University of Pretoria Yearbook 2025

BSc in Meteorology 4-year programme (02131007)

Department	Geography, Geoinformatics and Meteorology
Minimum duration of study	4 years
Total credits	494
NQF level	07

Programme information

This is an extended BSc degree programme with a four-year curriculum that is only presented on a full-time basis. It is designed to enable students, who show academic potential, to obtain a BSc degree.

This programme is directed at a general formative education in the natural sciences. It provides the student with a broad academic basis to continue with postgraduate studies and prepares the student for active involvement in a wide variety of career possibilities.

1. Students who are admitted to one of the BSc four-year programmes register for one specific programme.
2. These programmes are followed by students who, as a result of exceptional circumstances, will benefit from an extended programme.
3. Students who do not comply with the normal three-year BSc entrance requirements for study in the Faculty of Natural and Agricultural Sciences, may nevertheless be admitted to the Faculty in one of the BSc four-year programmes. Generally, an extended programme means that the first study year is extended to take two years. The possibility of switching over to other faculties after one or two years in the four-year programmes exists. This depends on selection rules and other conditions stipulated by the other faculties.
4. Applications for admission to the BSc four-year programmes should be submitted in accordance with the UP applications process, with applications considered up to 30 June and in a second round in August/September. Details are obtainable from the Student Administration at the Faculty of Natural and Agricultural Sciences.
5. The rules and regulations applicable to the mainstream study programmes apply mutatis mutandis to the BSc four-year programmes, with exceptions as indicated in the regulations pertaining to the BSc four-year programmes. For instance, students admitted into the BSc four-year programmes must have a National Senior Certificate with admission for degree purposes.

Admission requirements

Important information for all prospective students for 2025

The admission requirements below apply to all who apply for admission to the University of Pretoria with a **National Senior Certificate (NSC) and Independent Examination Board (IEB) qualifications. Click here for this Faculty Brochure.**

Minimum requirements
Achievement level

English Home Language or English First Additional Language	Mathematics	Physical Sciences	APS
NSC/IEB	NSC/IEB	NSC/IEB	
58%	58%	58%	**32**

Life Orientation is excluded when calculating the APS.

Applicants currently in Grade 12 must apply with their final Grade 11 (or equivalent) results.

Applicants who have completed Grade 12 must apply with their final NSC or equivalent qualification results.

Please note that meeting the minimum academic requirements does not guarantee admission.

Only students that have completed school in the last two years and have not studied at a tertiary institution will be considered for this programme.

Successful candidates will be notified once admitted or conditionally admitted.

Unsuccessful candidates will also be notified.

Applicants should check their application status regularly on the UP Student Portal at click here.

Applicants with qualifications other than the abovementioned should refer to the International undergraduate prospectus 2025: Applicants with a school leaving certificate not issued by Umalusi (South Africa), available at click here.

International students: Click here.

Examinations and pass requirements

Academic promotion requirements
Students who do not show progress during the first semester of the first year will be referred to the Admissions Committee of the Faculty.
It is expected of students who register for the first year of the BSc four-year programmes to pass all the prescribed modules of the first year.

Progression requirement
The first year is foundational to the mainstream modules that follow; students will be limited to repeating two foundation modules during year 2 of study. Students may apply for internal transfers at the end of year 2. Not all mainstream programmes will be accessible; the Faculty's transfer guide will clearly outline all possibilities and the overarching objective will be that approved transfers will not involve adding an additional year of study.

Curriculum: Year 1

Minimum credits: 100

Fundamental = 20
Core = 80

Fundamental modules

Academic information management 111 (AIM 111)

Module credits	4.00
NQF Level	05
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 and Religion
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	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
NQF Level	05
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 and Religion Faculty of Veterinary Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week

Language of tuition	Module is presented in English
Department	Informatics
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, life and study skills 133 (LST 133)

Module credits	6.00
NQF Level	05
Service modules	Faculty of Economic and Management Sciences
Prerequisites	Admission into BSc Four-year programme
Contact time	1 lecture per week, Foundation Course, 2 tutorials per week
Language of tuition	Module is presented in English
Department	Unit for Academic Literacy
Period of presentation	Semester 1

Module content

The module aims to equip students with the ability to cope with the academic demands of scientific disciplines, with a strong focus on high order thinking skills and academic reading skills and strategies.

Language, life and study skills 143 (LST 143)

Module credits	6.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
Prerequisites	LST 133
Contact time	2 tutorials per week, 1 lecture per week, Foundation Course
Language of tuition	Module is presented in English
Department	Unit for Academic Literacy
Period of presentation	Semester 2

Module content

The module aims to equip students with the ability to cope with the academic demands of scientific disciplines, with a strong focus on high order thinking skills and academic/scientific writing skills.

Academic orientation 102 (UPO 102)

Module credits	0.00

NQF Level	00
Language of tuition	Module is presented in English
Department	Natural and Agricultural Sciences Dean's Office
Period of presentation	Year

Core modules

Foundational biology 137 (BIO 137)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme
Contact time	1 practical fortnightly, 1 tutorial fortnightly, Foundation Course, 2 lectures per week
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 1

Module content

In this module, students will embark on a journey to understand the nature and scope of biology, delving into its importance in unravelling the mysteries of life. They will explore the essential characteristics of living organisms, encompassing cellular structure, metabolic processes, growth, reproduction, and adaptation. The scientific method, serving as a structured framework for inquiry, hypothesis formulation, experimentation, and evidence-based conclusion making, will be examined. The molecular basis of life, encompassing carbohydrates, lipids, proteins, and nucleic acids, and their significance in cellular structure and function will be studied. The intricate workings of cells and organelles will be introduced, along with DNA structure and replication. Furthermore, they will explore the complexities of the cell cycle, including mitosis and meiosis, and their important roles in growth, development, and genetic inheritance. Hands-on laboratory activities will include microscope operation, specimen preparation, and techniques for calculating magnification.

Foundational biology 147 (BIO 147)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme
Contact time	1 tutorial fortnightly, Foundation Course, 1 practical fortnightly, 2 lectures per week
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 2

Module content

In this module, students will explore various aspects of biology and ecology, starting with metabolic pathways like cellular respiration and photosynthesis, elucidating how cells obtain and utilize energy. They will delve into evolutionary principles such as natural selection, adaptation, and speciation, and their role in shaping the diversity of life. The concept of taxonomy will be introduced, clarifying its role in categorizing organisms based on shared characteristics. Additionally, students will explore the tree of life as a visual representation of the evolutionary lineage of all living beings. Ecological concepts such as trophic levels, biodiversity hotspots, and ecosystem services will be discussed to emphasize their critical role in sustaining life on Earth. The module will also showcase Africa's remarkable biodiversity, ranging from its megafauna to its diverse array of plant and microbial life. Students will delve into conservation ecology within the context of Africa, analyzing strategies aimed at preserving biodiversity, addressing human-wildlife conflicts, and fostering sustainable development practices. Lastly, the module will address global challenges such as food security and climate change, examining their profound implications for humanity's future.

