

Introductory soil science 250 (GKD 250)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	CMY 117 GS or TDH
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 1

Module content

Origin and development of soil, weathering and soil formation processes. Profile differentiation and morphology. Physical characteristics: texture, structure, soil water, atmosphere and temperature. Chemical characteristics: clay minerals, ion exchange, pH, buffer action, soil acidification and salinisation of soil. Soil fertility and fertilisation. Soil classification. Practical work: Laboratory evaluation of simple soil characteristics. Field practicals on soil formation in the Pretoria area.

Sedimentology 253 (GLY 253)

Module credits	12.00
Prerequisites	CMY 117, CMY 127, GLY 155, GLY 161, GLY 162, WTW 114/WTW 158 and PHY 114
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 3

Module content

Introduction to sedimentology; grain studies; composition and textures of sedimentary rocks; flow dynamics and behaviour of sediment particles in transport systems; description and genesis of sedimentary structures; diagenesis; depositional environments and their deposits, modern and ancient; chemical sedimentary rocks; economic sedimentology; field data acquisition from sedimentary rocks and writing of reports; sieve analysis; Markov analysis; analysis of palaeocurrent trends; interpretation of sedimentary profiles.

Structural geology 254 (GLY 254)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	GLY 151, GLY 161, WTW 114/WTW 158 and FSK 116/FSK 176

Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 2

Module content

Integrated theoretical and practical course dealing with the principles of rock deformation and analysis of deformed rocks. Stress, strain and rheology, joints, experimental rock deformation, fault systems and Anderson's theory of faulting. Folds and interference folding, tectonic fabrics, shear zones, progressive deformation. Stereographic projection and structural analysis.

Igneous petrology 261 (GLY 261)

Module credits	12.00
Prerequisites	GLY 255
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 3

Module content

Classification and nomenclature of igneous rocks. The nature of silicate melts; physical and chemical factors influencing crystallisation and textures of igneous rocks. Phase diagrams, fractional crystallisation and partial melting. Trace elements and isotopes, and their use in petrogenetic studies. Global distribution of magmatism and its origin. Mid-oceanic ridges, active continental margins, intraplate magmatism.

Metamorphic petrology 262 (GLY 262)

Module credits	12.00
Prerequisites	GLY 255
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 4

Module content

Classification of metamorphic rocks. Anatexis, migmatite and granite; eclogite. Metamorphic textures. PT-time loops. Metamorphism in various plate tectonic environments.

Groundwater 265 (GLY 265)

Module credits	12.00
Prerequisites	CMY 117, CMY 127, GLY 155, GLY 161, GLY 162, WTW 114/WTW 158 and PHY 114
Language of tuition	English

Academic organisation	Geology
Period of presentation	Quarter 3

Module content

Origin and classification of groundwater; classification of aquifers; groundwater movement; equations for groundwater flow into boreholes; the La Place equation and solutions for pump tests; execution and interpretation of pump tests. Groundwater flow modelling; classification of aquifers in southern Africa; groundwater exploration and management. Mapping techniques.

Strength of materials 210 (SWK 210)

Module credits	16.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	SWK 122, WTW 164/WTW 124
Contact time	4 lectures per week, 2 tutorials per week
Language of tuition	Both Afr and Eng
Academic organisation	Civil Eng
Period of presentation	Semester 1

Module content

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

Fundamental and applied mineralogy 255 (GLY 255)

Module credits	24.00
Prerequisites	CMY 117, CMY 127, GLY 155, GLY 161, GLY 162, WTW 114/WTW 158 and PHY 114
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geology
Period of presentation	Semester 1

Module content

Fundamental concepts in mineralogy, and practical applications of mineralogy, including: the basics of crystal structure; the crystallographic groups; the rules of atomic substitution; phase transitions and phase diagrams; the structure and uses of olivine, pyroxene, feldspar, amphibole, mica, aluminosilicates, garnet, cordierite, and more uncommon mineral groups such as oxides, sulphides and carbonates; the calculation of mineral formulae from chemical analyses using various methods. Practical sessions: the basics of optical mineralogy and the use of transmitted light microscopy for thin section examination of minerals and rocks; the practicals will develop mineral identification skills for the minerals covered in the lectures, and cover basic textural identification.

Elective modules

Physical chemistry 282 (CMY 282)

Module credits	12.00
Service modules	Faculty of Education
Prerequisites	CMY 117 and CMY 127
Contact time	4 lectures per week, 1 tutorial per week, 2 practicals per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 2

Module content

Theory: Classical chemical thermodynamics, gases, first and second law and applications, physical changes of pure materials and simple compounds. Phase rule: Chemical reactions, chemical kinetics, rates of reactions.

Analytical chemistry 283 (CMY 283)

Module credits	12.00
Service modules	Faculty of Education
Prerequisites	CMY 117 and CMY 127
Contact time	2 practicals per week, 4 lectures per week, 1 tutorial per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 3

Module content

Theory: Statistical evaluation of data, gravimetric analysis, aqueous solution chemistry, chemical equilibrium, precipitation-, neutralisation- and complex formation titrations, redox titrations, potentiometric methods, introduction to electrochemistry.

Organic chemistry 284 (CMY 284)

Module credits	12.00
Service modules	Faculty of Education

Prerequisites	CMY 117 and CMY 127
Contact time	2 practicals per week, 4 lectures per week, 1 tutorial per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 1

Module content

Theory: Resonance, conjugation and aromaticity. Acidity and basicity. Introduction to ^{13}C NMR spectroscopy. Electrophilic addition: alkenes. Nucleophilic substitution, elimination, addition: alkyl halides, alcohols, ethers, epoxides, carbonyl compounds: ketones, aldehydes, carboxylic acids and their derivatives.

Inorganic chemistry 285 (CMY 285)

Module credits	12.00
Service modules	Faculty of Education
Prerequisites	CMY 117 and CMY 127
Contact time	2 practicals per week, 1 tutorial per week, 4 lectures per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 4

Module content

Theory: Atomic structure, structure of solids (ionic model). Coordination chemistry of transition metals: Oxidation states of transition metals, ligands, stereochemistry, crystal field theory, consequences of d-orbital splitting, chemistry of the main group elements, electrochemical properties of transition metals in aqueous solution, industrial applications of transition metals. Introduction to IR spectroscopy.

Process geomorphology 252 (GGY 252)

Module credits	12.00
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	GGY 166 or GLY 155
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 2

Module content

Physical processes that influence the earth’s surface and management. Specific processes and their interaction in themes such as weathering; soil erosion; slope, mass movement and fluvial processes. Practical laboratory exercises are based on the themes covered in the module theory component.

Geomorphology of the built environment 265 (GGY 265)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	4 lectures per week
Language of tuition	Double Medium
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 3

Module content

*This module is for Architecture and Landscape Architecture students only.
The theory component covers geomorphological aspects of the built environment including landscape identification; weathering or deterioration of natural stone and application to design and preservation of buildings and monuments; slope hydrology and stability conditions; soil erosion processes and construction impacts; drainage modification in urban areas; wetland identification, human impacts and rehabilitation; recreational impacts and management. In addition to the theory a field-based project is undertaken.

Geographic data analysis 220 (GIS 220)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	2 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 2

Module content

The nature of geographical data and measurement. Probability, probability distributions and densities, expected values and variances, Central Limit theorem. Sampling techniques. Exploratory data analysis, descriptive statistics, statistical estimation, hypothesis testing, correlation analysis and regression analysis.

Geographic information systems introduction 221 (GIS 221)

Module credits	12.00
Prerequisites	Prohibited combination GGY 283
Contact time	1 practical per week, 2 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 2

Module content
*The content of this module is the same as GGY 283 and students are not allowed to earn credits for both GGY 283 and GIS 221.
Introduction to Geographic Information Systems (GIS), theoretical concepts and applications of GIS. The focus will be on the GIS process of data input, data analysis, data output and associated technologies.

Remote sensing 220 (GMA 220)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	1 practical per week, 2 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 1

Module content

This module will provide a thorough introduction to the basic scientific principles involved in remote sensing, and some of the applications to studies of the Earth's surface. This includes examining the basic physics of electromagnetic radiation and the complex interactions of radiation with the surface and atmosphere (i.e. spectral signatures). In addition, basic concepts of photogrammetry will be discussed. The theoretical background laid out in the first half of the module will provide the tools for examining various remote sensing applications using data obtained in different parts of the electromagnetic spectrum. The applications will include uses of satellite remote sensing data for mapping and monitoring vegetation, soils and minerals, snow and ice, water resources and quality, and urban landscapes. The laboratory section will include hands-on experience with various satellite image data sets.

General physics 263 (PHY 263)

Module credits	24.00
Service modules	Faculty of Education
Prerequisites	PHY 255 GS and WTW 218 GS and WTW 220# and WTW 248#
Contact time	1 practical per week, 4 lectures per week, 2 discussion classes per week
Language of tuition	English
Academic organisation	Physics
Period of presentation	Semester 2

Module content

Classical mechanics (28 lectures)
Fundamental concepts, energy and angular momentum, calculus of variations and Lagrangian mechanics, conservative central forces and two body problems, scattering, mechanics in rotating reference frames, many body systems.
Physical Optics (14 lectures)
Maxwell's equations, wave equation and plane wave solution, coherence, interference, diffraction, polarisation.
Physics of Materials (14 lectures)
Classification of materials. Atomic bonding. Crystallography. Defects. Material strength. Phase diagram's, Ceramics. Polymers. Composites. Fracture. Electrical and magnetic properties. Semiconductors. Smart materials Nanotechnology.
Experiments (14 sessions)