Foundational chemistry 137 (CMY 137)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme
Contact time	2 lectures per week, 1 tutorial fortnightly, Foundation Course, 1 practical fortnightly
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 1

Module content

The first semester of foundational chemistry will introduce scientific communication to students in terms of the language of chemistry and necessary mathematical skills. The semester will begin with an in-depth study of dimensional analysis which paves the way for mole concept calculations and complex stoichiometry. Chemical reactions, including equations, types of reactions and redox reactions will round off the first semester of study.

Foundational chemistry 147 (CMY 147)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	2 lectures per week, Foundation Course, 1 tutorial fortnightly, 1 practical fortnightly
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 2

Module content
The second semester of foundational chemistry will begin with naming, bonding and molecular geometries. Molecular geometry will form the basis for intermolecular forces, phases of matter and different domains of thinking within the chemistry discipline. Thinking on the macroscopic, submicroscopic and representational domains is essential for future scientists. Embedded throughout the course will be a systems thinking approach to chemistry, seeing chemistry as an integral part of a global whole.

Foundational physics 137 (PHY 137)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	2 lectures per week, 1 practical fortnightly, 1 tutorial fortnightly, Foundation Course
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 1

Module content
This module introduces the fundamental principles and tools of physics. Students will gain mastery in measurement techniques, data analysis through graphical representations, and dimensional analysis to identify hidden relationships. Subsequently, the module focuses on one-dimensional kinematics, emphasizing the concepts of position, velocity, and acceleration. Further exploration delves into longitudinal and transverse waves, investigating their properties and propagation mechanisms. The module then introduces physical optics, exploring the behaviour of light through lenses and the formation of images. Finally, the foundations of thermodynamics are established, focusing on the concepts of heat, temperature, and heat capacity.

Foundational physics 147 (PHY 147)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	1 tutorial fortnightly, 2 lectures per week, Foundation Course, 1 practical fortnightly
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 2

Module content

Building upon the previous semester, vector algebra will be introduced, including notation, addition, coordinate systems, and manipulation of magnitudes and angles. Kinematics expands to two- and three-dimensional motion, providing a comprehensive understanding of real-world scenarios. The core of the module focuses on mechanics, analysing the interplay of forces, inertia, and motion governed by Newton's laws. Concepts of momentum, impulse, and conservation laws are introduced. Further exploration investigates equilibrium of forces, friction, and the dynamics of circular motion. These concepts lead to energy principles including work, kinetic energy, the work-energy theorem and power, potential energy, conservative and non-conservative forces and collisions. The module concludes with an introduction to direct current circuits, exploring the flow of current in resistor-based circuits.

Foundational statistics 137 (STC 137)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	2 lectures per week, 1 tutorial per week, Foundation Course
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Data literacy in modern society: fundamental understanding of data and its presentation. Data ethics, importing, cleaning, manipulation and handling. Sources and types of data. Sampling methods and the collection of data. Statistical concepts are demonstrated and interpreted through Excel (practical coding) and simulation within a data science framework.

Foundational statistics 147 (STC 147)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	1 tutorial per week, Foundation Course, 2 lectures per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Exploratory data analysis: tabulation, data visualisation and descriptive measures of location and dispersion. Introduction to probability and counting techniques. Aims of data analysis: descriptive, inferential and predictive. Statistical concepts are demonstrated and interpreted through Excel (practical coding) and simulation within a data science framework.

Foundational mathematics 137 (WTW 137)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	2 lectures per week, Foundation Course, 1 tutorial per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

This module serves as an introduction to algebra, functions, sequences, and trigonometry, and it aims to deepen students' conceptual understanding of real numbers, elementary set notation, exponents, radicals, algebraic expressions, fractional expressions, linear and quadratic equations, and inequalities. Coordinate geometry: lines, and circles are discussed. Functions are presented numerically, symbolically, graphically, and verbally, focusing on the definition, notation, piecewise-defined functions, domain and range, graphs, transformations of functions, symmetry, even and odd functions, combining functions, one-to-one functions and inverses, polynomial functions and zeros. Trigonometry: the relationship between degrees and radians measure is discussed, as well as the unit circle, trigonometric functions, fundamental identities, trigonometric graphs, trigonometric identities, double-angle, half-angle formulae, trigonometric equations, and applications.

Foundational mathematics 147 (WTW 147)

Module credits	8.00
NQF Level	05
Prerequisites	Admission to relevant programme.
Contact time	1 tutorial per week, Foundation Course, 2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

The second-semester mathematics module focuses on the mathematical order of numbers and applications: Arithmetic and geometric sequences and series, summation notation, infinite geometric series, compound interest, annuities and instalments, exponential and logarithmic equations, followed by the laws of logarithms. Furthermore, one-to-one functions are extended to exponential and logarithmic functions. An introduction to calculus focusing on finding limits numerically and graphically, finding limits algebraically, techniques for evaluating limits, and differentiation rules.

Curriculum: Year 2

Minimum credits: 122

Core = 90
Elective = 32

Additional information:
Students are advised to choose elective modules based on the requirements for a second major of interest. It is the student's responsibility to ensure that all prerequisites are taken into account. Electives must be chosen according to the combinations below with a view to pursuing specialisation in the relevant field. Students continue with the electives pertaining to the specific second major chosen, through to the third and fourth years of study.

- **Applied mathematics as second major**: WST 111, WTW 123, WTW 162 (32 credits)
- **Geography and environmental science as second major**: GGY 156, GGY 166, ENV 101 and one of [ZEN 161, WTW 123] (32 credits)
- **Geoinformatics as second major**: INF 154, INF 112, INF 164, WTW 123 (38 credits)
- **Statistics as second major**: STK 110, STC 122, WTW 123 (34 credits)
- **Zoology as second major**: ZEN 161, BOT 161, MLB 111 (32 credits)

Core modules

Biometry 120 (BME 120)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences Faculty of Veterinary Science
Prerequisites	At least 4 (50-59%) in Mathematics in the Grade 12 examination, or at least 50% in both Statistics 113, 123
Contact time	4 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Simple statistical analysis: Data collection and analysis: Samples, tabulation, graphical representation, describing location, spread and skewness. Introductory probability and distribution theory. Sampling distributions and the central limit theorem. Statistical inference: Basic principles, estimation and testing in the one- and two-sample cases (parametric and non-parametric). Introduction to experimental design. One- and twoway designs, randomised blocks. Multiple statistical analysis: Bivariate data sets: Curve fitting (linear and non-linear), growth curves. Statistical inference in the simple regression case. Categorical analysis: Testing goodness of fit and contingency tables. Multiple regression and correlation: Fitting and testing of models. Residual analysis. Computer literacy: Use of computer packages in data analysis and report writing.