Surveying 210 (SUR 210)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	4 practicals per week, 3 lectures per week
Language of tuition	Double Medium
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 1

Module content

Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and levelling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

Surveying 220 (SUR 220)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 114 GS/WTW 134
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 2

Module content

Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and leveling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

Site surveying 213 (TRN 213)

Module credits	12.00
Prerequisites	No prerequisites.
Contact time	1 practical per week, 2 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 1

Module content

General surveying; instruments, their handling and adjusting; surveying systems and simple calculations; determining of levels; setting out of the works; tacheometry and plotting; scales, planimetry; areas and volumes; construction surveying; aerial photography.

Physical meteorology 261 (WKD 261)

Module credits	14.00
Prerequisites	WTW 114
Contact time	4 lectures per week, 1 tutorial per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 1

Module content

Conservative forces and conservation laws. Basic thermodynamic laws for dry and humid air. The equation of state. Adiabatic processes and temperature lapse rates. The Clausuis-Claperon equation. Calculation of the wet adiabat.

Linear algebra 211 (WTW 211)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 124
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

This is an introduction to linear algebra on Rn. Matrices and linear equations, linear combinations and spans, linear independence, subspaces, basis and dimension, eigenvalues, eigenvectors, similarity and diagonalisation of matrices, linear transformations.

Calculus 218 (WTW 218)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114 and WTW 124
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Calculus of multivariable functions, directional derivatives. Extrema and Lagrange multipliers. Multiple integrals, polar, cylindrical and spherical coordinates.

Analysis 220 (WTW 220)

Module credits	12.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114 and WTW 124
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Properties of real numbers. Analysis of sequences and series of real numbers. Power series and theorems of convergence. The Bolzano-Weierstrass theorem. The intermediate value theorem and analysis of real-valued functions on an interval. The Riemann integral: Existence and properties of the interval.

Linear algebra 221 (WTW 221)

Module credits	12.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 211

Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Abstract vector spaces, change of basis, matrix representation of linear transformations, orthogonality, diagonalisability of symmetric matrices, some applications.

Differential equations 256 (WTW 256)

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

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

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
Service modules	Faculty of Engineering, Built Environment and Information Technology

Prerequisites	WTW 164
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

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.

Discrete structures 285 (WTW 285)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	WTW 115
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Setting up and solving recurrence relations. Equivalence and partial order relations. Graphs: paths, cycles, trees, isomorphism. Graph algorithms: Kruskal, Prim, Fleury. Finite state automata.

Differential equations 286 (WTW 286)

Module credits	12.00
Service modules	Faculty of Economic and Management Sciences
Prerequisites	WTW 114, WTW 124 and WTW 162
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

*Students will not be credited for more than one of the modules for their degree: WTW 264, WTW 286
Theory and solution methods for ordinary differential equations and initial value problems: separable and linear first-order equations, linear equations of higher order, systems of linear equations. Application to mathematical models. Numerical methods applied to nonlinear systems.Qualitative analysis of linear systems.

Waves, thermodynamics and modern physics 255 (PHY 255)

Module credits	24.00
Service modules	Faculty of Education
Prerequisites	[PHY114 and PHY124] or [PHY171] or [PHY143 and PHY153 and PHY163] and [WTW211#] and [WTW218#]
Contact time	4 lectures per week, 1 practical per week, 2 discussion classes per week
Language of tuition	English
Academic organisation	Physics
Period of presentation	Semester 1

Module content

Vibrating systems and waves (14 lectures)
Simple harmonic motion (SHM). Superposition (different frequencies, equal frequencies). Perpendicular vibrations (Lissajous figures). Damped SHM. Forced oscillations. Resonance. Q-value. Transverse wave motion. Plane wave solution using method of separation of variables. Reflection and transmission at a boundary. Normal and eigenmodes. Wave packets. Group velocity.
Modern physics (30 lectures)
Special relativity: Galilean and Lorentz transformations. Postulates. Momentum and energy. 4 vectors and tensors. General relativity. Quantum physics. Failure of classical physics. Bohr model. Particle-wave duality. Schrödinger equation. Piece-wise constant potentials. Tunneling. X-rays. Laser. Nuclear physics: Fission. Fusion. Radioactivity.
Heat and thermodynamics (12 lectures)
Heat. First Law. Kinetic theory of gases. Mean free path. Ideal, Clausius, Van der Waals and virial gases. Entropy. Second Law. Engines and refrigerators. Third Law. Thermodynamic potentials: Enthalpy Helmholtz and Gibbs free energies, Chemical potential. Legendre transformations (Maxwell relations). Phase equilibrium. Gibbs phase rule.
Modelling and simulation (7 practical sessions)
Introduction to programming in a high level system: Concept of an algorithm and the basic logic of a computer programme. Symbolic manipulations, graphics, numerical computations. Applications: Selected illustrative examples.
Error Analysis (7 practical sessions)
Experimental uncertainties. Propagation of uncertainties. Statistical analysis of random uncertainties. Normal distribution. Rejection of data. Least-squares fitting. Covariance and correlation.