Cartography 110 (GMC 110)

Module credits	10.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	No prerequisites.
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

History, present and future of cartography. Introductory geodesy: shape of the earth, graticule and grids, datum definition, elementary map projection theory, spherical calculations. Representation of geographical data on maps: Cartographic design, cartographic abstraction, levels of measurement and visual variables. Semiotics for cartography: signs, sign systems, map semantics and syntactics, explicit and implicit meaning of maps (map pragmatics). Critique maps of indicators to measure United Nations Sustainable Development Goals in South Africa.

First course in physics 114 (PHY 114)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	A candidate must have passed Mathematics and Physical Science with at least 60% in the Grade 12 examination
Contact time	1 practical per week, 1 discussion class per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	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.

Atmospheric structure and processes 155 (WKD 155)

Module credits	16.00
NQF Level	05
Prerequisites	At least 50% for mathematics in grade 12.
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Introduction to weather and climate. Climate of South Africa. Urban and rural climate. Meteorological instruments. Motion of the earth. Atmospheric mass and pressure. Energy and heat budget. Moisture in the atmosphere. Cloud development. Climate change. ENSO. Electromagnetic spectrum and remote sensing in meteorology. Synoptic weather systems of South Africa.

Calculus 114 (WTW 114)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
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 serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 218 and WTW 220). Students will not be credited for more than one of the following modules for their degree: WTW 114, WTW 158, WTW 134, WTW 165.
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. Definite and indefinite integrals, evaluating definite integrals using anti-derivatives, the substitution rule.

Mathematics 124 (WTW 124)

Module credits	16.00
NQF Level	05

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114
Contact time	4 lectures per week, 1 tutorial per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

*Students will not be credited for more than one of the following modules for their degree:
WTW 124, WTW 146, WTW 148 and WTW 164. This module serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 218, WTW 211 and WTW 220).

The vector space Rn, vector algebra with applications to lines and planes, matrix algebra, systems of linear equations, determinants. Complex numbers and factorisation of polynomials. Integration techniques and applications of integration. The formal definition of a limit. The fundamental theorem of Calculus and applications. Vector functions and quadratic curves.

Elective modules

Plants and society 161 (BOT 161)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	MLB 111 GS
Contact time	2 lectures per week, fortnightly practicals
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 2

Module content

Botanical principles of structure and function; diversity of plants; introductory plant systematics and evolution; role of plants in agriculture and food security; principles and applications of plant biotechnology; economical and valuable medicinal products derived from plants; basic principles of plant ecology and their application in conservation and biodiversity management.
This content aligns with the United Nation's Sustainable Debelopment Goals of No Poverty, Good Health and Well-being, Climate Action, Responsible Consumption and Production, and Life on Land.

General chemistry 117 (CMY 117)

Module credits	16.00

NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Health Sciences Faculty of Veterinary Science
Prerequisites	A candidate must have Mathematics for at least 60% and 60% for Physical Sciences.
Contact time	4 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 1

Module content

General introduction to inorganic, analytical and physical chemistry. Atomic structure and periodicity. Molecular structure and chemical bonding using the VSEPR-model. Nomenclature of inorganic 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
NQF Level	05
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	Module is presented in English
Department	Chemistry
Period of presentation	Semester 2

Module content

Theory: General physical-analytical chemistry: Chemical equilibrium, acids and bases, buffers, solubility equilibrium, 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 aminoacids. Practical: Molecular structure (model building), synthesis and properties of simple organic compounds.

Introduction to environmental sciences 101 (ENV 101)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities
Prerequisites	Max 600 students.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Introducing the basic concepts and interrelationships required to understand the complexity of natural environmental problems, covering an introduction to environmental science and biogeography; including a first introduction to SDGs and Aichi targets.

Aspects of human geography 156 (GGY 156)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Health Sciences
Prerequisites	Max 600 students.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

This module begins by fostering an understanding of human geography. Then follows with the political ordering of space; cultural diversity as well as ethnic geography globally and locally; population geography of the world and South Africa: and four economic levels of development. The purpose is to place South Africa in a world setting and to understand the future of the country.

Southern African geomorphology 166 (GGY 166)

Module credits	8.00
NQF Level	05

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Health Sciences
Prerequisites	A candidate must have passed Mathematics and Physical Science with at least 60% in the Grade 12 examination OR a candidate must have passed PHY 143 and WTW 143. Max 600 students.
Contact time	3 lectures per week, 1 tutorial per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

Note: Students cannot register for both GGY 166 and GGY 168.

Investigating southern African landscapes and placing them in a theoretical and global context. The geomorphological evolution of southern Africa. Introduction to the concepts of Geomorphology and its relationships with other physical sciences (e.g. meteorology, climatology, geology, hydrology and biology). The processes and controls of landform and landscape evolution. Tutorial exercises cover basic techniques of geomorphological analysis, and topical issues in Geomorphology.

Introduction to geology 155 (GLY 155)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	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	Module is presented in English
Department	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. Interaction between man and the environment, and nature of anthropogenic climate change.

Earth history 163 (GLY 163)

Module credits	16.00

NQF Level	05
Prerequisites	GLY 155
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Geology
Period of presentation	Semester 2

Module content

This module will give an overview of earth history, from the Archaean to the present. Important concepts such as the principles of stratigraphy and stratigraphic nomenclature, geological dating and international and South African time scales will be introduced. A brief introduction to the principles of palaeontology will be given, along with short descriptions of major fossil groups, fossil forms, ecology and geological meaning. In the South African context, the major stratigraphic units, intrusions and tectonic/metamorphic events will be detailed, along with related rock types, fossil contents, genesis and economic commodities. Anthropogenic effects on the environment and their mitigation. Practical work will focus on the interpretation of geological maps and profiles.

Informatics 112 (INF 112)

Module credits	10.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	A candidate must have passed Mathematics with at least 4 (50-59%) in the Grade 12 examination; or STK 113 60%, STK 123 60% or STK 110
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Semester 2

Module content

Introduction to information systems, information systems in organisations, hardware: input, processing, output, software: systems and application software, organisation of data and information, telecommunications and networks, the Internet and Intranet. Transaction processing systems, management information systems, decision support systems, information systems in business and society, systems analysis, systems design, implementation, maintenance and revision.

Informatics 154 (INF 154)

Module credits	10.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences

Prerequisites	A candidate must have passed Mathematics with at least 5 (60-69%) in the Grade 12 examination.
Contact time	1 lecture per week, 2 practicals per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Semester 1

Module content

Introduction to programming.

Informatics 164 (INF 164)

Module credits	10.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	INF 154
Contact time	2 practicals per week, 1 lecture per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Semester 2

Module content

Programming.

Molecular and cell biology 111 (MLB 111)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Health Sciences Faculty of Veterinary Science
Prerequisites	A candidate who has passed Mathematics with at least 60% in the Grade 12 examination
Contact time	4 lectures per week, 1 practical/tutorial per week
Language of tuition	Module is presented in English
Department	Biochemistry, Genetics and Microbiology
Period of presentation	Semester 1

Module content

Introduction to the molecular structure and function of the cell. Basic chemistry of the cell. Structure and composition of prokaryotic and eukaryotic cells. Ultrastructure and function of cellular organelles, membranes and the cytoskeleton. General principles of energy, enzymes and cell metabolism. Selected processes, e.g. glycolysis, respiration and/or photosynthesis. Introduction to molecular genetics: DNA structure and replication, transcription, translation. Cell growth and cell division.

First course in physics 124 (PHY 124)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	(WTW 114 GS or WTW 158 GS or WTW 134) and PHY 114 GS
Contact time	1 practical per week, 1 discussion class per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 2

Module content

Simple harmonic motion and pendulums. Coulomb’s law. Electric field: dipoles, Gauss’ law.Electric potential. Capacitance. Electric currents: resistance, resistivity, Ohm’s law, energy, power, emf, RC-circuits. Magnetic Field: Hall-effect, Bio-Savart. Faraday’s and Lenz’s laws. Oscillations: LR-circuits. Alternating current: RLC-circuits, power, transformers. Introductory concepts to modern physics. Nuclear physics: Radioactivity.

Exploring the universe 154 (SCI 154)

Module credits	16.00
NQF Level	05
Prerequisites	Prohibited combination SCI 164
Contact time	4 lectures per week
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 1

Module content

Students from all faculties are welcome to join us in our exploration of the universe from an earth-bound perspective. We reflect on the whole universe from the sub microscopic to the vast macroscopic and mankind's modest position therein. To what degree is our happiness determined by stars? Echoes from ancient firmaments - the astronomy of old civilisations. The universe is born with a bang. Stars, milky ways and planets are formed. Life is breathed into the landscape on earth, but is there life elsewhere? The architecture of the universe – distance measurements, structure of our solar system and systems of stars. How does it look like on neighbouring planets? Comets and meteorites. Life cycles of stars. Spectacular exploding stars! Exotica like pulsars and black holes.

Statistics 122 (STC 122)

Module credits	13.00
NQF Level	05
Prerequisites	Minimum final mark of 60% in STK110/STK120/STK121/STC121. Average of modules equivalent to STK110 may not be a prerequisite. If minimum final mark of 60% not obtained in STK110,minimum final mark of 60% should be obtained in STK120/STK121/STC121.
Contact time	1 tutorial per week, 1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Introduction to data and exploratory data analysis: Graphical representations and descriptive measures for numerical and categorical data; relationships between explanatory and response variables; data transformations. Foundations of inference: Simulation; sampling with and without replacement; confidence intervals with bootstrapping; hypothesis testing with randomization; inference with mathematical models (normal distribution and central limit theorem). Statistical inference: Inference for a single proportion, for comparing two proportions, for two-way tables, for a single mean, for comparing two independent means, for comparing paired means, and for comparing many means. Regression and inferential modelling: Correlation; simple linear regression models with numerical or categorical predictors; least squares regression; residual analysis; goodness-of-fit; outliers; prediction and extrapolation; inference. All module content is demonstrated and interpreted through practical coding and simulation within a data science framework.
This module is also presented as a summer school for students who initially elected and passed STK 120 or STK 121 or STC 121 with a final mark of at least 60% and then decide to further their studies in Statistics as well as for students who failed STC 122 during semester 2.

Statistics 110 (STK 110)

Module credits	13.00
NQF Level	05

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	At least 5 (60-69%) in Mathematics in the Grade 12 examination. Candidates who do not qualify for STK 110 must register for STK 113 and STK 123
Contact time	3 lectures per week, 1 practical per week, 1 tutorial per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

PART A: Mathematical concepts for the business student: Statistical applications of quantitative techniques. Systems of linear equations: solving and application. Differentiation: Rules and application using the rules. Optimisation, linear functions, non-linear functions, Integration: Rules and application using the rules, Marginal and total functions, Stochastic and
deterministic variables in a statistical and practical context: producers' and consumers' surplus. Linear programming. Matrix algebra. Limits and continuity.

PART B: Descriptive statistics: Sampling and the collection of data; frequency distributions and graphical representations. Descriptive measures of location and dispersion. Probability. Introductory probability theory and theoretical distributions. Statistical and mathematical concepts are demonstrated and interpreted through Excel (practical coding) and simulation within a data science framework.

Exam entrance requires a subminimum of 40% in both Part A and Part B. To pass the module a student has to pass both Part A and Part B.

Mathematical statistics 111 (WST 111)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	At least 5 (60-69%) in Mathematics in the Grade 12 examination
Contact time	4 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Aims of data analysis (descriptive, inferential and predictive). Stages of conducting a data analysis. Sources and types of data. Reproducible research. Characterisation of a set of measurements: Graphical and numerical methods. Random sampling. Probability theory. Discrete and continuous random variables. Probability distributions. Generating functions and moments.

Mathematical statistics 121 (WST 121)

Module credits	16.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 111 or WST 133, 143 and 153
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Sampling distributions and the central limit theorem. Statistical inference: Point and interval estimation. Hypothesis testing with applications in one and two-sample cases. Introductory methods for: Linear regression and correlation, analysis of variance, categorical data analysis and non-parametric statistics. Identification, use, evaluation and interpretation of statistical computer packages and statistical techniques.

Numerical analysis 123 (WTW 123)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 114
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

Non-linear equations, numerical integration, initial value problems for differential equations, systems of linear equations. Algorithms for elementary numerical techniques are derived and implemented in computer programmes. Error estimates and convergence results are treated.

Dynamical processes 162 (WTW 162)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 114
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

*Students will not be credited for more than one of the following modules for their degree: WTW 162 and WTW 264.

Introduction to the modelling of dynamical processes using elementary differential equations. Solution methods for first order differential equations and analysis of properties of solutions (graphs). Applications to real life situations.

Animal diversity 161 (ZEN 161)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Education Faculty of Veterinary Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week, fortnightly practicals
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 2

Module content

Animal classification, phylogeny organisation and terminology. Evolution of the various animal phyla, morphological characteristics and life cycles of parasitic and non-parasitic animals. Structure and function of reproductive,
respiratory, excretory, circulatory and digestive systems in various animal phyla. In-class discussion will address the sustainable development goals #3, 12, 13, 14 and 15 (Good Health and Well-being. Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land).