City structure, environment and society 266 (GGY 266)

Module credits	24.00
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor

Period of presentation	Semester 2

Module content

An urbanising world. Urban structure and land use. Urban processes. The urban environment. Social structure and change in cities. Living in the city. Economy, society and politics in the city. Third-world cities and South African cities. Urban futures.

Basic principles of pasture science 253 (WDE 253)

Module credits	18.00
Service modules	Faculty of Veterinary Science
Prerequisites	No prerequisites.
Language of tuition	English
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 1

Module content

The influence of biotic and abiotic factors on the productivity of different strata and components of natural and planted pastures. This will enable the student to understand the management, production, appropriate and optimal utilisation as well as the conservation of these pastures. These principles can be used to ensure sustainable animal production and health.

Vector analysis 248 (WTW 248)

Module credits	12.00
Service modules	Faculty of Education
Prerequisites	WTW 218
Contact time	1 discussion class per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Vectors and geometry. Calculus of vector functions with applications to differential geometry, kinematics and dynamics. Vector analysis, including vector fields, line integrals of scalar and vector fields, conservative vector fields, surfaces and surface integrals, the Theorems of Green, Gauss and Stokes with applications.

Introduction to dynamic meteorology 263 (WKD 263)

Module credits	14.00
Prerequisites	WTW 126 and WTW 128 (students should simultaneously be enrolled for WTW 218).
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	English

Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 2

Module content

Vector algebra, curl of a vector, total and partial derivatives, second law of motion. Spherical coordinates Acceleration in rotating co-ordinates, fundamental forces, momentum equation. Three dimensional flow balance, conservation of mass, heat equation, thermodynamic energy equation. Introduction to finite difference methods. Numerical estimation of the geostrophic wind, vorticity and divergence. Advection of temperature. Development of a two-dimensional temperature advection model.

Differential equations 264 (WTW 264)

Module credits	12.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114 and WTW 124
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

*Students will not be credited for both WTW 162 and WTW 264 or both WTW 264 and WTW 286 for their degree.

Theory and solution methods for ordinary differential equations and initial value problems: separable and linear first order equations, linear equations of higher order, systems of linear equations. Laplace transform.

Curriculum: Final year

Minimum credits: 144

Core modules

Soil chemistry 320 (GKD 320)

Module credits	14.00
Prerequisites	GKD 250
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Both Afr and Eng
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 2

Module content

The more exact chemistry of soils systematically explained by understanding the particular chemical principles. Charge origin. Chemical equilibriums. Manifestations of sorption. Ion exchange. Acidic soils, saline soils and the organic fraction of soil. The chemistry of the important plant nutrient elements P, K and N is explained.

Soil classification and surveying 350 (GKD 350)

Module credits	14.00
Prerequisites	GKD 250 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 1

Module content

A taxonomic system for South Africa. USDA’s Soil Taxonomy. Land suitability evaluation. Optimal resource utilization. The conservation component. Ecological aspects. Ecotype, land types. Soil maps. Practical work: Field practicals and compulsory excursion. Identification of soil horizons, forms and families. Land suitability evaluation. Elementary mapping exercise.

Ore deposits 361 (GLY 361)

Module credits	18.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	Five of the second year modules: GLY 253, GLY 254, GLY 255, GLY 261, GLY 262, GLY 265
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 2

Module content

Systematic review of major metallic and non-metallic ore types and examples in South Africa and world-wide; ore type models (grades, tonnages); geometry of ore bodies; mining. Ore samples and ore mineralogy. Mapping techniques.

Geostatistics and ore reserve calculations 362 (GLY 362)

Module credits	18.00
Prerequisites	GLY 253, GLY 254, GLY 255, GLY 261, GLY 262, GLY 265
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 1

Module content

Review of classical geostatistical methods; problem evaluation; descriptive statistics, normal-, lognormal, three parameter lognormal distributions; confidence intervals; t-test. Sampling; cut-off values; grid generation and trend surface analysis. Semivariogram; error estimation; Kriging (BLUE) techniques. Ore reserve calculations.

Engineering geology 363 (GLY 363)

Module credits	18.00
Prerequisites	GLY155 and GLY265 and 4 of the second year modules: GLY253, GLY254, GLY255, GLY261, GLY262
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 3

Module content

Definition and scope of engineering geology; engineering geological properties and problems of rocks and soils within different stratigraphic units and climatic regions in southern Africa.

Soil mechanics 311 (SGM 311)

Module credits	16.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	(SWK 210)
Contact time	3 lectures per week, 2 practicals per week, 1 tutorial per week
Language of tuition	Both Afr and Eng
Academic organisation	Civil Eng
Period of presentation	Semester 1

Module content
Introduction to soil mechanics. Introduction to clay mineralogy. Mass, volume relationships and phases of soil. Groundwater flow and permeability. Effective stress principles. Suction pressures in saturated as well as partially saturated soil. The Mohr circle and stresses at a point. The Mohr-Coulomb strength theory and the stress-strain properties of soil. The Boussinesq theory. Consolidation theory and soil settlement.

Rock mechanics 364 (GLY 364)

Module credits	18.00
Prerequisites	GLY 254 and 4 of the second-year modules: GLY 255, GLY 253, GLY 261, GLY 262, GLY 265
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geology
Period of presentation	Quarter 4

Module content
Strength and failure modes of rock material and rock failure criteria. The characteristics of joints in rock. Joint line surveys and interpretation of data. Characteristics of a rock mass, rock mass classification and determination of strength. Slope stability in surface mines. Induced seismicity due to deep mining and rock bursts.

Elective modules

Physical chemistry 382 (CMY 382)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	2 practicals per week, 4 lectures per week, 1 discussion class per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 4

Module content
Theory: Molecular quantum mechanics. Introduction: Shortcomings of classical physics, dynamics of microscopic systems, quantum mechanical principles, translational, vibrational and rotational movement. Atomic structure and spectra: Atomic hydrogen, multiple electron systems, spectra of complex atoms, molecular structure, the hydrogen molecule ion, diatomic and polyatomic molecules, structure and properties of molecules. Molecules in motion: Viscosity, diffusion, mobility. Surface chemistry: Physisorption and chemisorption, adsorption isotherms, surface tension, heterogeneous catalytic rate reactions, capillarity.

Analytical chemistry 383 (CMY 383)

Module credits	18.00

Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	2 practicals per week, 1 discussion class per week, 4 lectures per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 1

Module content

Theory: Separation methods: Extraction, multiple extraction, chromatographic systems. Spectroscopy: Construction of instruments, atomic absorption and atomic emission spectrometry, surface analysis techniques. Mass spectrometry. Instrumental electrochemistry.

Organic chemistry 384 (CMY 384)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	2 practicals per week, 1 discussion class per week, 4 lectures per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 3

Module content

Theory: NMR spectroscopy: applications. Aromatic chemistry, Synthetic methodology in organic chemistry. Carbon-carbon bond formation: alkylation at nucleophilic carbon sites, aldol and related condensations, Wittig and related reactions, acylation of carbanions (Claisen condensation).

Inorganic chemistry 385 (CMY 385)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	2 practicals per week, 4 lectures per week, 1 discussion class per week
Language of tuition	English
Academic organisation	Chemistry
Period of presentation	Quarter 2

Module content

Theory: Structure and bonding in inorganic chemistry. Molecular orbital approach, diatomic and polyatomic molecules, three-centre bonds, metal-metal bonds, transition metal complexes, magnetic properties, electronic spectra, reactivity and reaction mechanisms, reaction types, acid-base concepts, non-aqueous solvents, special topics.

Environmental geomorphology 361 (GGY 361)

Module credits	18.00
Service modules	Faculty of Humanities
Prerequisites	GGY 252 and only for students studying BSc (Geography) or BSc (Environmental Sciences).
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 4

Module content

*Note: The module is available for BSc (Geography) and BSc (Environmental Sciences) students only. The theory content of this module is the same as GGY 363 and students are not allowed to earn credits for both GGY 361 and GGY 363.

Interactions of geomorphic processes within the physical and built environments; themes such as geomorphology and environmental change, slope processes and the environment, geomorphic risks and hazards, soil erosion and conservation, geomorphology in environmental management, applied weathering. Practicals involve fieldwork including sampling and mapping and subsequent laboratory analysis.

Applied geomorphology 363 (GGY 363)

Module credits	12.00
Service modules	Faculty of Education
Prerequisites	GGY 252
Contact time	4 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 4

Module content

*Note: The content of this module is the same as GGY 361 and students are not allowed to earn credits for both GGY 361 and GGY 363.
Interactions of geomorphic processes within the physical and built environments; themes such as geomorphology and environmental change, slope processes and the environment, geomorphic risks and hazards, soil erosion and conservation, geomorphology in environmental management, applied weathering.

Geographic information systems 310 (GIS 310)

Module credits	24.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	GGY 283 or GIS 221

Contact time	1 practical per week, 2 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 1

Module content

Advanced theory and practice of Geographic Information Systems; GIS applications; design and implementation of GIS applications.