Curriculum: Year 3

Minimum credits: 128

Core = 90
Elective = 32

Additional information:
Students are advised to choose elective modules based on the requirements for a second major of interest. It is the student's responsibility to ensure that all prerequisites are taken into account. Electives must be chosen according to the combinations below with a view to pursuing specialisation in the relevant field. Students continue with the electives pertaining to the specific second major chosen, through to the third and fourth years of study.

- **Applied mathematics as second major**: WST 111, WTW 123, WTW 162 (32 credits)
- **Geography and environmental science as second major**: GGY 156, GGY 166, ENV 101 and one of [ZEN 161, WTW 123] (32 credits)
- **Geoinformatics as second major**: INF 154, INF 112, INF 164, WTW 123 (38 credits)
- **Statistics as second major**: STK 110, STC 122, WTW 123 (34 credits)
- **Zoology as second major**: ZEN 161, BOT 161, MLB 111 (32 credits)

Core modules

Environmental sciences 201 (ENV 201)

Module credits	14.00
NQF Level	06
Prerequisites	ENV 101 or WKD 155 or BOT 161 or ZEN 161.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Introduces basic concepts and interrelationships required to understand our atmosphere, with a strong focus on an introduction to weather and climate. A key component of the course is an introduction to climate change, including the science of climate change, introducing climate change projections, and climate change impacts. A key focus of the second part of the course will be climate change implications for the attainment of SDGs and Aichi targets on the African continent, under a range of plausible scenarios.

Remote sensing 220 (GMA 220)

Module credits	14.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	GMC 110

Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

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, practical exercises research tasks and a project or assignments of at least 64 notional hours. In particular, the practical exercises and research tasks incorporate South African examples using satellite remotely-sensed data, as well as field spectral data measurements, to promote understanding of the state of land cover and land use types (e.g. spanning agricultural resources, water resources, urbanization) and how changes over time could impact on the changing climate in accordance with the United Nation’s Sustainable Development Goals.

Programming in meteorology 254 (WKD 254)

Module credits	12.00
NQF Level	06
Prerequisites	WKD 155 and WKD 263.
Contact time	1 practical per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

Meteorological data acquisition. Manipulation of multidimensional meteorological data sets. Spatial representation and interpretation of weather data. Application and interpretation of dynamic equations.

Physical meteorology 261 (WKD 261)

Module credits	12.00
NQF Level	06
Prerequisites	(WTW 114 or WTW 158 or WTW 134 or WTW 165) and (WKD 155 or ENV 201)
Contact time	1 tutorial every 2nd week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

Basic thermodynamic laws for dry and humid air. The equation of state. Adiabatic processes and temperature lapse rates. The Clausius-Clapeyron equation. Cloud microphysics. The physical basis of climate change. Practical application and Areological diagrams.

Introduction to dynamic meteorology 263 (WKD 263)

Module credits	14.00
NQF Level	06
Prerequisites	WTW 124
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Mathematical methods for meteorology, second law of motion in 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.

Satellite meteorology 265 (WKD 265)

Module credits	12.00
NQF Level	06
Prerequisites	GMA 220, WKD 155 or ENV 201
Contact time	1 tutorial every 2nd week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

Display formats of remote sensed data, projections and color schemes. Common channels available from meteorological satellite sensors, including visible, near infra-red, water vapour and infra-red. Channel combination, channel differencing and RGB images. Image selection for observation of synoptic and mesoscale weather systems, natural hazards and clouds.

Elective modules

South African flora and vegetation 251 (BOT 251)

Module credits	12.00

NQF Level	06
Service modules	Faculty of Education
Prerequisites	BOT 161
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 1

Module content

Origin and affinity of South African flora and vegetation types; principles of plant geography; plant diversity in southern Africa; characteristics, environments and vegetation of South African biomes and associated key ecological processes; centra of plant endemism; rare and threatened plant species; biodiversity conservation and ecosystem management; invasion biology; conservation status of South African vegetation types.

City, structure, environment and society 201 (GGY 201)

Module credits	14.00
NQF Level	06
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	GGY 156
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

The module introduces students to urban settlement patterns, processes and structures. Using a series of case studies, it aims to develop an understanding of the challenges facing urban areas both in South Africa and globally.

Process geomorphology 252 (GGY 252)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	GGY 166 or GLY 155
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology

Period of presentation	Semester 1

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 periglacial processes. Practical laboratory exercises and assignments are based on the themes covered in the module theory component.

Introductory geographic information systems 283 (GGY 283)

Module credits	14.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities
Prerequisites	GMC 110
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

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. This module provides the foundations for more advanced GIS and Geoinformatics topics. Practical assessments and a mini-project make use of South African and African examples and foster learning and application of concepts aligned to the UN Sustainable Development Goals.

Geographic data analysis 220 (GIS 220)

Module credits	14.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	GMC 110 and (STK 110 OR BME 120)
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

The nature of geographical data and measurement.Application of statistics in the geographical domain. 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. Examples used throughout the course are drawn from South African and African case studies and taught within the framework of the UN Sustainable Development Goals.

Introductory soil science 250 (GKD 250)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	CMY 117 GS
Contact time	3 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 1

Module content

Soil is a finite resource and with the global challenges we are facing, it is more important than ever to understand and sustainably manage soil. Our daily lives are impacted by soil in several ways, including the food we eat, the water we drink, and the environment we live in. In this Introductory Soils module, we will look at how basic and more advanced abiotic and biotic soil properties impact us and the larger environment. We will also examine the fundamental principles behind sustainable soil use management.

Informatics 214 (INF 214)

Module credits	14.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	A candidate must have passed Mathematics with at least 5 (60-69%) in the Grade 12 examination; AIM 101 or AIM 111 and AIM 121.
Contact time	2 lectures per week, 2 practicals per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Semester 1

Module content

Database design: the relational model, structured query language (SQL), entity relationship modelling, normalisation, database development life cycle; practical introduction to database design. Databases: advanced entity relationship modelling and normalisation, object-oriented databases, database development life cycle, advanced practical database design.

Informatics 225 (INF 225)

Module credits	14.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	A candidate must have passed Mathematics with at least 5 (60-69%) in the Grade 12 examination, INF 112, AIM 111 and AIM 121
Contact time	3 practicals per week, 1 lecture per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Semester 2

Module content

An overview of systems infrastructure and integration.

Informatics 261 (INF 261)

Module credits	7.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Natural and Agricultural Sciences
Prerequisites	INF 214
Contact time	1 practical per week, 1 lecture per week
Language of tuition	Module is presented in English
Department	Informatics
Period of presentation	Semester 2

Module content

Database management: transaction management, concurrent processes, recovery, database administration: new developments: distributed databases, client-server databases: practical implementation of databases.

Waves, thermodynamics and modern physics 255 (PHY 255)

Module credits	24.00
NQF Level	06

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

Module content

Vibrating systems and waves
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
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
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 (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 (practical sessions)
Experimental uncertainties. Propagation of uncertainties. Statistical analysis of random uncertainties. Normal distribution. Rejection of data. Least-squares fitting. Covariance and correlation.