Spatial analysis 320 (GIS 320)

Module credits	24.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	GIS 310 or TDH
Contact time	2 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 2

Module content

Construction of Raster Geovisualisations, spatial model construction and use, multi-criteria decision analysis. Factor analysis: Principle component analysis. Geostatistics: Spatial dependence modelling, ordinary kriging. Markov chains and cellular Automata, combined models.

Remote sensing 320 (GMA 320)

Module credits	24.00
Prerequisites	GMA 220 or TDH
Contact time	1 practical per week, 2 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 2

Module content

This module aims to provide students with a working knowledge and skills to learn methods and techniques for collecting, processing and analysing remotely sensed data. Throughout the module, emphasis will be placed on image processing, image analysis, image classification, remote sensing and applications of remote sensing in geographical analysis and environmental monitoring. The module is composed of lectures, readings, laboratory exercises and research tasks.

Geometrical and space geodesy 310 (GMC 310)

Module credits	24.00

Prerequisites	GMC110 and WTW114/WTW 134
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Double Medium
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 1

Module content

Spherical trigonometry. Geometrical Geodesy: Datum surfaces and coordinate systems in Geodesy, Calculations on the ellipsoid, Datum transformations. Map projections: Projection principles, distortion determination, construction of conformal, equivalent and equidistant projections, the Transverse Mercator projection and UTM projection of an ellipsoidal earth, projection transformations. Space Geodesy: Time systems, Celestial and observer coordinate systems, Global Navigation Satellite Systems (GNSS), Satellite orbits and orbital parameters, 3¬ D positioning.

Soil-water relationship and irrigation 350 (PGW 350)

Module credits	16.00
Prerequisites	GKD 250
Contact time	fortnightly practicals, 2 lectures per week
Language of tuition	Both Afr and Eng
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 1

Module content

Quantitative description and measurement of soil water content and potential as well as saturated and unsaturated hydraulic conductivity. Modelling water flow in soil (Darcy’s law, Richards's equation). Infiltration, redistribution, evaporation, runoff and percolation. Irrigation in South Africa. Modelling and managing the soil water balance. Plant water consumption and the soil-plant-atmosphere continuum. Irrigation scheduling (soil, plant and atmosphere approaches). Managing poor quality water. Irrigation systems. The module includes a field trip to an irrigation scheme.

Statistical mechanics, solid state physics and modelling 364 (PHY 364)

Module credits	36.00
Service modules	Faculty of Education
Prerequisites	PHY 356 and WTW 211 and WTW 218 and WTW 220 GS and WTW 248 GS
Contact time	2 discussion classes per week, 4 lectures per week, 2 practicals per week
Language of tuition	English
Academic organisation	Physics
Period of presentation	Semester 2

Module content
Statistical mechanics (28 lectures)
Isolated systems in thermodynamical equilibrium. Systems in equilibrium with a heat bath: the canonical ensemble, Gibbs' entropic formula, classical statistical mechanics, energy equipartition theorem, thermodynamic potentials, paramagnetism.
The classical limit of perfect gases: non-distinguishable character of quantum particles, the equation of state of the classical ideal gas. Quantum perfect gases: Black body radiation, the grand canonical ensemble, Fermi-Dirac distribution, the free electron gas in metals, the Bose-Einstein distribution, Bose-Einstein condensation.
Solid state physics (28 lectures)
Crystal structures, the reciprocal lattice, x-ray diffraction, lattice vibration, the Debye model, characteristics of solids, the free electron model, Pauli paramagnetism, electronic heat capacity, the relaxation time, electrical conduction, the classical Hall effect, thermal conduction in metals, failures of the free electron model, the independent electron model, band theory of solids.
Computational Physics and modelling. Assessment will be done through a portfolio of project reports. The topics for the projects will be selected from various sub-disciplines of Physics.

Principles of veld management 310 (WDE 310)

Module credits	14.00
Prerequisites	No prerequisites.
Contact time	fortnightly practicals, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 1

Module content

The influence of biotic and abiotic factors on the productivity of different strata and components of natural pastures. This will enable the student to advise users, with the necessary motivation, on the appropriate use of these strata and components and will form a basis for further research on this system. The principles of veld management s and the influence of management practices on sustainable animal production from natural pastures. This will enable the student to advise users on veld management and veld management principles. It will also form a basis for further research on veld management.

Planted pastures and fodder crops 320 (WDE 320)

Module credits	14.00
Prerequisites	WDE 310
Contact time	2 lectures per week, fortnightly practicals
Language of tuition	Double Medium
Academic organisation	Plant Production and Soil Sc
Period of presentation	Semester 2

Module content

The establishment and use of planted pastures species and fodder crops and the conservation of fodder. This will enable students to advise users on establishment and utilization of planted pastures species as well as farmers on the production,
conservation and optimum use of fodder. This will also form a basis for further research on planted pastures.

Atmospheric vorticity and divergence 352 (WKD 352)

Module credits	18.00
Prerequisites	WKD 263 GS and WTW 248 GS
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 3

Module content

Scale analyses and simplification of the basic equations. The geostrophic, thermal and gradient wind. The vorticity equation and divergence.

Quasi-geostrophic analysis 361 (WKD 361)

Module credits	18.00
Prerequisites	WKD 352 GS and WKD 254
Contact time	4 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 4

Module content

Tendency and Omega equations. Model of a boroclinic system. Introduction to numerical models. Application in meteorological display and analysis software.

Multivariate analysis 311 (WST 311)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Statistics
Period of presentation	Semester 1

Module content

Multivariate statistical distributions: Moments of a distribution, moment generating functions, independence. Multivariate normal distribution: Conditional distributions, partial and multiple correlations. Multinomial and multivariate Poisson distributions: Asymptotic normality and estimation of parameters. Distribution of quadratic forms in normal variables. Multivariate normal samples: Estimation of the mean vector and covariance matrix, estimation of correlation coefficients, distribution of the sample mean, sample covariance matrix and sample correlation coefficients. The linear model: Models of full rank, least squares estimators, test of hypotheses. Practical applications: Practical statistical modelling and analysis using statistical computer packages and interpretation of the output.

Stochastic processes 312 (WST 312)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Statistics
Period of presentation	Semester 1

Module content

Definition of a stochastic process. Stationarity. Covariance stationary. Markov property. Random walk. Brownian motion. Markov chains. Chapman-Kolmogorov equations. Recurrent and transient states. First passage time. Occupation times. Markov jump processes. Poisson process. Birth and death processes. Structures of processes. Structure of the time-homogeneous Markov jump process. Applications in insurance. Practical statistical modelling, analysis and simulation using statistical computer packages and the interpretation of the output.

Time-series analysis 321 (WST 321)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WST 311 GS, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Stationary and non-stationary univariate time-series. Properties of autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) processes. Identification, estimation and diagnostic testing of a time-series model. Forecasting. Multivariate time-series. Practical statistical modelling and analysis using statistical computer packages.

Actuarial statistics 322 (WST 322)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Decision theory. Loss distributions. Reinsurance. Risk models. Ruin theory. Credibility theory. Methods to forecast future claim numbers and amounts. The generalised linear model: Exponential family, mean and variance, link functions, deviance and residual analysis, test statistics, log-linear and logit models. Practical statistical modelling and analysis using statistical computer packages.

Analysis 310 (WTW 310)

Module credits	18.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 220
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Topology of finite dimensional spaces: Open and closed sets, compactness, connectedness and completeness. Theorems of Bolzano-Weierstrass and Heine-Borel. Properties of continuous functions and applications. Integration theory for functions of one real variable. Sequences of functions.

Complex analysis 320 (WTW 320)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	WTW 218 and WTW 220
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths

Period of presentation	Semester 2

Module content

Series of functions, power series and Taylor series. Complex functions, Cauchy- Riemann equations, Cauchy's theorem and integral formulas. Laurent series, residue theorem and calculation of real integrals using residues.

Financial engineering 354 (WTW 354)

Module credits	18.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
Prerequisites	WST 211, WTW 211 and WTW 218
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Mean variance portfolio theory. Market equilibrium models such as the capital asset pricing model. Factor models and arbitrage pricing theory. Measures of investment risk. Efficient market hypothesis. Stochastic models of security prices

Financial engineering 364 (WTW 364)

Module credits	18.00
Prerequisites	WST 211, WTW 126, WTW 218 and WTW 286 or WTW 264
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Discrete time financial models: Arbitrage and hedging; the binomial model. Continuous time financial models: The Black-Scholes formula; pricing of options and the other derivatives; interest rate models; numerical procedures.

Algebra 381 (WTW 381)

Module credits	18.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 114 and WTW 211
Contact time	1 tutorial per week, 2 lectures per week

Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Group theory: Definition, examples, elementary properties, subgroups, permutation groups, isomorphism, order, cyclic groups, homomorphisms, factor groups. Ring theory: Definition, examples, elementary properties, ideals, homomorphisms, factor rings, polynomial rings, factorisation of polynomials. Field extensions, applications to straight-edge and compass constructions.

Dynamical systems 382 (WTW 382)

Module credits	18.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 218 and WTW 286 or WTW 264
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Matrix exponential function: homogeneous and non-homogeneous linear systems of differential equations. Qualitative analysis of systems: phase portraits, stability, linearisation, energy method and Liapunov's method. Introduction to chaotic systems. Application to real life problems.

Numerical analysis 383 (WTW 383)

Module credits	18.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 114, WTW 124 and WTW 211
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Direct methods for the numerical solution of systems of linear equations, pivoting strategies. Iterative methods for solving systems of linear equations and eigenvalue problems. Iterative methods for solving systems of nonlinear equations. Introduction to optimization. Algorithms for the considered numerical methods are derived and implemented in computer programmes. Complexity of computation is investigated. Error estimates and convergence results are proved.