General physics 263 (PHY 263)

Module credits	24.00
NQF Level	06
Service modules	Faculty of Education
Prerequisites	PHY 255 GS and WTW 218 GS and WTW 220# and WTW 248#
Contact time	4 lectures per week, 2 discussion classes per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 2

Module content

Classical mechanics
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
Maxwell’s equations, wave equation and plane wave solution, coherence, interference, diffraction, polarisation.
Physics of Materials
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

Introduction to crop protection 251 (PLG 251)

Module credits	12.00
NQF Level	06
Prerequisites	No prerequisites.
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 1

Module content

Development and importance of crop protection. Basic principles in crop protection i.e. epidemic development of disease and insect pest populations, ecology of plant diseases and abiotic factors that affect plant health i.e. environmental pollution and pesticides, nutrient deficiencies and extreme environmental conditions. Ecological aspects of plant diseases, pest outbreaks and weed invasion. Important agricultural pests and weeds, globally as well as in African context. Life cycles of typical disease causing organisms. Basic principles of integrated pest and disease management. The importance of crop protection in the context of sustainable development will be highlighted.

Sustainable crop production and agroclimatology 251 (PPK 251)

Module credits	15.00
NQF Level	06
Prerequisites	BOT 161
Contact time	3 lectures per week, fortnightly practicals
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 2

Module content
Influence of climate on cropping systems in South Africa. The surface energy balance. Hydrological cycles and the soil water balance. Sustainable crop production. Simple radiation and water limited models. Potential yield, target yield and maximum economic yield. Crop nutrition and fertiliser management. Principles of soil cultivation and conservation. Climate change and crop production – mitigation and adaptation.

Statistics 210 (STK 210)

Module credits	20.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	STK 110, STC 122 or WST 111, WST 121
Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Statistical problem solving. Causality, experimental and observational data. Probability theory. Multivariate random variables. Discrete and continuous probability distributions. Stochastic representations. Measures of association. Expected values and conditional expectation. Simulation techniques. Supporting mathematical concepts. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

Statistics 220 (STK 220)

Module credits	20.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	STK 210
Contact time	3 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Multivariate probability distributions. Sampling distributions and the central limit theorem. Frequentist and Bayesian inference. Statistical learning and decision theory. Simulation techniques enhancing statistical thinking. Supervised learning: linear regression, estimation and inference. Non-parametric modelling. Supporting mathematical concepts. Statistical algorithms. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

Surveying 220 (SUR 220)

Module credits	14.00
NQF Level	06
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	Module is presented in English
Department	Geography Geoinformatics and Meteorology
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.

Mathematical statistics 211 (WST 211)

Module credits	24.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 111, WST 121, WTW 114 GS and WTW 124 GS
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Set theory. Probability measure functions. Random variables. Distribution functions. Probability mass functions. Density functions. Expected values. Moments. Moment generating functions. Special probability distributions: Bernoulli, binomial, hypergeometric, geometric, negative binomial, Poisson, Poisson process, discrete uniform, uniform, gamma, exponential, Weibull, Pareto, normal. Joint distributions: Multinomial, extended hypergeometric, joint continuous distributions. Marginal distributions. Independent random variables. Conditional distributions. Covariance, correlation. Conditional expected values. Transformation of random variables: Convolution formula. Order statistics. Stochastic convergence: Convergence in distribution. Central limit theorem. Sources and types of data and characteristics of extremely large or complex data sets. Practical applications. Practical statistical modelling and analysis using statistical computer packages and the interpretation of the output.

Applications in data science 212 (WST 212)

Module credits	12.00
NQF Level	06
Prerequisites	WST 111, WST 121 or STK 110, STC 122
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Introduction to Databases. Database design and use. Data preparation and extraction: basic SQL queries, SQL joins and subqueries. Statistical modelling using database structures. Aims of data analysis (descriptive, inferential and predictive). Stages of conducting a data analysis to solve real-world problems. Sources and types of data and characteristics of extremely large or complex data sets. Introductory machine learning concepts: bias/variance trade-off, model complexity, cross-validation, regularisation, overfitting/underfitting, precision, recall, F1 score, ROC curve and confusion matrix. Data visualisation, data wrangling, supervised learning (linear, local and logistic regression) and unsupervised learning (k-means clustering). Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

Mathematical statistics 221 (WST 221)

Module credits	24.00
NQF Level	06
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Stochastic convergence: Asymptotic normal distributions, convergence in probability. Statistics and sampling distributions: Chi-squared distribution. Distribution of the sample mean and sample variance for random samples from a normal population. T-distribution. F-distribution. Beta distribution. Point estimation: Method of moments. Maximum likelihood estimation. Unbiased estimators. Uniform minimum variance unbiased estimators. Cramer-Rao inequality. Efficiency. Consistency. Asymptotic relative efficiency.
Bayes estimators. Sufficient statistics. Completeness. The exponential class. Confidence intervals. Test of statistical hypotheses. Reliability and survival distributions. Aims of data analysis (descriptive, inferential and predictive). Stages of conducting a data analysis. Reproducible research. Practical applications. Practical statistical modelling and analysis using statistical computer packages and the interpretation of the output.

Linear algebra 211 (WTW 211)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 124
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
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
NQF Level	06
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	Module is presented in English
Department	Mathematics and Applied Mathematics
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
NQF Level	06
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, WTW 211 and WTW 218
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

*This module is recommended as an elective only for students who intend to enrol for WTW 310 and/or WTW 320. Students will not be credited for more than one of the following modules for their degree: WTW 220 and WTW 224.

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.

Vector analysis 248 (WTW 248)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	WTW 218
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

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.

Differential equations 264 (WTW 264)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
Prerequisites	WTW 114, WTW 124, and WTW 211
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

*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.

Differential equations 286 (WTW 286)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
Prerequisites	WTW 114, WTW 124, WTW 162, WTW 211#
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

*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.

Invertebrate biology 251 (ZEN 251)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Education
Prerequisites	ZEN 161 GS

Contact time	2 lectures per week, 1 practical every 2nd week
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 1

Module content

Origin and extent of modern invertebrate diversity; parasites of man and domestic animals; biology and medical importance of arachnids and insects; insect life styles; the influence of the environment on insect life histories; insect herbivory; predation and parasitism; insect chemical, visual, and auditory communication. Examples used in the module are relevant to the sustainable development goals of Life on Land and Good Health and Well-being.

African vertebrates 261 (ZEN 261)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Education
Prerequisites	ZEN 161 GS
Contact time	2 lectures per week, 1 practical every 2nd week
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 2

Module content

Introduction to general vertebrate diversity; African vertebrate diversity; vertebrate structure and function; vertebrate evolution; vertebrate relationships; aquatic vertebrates; terrestrial ectotherms; terrestrial endotherms; vertebrate characteristics; classification; structural adaptations; habits; habitats; conservation problems; impact of humans on other vertebrates. The module addresses the sustainable development goals of Life below Water and Life on Land.