Partial differential equations 386 (WTW 386)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	WTW 248 and WTW 286 or WTW 264
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Conservation laws and modelling. Fourier analysis. Heat equation, wave equation and Laplace's equation. Solution methods including Fourier series. Energy and other qualitative methods.

Continuum mechanics 387 (WTW 387)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	WTW 248 and WTW 286 or WTW 264
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Kinematics of a continuum: Configurations, spatial and material description of motion. Conservation laws. Analysis of stress, strain and rate of deformation. Linear constitutive equations. Applications: Vibration of beams, equilibrium problems in elasticity and special cases of fluid motion.

Geometry 389 (WTW 389)

Module credits	18.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities
Prerequisites	WTW 211

Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Double Medium
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Axiomatic development of neutral, Euclidean and hyperbolic geometry. Using models of geometries to show that the parallel postulate is independent of the other postulates of Euclid.

Electronics, electromagnetism and quantum mechanics 356 (PHY 356)

Module credits	36.00
Service modules	Faculty of Education
Prerequisites	PHY 255 GS and PHY 263 GS and WTW 211 GS and WTW 218 GS and WTW 220 GS and WTW 248 GS
Contact time	2 discussion classes per week, 4 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Physics
Period of presentation	Semester 1

Module content

Electronics (14 lectures)
Thévenin and Norton equivalent circuits, superposition principle, RC, LC and LRC circuits. Semiconductor diode. Bipolar transistor. Operational amplifiers. Computer controlled instrumentation.
Electromagnetism (21 lectures)
Electrostatics: Coulomb’s law, divergence and curl of E, Gauss’ law, Laplace’s equation, image charge problems, multipole expansion.
Magnetostatics: Lorenz force, Biot-Savart law, divergence and curl of magnetic field strength, Ampère’s law, magnetic vector potential, multipole expansion, boundary conditions.
Electrodynamics: Electromotive force, electromagnetic induction, Maxwell’s equations, wave equation.
Electric and magnetic fields in matter: Polarisation, electric displacement and Gauss’s law in dielectrics, linear dielectrics. Magnetisation (diamagnets, paramagnets, ferromagnets), auxiliary field H and Ampère’s law in magnetised materials, linear and nonlinear media.
Quantum mechanics (28 lectures)
The Schrödinger equation, the statistical interpretation of the wave function, momentum, the uncertainty principle, the time-independent Schrödinger equation, stationary states, the infinite square well potential, the harmonic oscillator, the free particle, the Delta-Function potential, the finite square well potential, Hilbert spaces, observables, eigen functions of a Hermitian operator, Dirac notation, the Schrödinger equation in spherical coordinates, the hydrogen atom, angular momentum spin.

Sustainable development 356 (GGY 356)

Module credits	18.00

Service modules	Faculty of Education Faculty of Humanities
Prerequisites	No prerequisites.
Contact time	3 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 1

Module content

The module conceptually integrates environmental, economic, and social components of sustainable development. Other topics covered include changing perceptions on development and environment, development paradigms, challenges of sustainable development, actors and actions in sustainable development, rural and urban livelihoods, and a Third World assessment of sustainable development in the developing world.

Development frameworks 366 (GGY 366)

Module credits	18.00
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	No prerequisites.
Contact time	3 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 3

Module content

Classic development frameworks. Spatial development history and legacy in South Africa. Overview of contemporary environmental legislation in South Africa. Rural development strategy. Rural and agricultural reconstruction. Land reform. Urban development and strategy. Urban spatial reconstruction. National spatial development frameworks.

Human environmental interactions 301 (ENV 301)

Module credits	18.00
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	No prerequisites.
Contact time	4 lectures per week, 1 practical per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Quarter 2

Module content

The module focuses on contemporary environmental issues in southern Africa. Recent and future impacts of human pressures on natural resources, the state of the environment in South Africa, management of critical resources, population trends, biodiversity loss, pollution, water scarcity, desertification, climate change, waste accumulation and management, environmental management tools, environmental education and environmental management legislation.

Fundamentals of weather forecasting 366 (WKD 366)

Module credits	36.00
Prerequisites	WKD 155, WKD 261, WKD 254 (students should simultaneously be enrolled for WKD 361)
Contact time	1 practical per week, 4 lectures per week
Language of tuition	English
Academic organisation	Geography, Geoinf + Meteor
Period of presentation	Semester 2

Module content

Meterological observations data codes. Weather applications software and computing environments of meteorological analysis and weather forecasting techniques. Applications of remote sensing in weather forecasting. Aaerological diagrams. Applications of numerical weather prediction, and types of weather forecasts. Integration of information to describe the current state of the atmosphere and to predict a future state of the atmosphere.

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