Curriculum: Final year

Minimum credits: 144

Core = 72
Elective = 72

Additional information:
Students must continue with electives pertaining to the second major chosen in the previous years of study.

- **Applied mathematics as second major**: WTW 382, WTW 383, WTW 386 and WTW 387 (72 credits)
- **Geography and environmental science as second major**: ENV 301, GGY 301, GGY 361 and GIS 310 (76 credits)
- **Geoinformatics as second major**: GMA 320, GIS 310, GIS 311, GMC 310 (88 credits). Students who are accepted for BScHons Geoinformatics will have to complete GIS 320 in addition to the other honours modules
- **Statistics as second major**: STK 310, STK 320 and STK 353 (75 credits)
- **Zoology as second major**: ZEN 351, ZEN 352, ZEN 353, ZEN 354 (72 credits)

Core modules

Mid-latitude and polar meteorology 315 (WKD 315)

Module credits	18.00
NQF Level	07
Prerequisites	WKD 261 and WKD 265
Contact time	2 lectures per week, 1 tutorial every 2nd week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Mean state, major patterns of atmospheric variability in the mid-latitudes and polar regions. Air masses. Synoptic scale cold, warm, occluded and quasistationary fronts, frontogenesis. Mid-latitude depressions, Norwegian cyclone model, conveyor belts. Basic cyclone model, Shapiro-Keyser model hybrid models, cyclogenesis. Polar weather systems; katabatic winds, barrier winds, cold-air damming, polar lows. Jet stream and jet streaks. Extreme weather and impacts. Conceptual models.

Tropical meteorology 316 (WKD 316)

Module credits	18.00
NQF Level	07
Prerequisites	WKD 261 and WKD 265
Contact time	1 tutorial every 2nd week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology

Period of presentation	Semester 1

Module content

Mean state, major patterns of atmospheric variability in the tropics. Tropical weather systems and their temporal variability, inter tropical convergence zone, tropical waves, trade inversions, trade winds, tropical and sub-tropical jet streams, cloud clusters, tropical depressions, Africánes, sub-tropical ridges, upper-level anticyclones. Tropical cyclones and warnings. Analysis techniques. Tropical waves, Kelvin waves, equatorial Rossby waves and Madden Julian Oscillation. Physical and dynamical process in monsoon circulation. Hazardous weather. Conceptual models and case studies.

Elective modules

Human environmental interactions 301 (ENV 301)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education Faculty of Humanities
Prerequisites	ENV 201
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

The module serves as an introduction to human-environment relations, on contemporary environmental issues in Africa.
The module begins with different theories and schools of thought in human-environment relations, followed by 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. A key focus here is future scenarios for the African continent in terms of SDGs and Aichi targets; given current and projected driving forces.

Theories and applications of human geography 301 (GGY 301)

Module credits	18.00
NQF Level	07
Prerequisites	GGY 201
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

Module content

Classic economic development theories and frameworks. Spatial development history and legacy in South Africa. Rural and agricultural reconstruction. Land reform. Urban development and strategy. Urban spatial reconstruction. National spatial development frameworks. Integration of environmental, economic, and social components of sustainable development, including challenges, actors and actions in sustainable development.

Environmental geomorphology 361 (GGY 361)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Humanities
Prerequisites	GGY 252 and only for students studying BSc (Geography) or BSc (Environmental Sciences).
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 2

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.

Geographic information systems 310 (GIS 310)

Module credits	22.00
NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	GGY 283
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Advanced theory and practice of Geographic Information Systems; GIS applications; design and implementation of GIS applications. A project or assignments of at least 64 notional hours. Diverse South African examples will be used to expose the students to various data sources, geospatial analyses, and data representation to support the UN Sustainable Development Goals.

Geoinformatics 311 (GIS 311)

Module credits	22.00
NQF Level	07
Prerequisites	(GGY 283 and INF 164 and INF 261) or (GGY 283 and WKD 254) For BSc (Geoinformatics) and BSc (Meteorology) students only.
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
Period of presentation	Semester 1

Module content

Advanced geoinformatics topics in geovisualisation and geocomputation. A project or assignments of at least 64 notional hours. The topics will be discussed using various local and international examples with the project focusing on at least one of the UN Sustainable Development Goals.

Soil chemistry 320 (GKD 320)

Module credits	14.00
NQF Level	07
Prerequisites	GKD 250
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
Period of presentation	Semester 2

Module content

Soil chemistry is the study of the chemical behaviour (precipitation, dissolution, sorption, oxidation, reduction, volatilization etc.) of elements and compounds in the soil. Soil exerts a control on nutrient availability and therefore on nutrient cycling (for example the soil-plant system). The growing anthropogenic pressure on soil and the larger environment means a fundamental understanding of the behaviour of pollutants is an increasingly important skill set required by industry. In this module we will look at the soil solution chemistry, mineral solubility, redox chemistry, as well as the chemistry at the surface of soil minerals, of a wide range of nutrients and pollutants. Soil acidification, weathering and associated chemicalmineralogical transformation, as well as landscape dynamics of carbon, iron and manganese receive special attention in this module.

Remote sensing 320 (GMA 320)

Module credits	22.00
NQF Level	07
Prerequisites	GMA 220
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
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, practical exercises research tasks and a project or assignments of at least 64 notional hours. In particular, the practical exercises and research tasks incorporate South African examples using satellite remotely-sensed data, as well as field spectral data measurements, to promote understanding of the state of land cover and land use types (e.g. spanning agricultural resources, water resources, urbanization) and how changes over time could impact on the changing climate in accordance with the United Nation’s Sustainable Development Goals.

Geometrical and space geodesy 310 (GMC 310)

Module credits	22.00
NQF Level	07
Prerequisites	GMC 110 and WTW 114/WTW 134
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Geography Geoinformatics and Meteorology
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. A project or assignments of at least 64 notional hours. Examples using data from South Africa are implemented.

Electronics, electromagnetism and quantum mechanics 356 (PHY 356)

Module credits	36.00
NQF Level	07

Service modules	Faculty of Education
Prerequisites	PHY 255 GS and PHY 263 GS and WTW 211 GS and WTW 218 GS and WTW 248 GS
Contact time	4 lectures per week, 2 discussion classes per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 1

Module content

Electronics
Thévenin and Norton equivalent circuits, superposition principle, RC, LC and LRC circuits. Semiconductor diode. Bipolar transistor. Operational amplifiers. Computer controlled instrumentation.
Electromagnetism
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
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.

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

Module credits	36.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	PHY 356 and WTW 211 and WTW 218 and WTW 248 GS
Contact time	2 discussion classes per week, 2 practicals per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Physics
Period of presentation	Semester 2

Module content

Statistical mechanics
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
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.

Statistics 310 (STK 310)

Module credits	25.00
NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	STK 210, STK 220
Contact time	3 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Supervised learning. Linear and non-linear regression. Ordinary least squares and maximum likelihood estimation. Violations of the assumptions, residual analysis. Cross validation. Statistical inference. Bootstrap inference. Supporting mathematical concepts. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

Statistics 320 (STK 320)

Module credits	25.00
NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	STK 210, STK 220 or WST 211, WST 221

Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Note: Only one of the modules WST 321 or STK 320 may be included in any study programme.

Stationary and non-stationary univariate time series. Properties of ARIMA processes. Identification, estimation and diagnostic testing of a time series models. Forecasting. Multivariate time series. Supervised learning: introduction to generalised linear models. Modelling of binary response variables, logistic regression. Supporting mathematical concepts. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

The science of data analytics 353 (STK 353)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	WST 212
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Introduction to coding: data types, basic arithmetic, logical comparisons, functions, loops, conditional statements, packages. Data exploration and visualisation. Visualisation best practices. Data wrangling: data cleaning, missing values, duplicate data, outliers. Data transformation. Principal component analysis. Statistical coding. Algorithmic thinking. Sampling: basic techniques in probability, non-probability, and resampling methods, Monte Carlo, probability integral transformation, bootstrap method, acceptance/rejection algorithm. Machine learning: train/test split, performance metrics, classification and clustering, performance metrics, cross-validation. Supervised and unsupervised learning: linear regression, decision tree, random forest, naïve Bayes, K-nearest neighbour, hierarchical clustering. Interpretation and communication of results. Text mining and analytics: topic modelling and word embeddings. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

Principles of veld management 310 (WDE 310)

Module credits	12.00
NQF Level	07
Prerequisites	No prerequisites.
Contact time	2 lectures per week, fortnightly practicals

Language of tuition	Module is presented in English
Department	Department of Plant and Soil Sciences
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.

Multivariate analysis 311 (WST 311)

Module credits	18.00
NQF Level	07
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	Module is presented in English
Department	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. 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. Principal component analysis.The linear model: Models of full rank, least squares estimators, test of hypotheses.The generalised linear model: Exponential family mean and variance, link functions, and deviance. Poisson and Logistic regression. Cross-validation for model checking and hyperparameter selection. Model regularisation. Reproducible research. Metrics for model performance. Practical applications: Practical statistical modelling and analysis using statistical computer packages and interpretation of the output.

Time-series analysis 321 (WST 321)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221 or STK 210, STK 210
Contact time	2 lectures per week, 1 practical per week

Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Note: Only one of the modules WST 321 or STK 320 may be included in any study programme.

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, including that of social responsibility phenomena.

Dynamical systems 382 (WTW 382)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 218 and WTW 286/264
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

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
NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 114, WTW 123 WTW 124 and WTW 211
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
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
NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	WTW 248 and WTW 286/264
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
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
NQF Level	07
Prerequisites	WTW 248 and WTW 286/264
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

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.

Population ecology 351 (ZEN 351)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education

Prerequisites	No prerequisites.
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 1

Module content

Scientific approach to ecology; evolution and ecology; the individual and its environment; population characteristics and demography; competition; predation; plant-herbivore interactions; regulation of populations; population manipulation, human population. Examples throughout the module are relevant to the sustainable development goals of Life on Land and Good Health and Well-being.

Mammalogy 352 (ZEN 352)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	No prerequisites.
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 1

Module content

Mammalian origins and their characteristics: evolution of African mammals; structure and function: integument, support and movement; foods and feeding; environmental adaptations; reproduction; behaviour; ecology and biogeography; social behaviour; sexual selection; parental care and mating systems; community ecology; zoogeography. Special topics: parasites and diseases; domestication and domesticated mammals; conservation. The module addresses the sustainable development goals of Life on Land and Good Health and Well-being.

Community ecology 353 (ZEN 353)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	ZEN 351 GS or BOT 358 GS
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 2

Module content

The scientific approach; characteristics of the community; the community as a superorganism; community changes; competition as a factor determining community structure; disturbance as a determinant of community structure; community stability; macroecological environmental gradients and communities. A field trip will be conducted during the September vacation to the Sani Pass region of the Maloti- Drakensberg Mountains. The module addresses the sustainable development goals Good Health and Well-being, Sustainable Cities and Communities, Climate Action and Life on Land.

Evolutionary physiology 354 (ZEN 354)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	No prerequisites.
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Zoology and Entomology
Period of presentation	Semester 1

Module content

This module focuses on the integration of physiological systems in the context of animal form and function, and the ways in which evolution shapes the physiological processes that determine the energy, water and nutrient fluxes between animals and their environments. Topics covered include: (i) circulation, gas exchange and excretion; (ii) nutritional ecology; (iii) osmoregulation and thermoregulation; and (iv) reproductive physiology. The major focus of this module is to understand the major sources of physiological diversity, namely scaling, phylogenetic inertia, adaptation and phenotypic plasticity, and applying this knowledge to conceptually link physiological processes at the cellular level to macrophysiological patterns at a global scale. Many examples used in this module are directly relevant to the sustainable development goals of Good Health and Well-being, Sustainable Cities and Communities, Climate Action and Life on Land.

General Academic Regulations and Student Rules

The General Academic Regulations (G Regulations) and General Student Rules apply to all faculties and registered students of the University, as well as all prospective students who have accepted an offer of a place at the University of Pretoria. On registering for a programme, the student bears the responsibility of ensuring that they familiarise themselves with the General Academic Regulations applicable to their registration, as well as the relevant faculty-specific and programme-specific regulations and information as stipulated in the relevant yearbook. Ignorance concerning these regulations will not be accepted as an excuse for any transgression, or basis for an exception to any of the aforementioned regulations. The G Regulations are updated annually and may be amended after the publication of this information.

Regulations, degree requirements and information

The faculty regulations, information on and requirements for the degrees published here are subject to change and may be amended after the publication of this information.

University of Pretoria Programme Qualification Mix (PQM) verification project

The higher education sector has undergone an extensive alignment to the Higher Education Qualification Sub-Framework (HEQSF) across all institutions in South Africa. In order to comply with the HEQSF, all institutions are legally required to participate in a national initiative led by regulatory bodies such as the Department of Higher Education and Training (DHET), the Council on Higher Education (CHE), and the South African Qualifications Authority (SAQA). The University of Pretoria is presently engaged in an ongoing effort to align its qualifications and programmes with the HEQSF criteria. Current and prospective students should take note that changes to UP qualification and programme names, may occur as a result of the HEQSF initiative. Students are advised to contact their faculties if they have any questions.