

University of Pretoria Yearbook 2025

BSc in Mathematics 4-year programme (02131003)

Department Mathematics and Applied Mathematics

Minimum duration of study 4 years

Total credits 502

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	APS
NSC/IEB	NSC/IEB	
58%	65%	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: 126

Core = 64

Elective = 62

Additional information:

Choose electives according to the following combinations with a view to pursuing specialisation in the relevant field:

- **Physics:** PHY 114 & PHY 124 and WST 111 & WST 121 or CMY 117 & CMY 127 (64 credits)
- **Chemistry:** CMY 117 & CMY 127 and WST 111 & WST 121 or PHY 114 & PHY 124 (64 credits)
- **Economics:** WST 111, WST 121, EKN 110, EKN 120 and one of FRK 111 or OBS 114 or FBS 112 (62 credits)
(Please note: If FRK is selected as an elective, INF 183 has to be taken as well)
- **Mathematical Statistics:** WST 111 & WST 121, EKN 110, EKN 120 and one of FRK 111 or OBS 114 or FBS 112 (62 credits)
- **Computer Science:** COS 110, COS 132, COS 151, WST 111 and WST 121 (72 credits)

Students who want to take other electives must consult the Undergraduate Programme Coordinator in the Department of Mathematics and Applied Mathematics.

Core modules

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.

Discrete structures 115 (WTW 115)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
Prerequisites	50% for Mathematics in Grade 12
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

Propositional logic: truth tables, logical equivalence, implication, arguments. Mathematical induction and well-ordering principle. Introduction to set theory. Counting techniques: elementary probability, multiplication and addition rules, permutations and combinations, binomial theorem, inclusion-exclusion rule.

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.

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 R^n , 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.

Mathematical modelling 152 (WTW 152)

Module credits	8.00
NQF Level	05
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	50% for Mathematics in Grade 12
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 1

Module content

The module serves as an introduction to computer programming as used in science. Modelling of dynamical processes using difference equations; curve fitting and linear programming are studied. Applications are drawn from real-life situations in, among others, finance, economics and ecology.

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.

Elective modules

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.

Program design: Introduction 110 (COS 110)

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 COS 132 AND (COS 151 OR 12130009 OR 12136009) AND Maths level 5

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

Language of tuition Module is presented in English

Department Computer Science

Period of presentation Semester 2

Module content

The focus is on object-oriented (OO) programming. Concepts including inheritance and multiple inheritance, polymorphism, operator overloading, memory management (static and dynamic binding), interfaces, encapsulation, reuse, etc. will be covered in the module. The module teaches sound program design with the emphasis on modular code, leading to well structured, robust and documented programs. A modern OO programming language is used as the vehicle to develop these skills. The module will introduce the student to basic data structures, lists, stacks and queues.

Imperative programming 132 (COS 132)

Module credits 16.00

NQF Level 05

Service modules Faculty of Economic and Management Sciences
Faculty of Natural and Agricultural Sciences

Prerequisites APS of 30 and level 5 (60-69%) Mathematics

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

Language of tuition Module is presented in English

Department Computer Science

Period of presentation Semester 1

Module content

This module introduces imperative computer programming, which is a fundamental building block of computer science. The process of constructing a program for solving a given problem, of editing it, compiling (both manually and automatically), running and debugging it, is covered from the beginning. The aim is to master the elements of a programming language and be able to put them together in order to construct programs using types, control structures, arrays, functions and libraries. An introduction to object orientation will be given. After completing this module, the student should understand the fundamental elements of a program, the importance of good program design and user-friendly interfaces. Students should be able to conduct basic program analysis and write complete elementary programs.

Introduction to computer science 151 (COS 151)

Module credits 8.00

NQF Level 05

Service modules Faculty of Education
Faculty of Natural and Agricultural Sciences

Prerequisites APS of 30 and level 5 (60-69%) Mathematics.

Contact time 2 lectures per week, 1 practical per week

Language of tuition Module is presented in English

Department Computer Science

Period of presentation Semester 1

Module content

This module introduces concepts and terminology related to the computer science discipline. General topics covered include the history of computing, machine level representation of data, Boolean logic and gates, basic computer systems organisation, algorithms and complexity and automata theory. The module also introduces some of the subdisciplines of computer science, such as computer networks, database systems, compilers, information security and intelligent systems. The module also focuses on modelling of algorithms.

Economics 110 (EKN 110)

Module credits 10.00

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 No prerequisites.

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

Language of tuition Module is presented in English

Department Economics

Period of presentation Semester 1

Module content

This module deals with the core principles of economics. A distinction between macroeconomics and microeconomics is made. A discussion of the market system and circular flow of goods, services and money is followed by a section dealing with microeconomic principles, including demand and supply analysis, consumer behaviour and utility maximisation, production and the costs thereof, and the different market models and firm behaviour. Labour market institutions and issues, wage determination, as well as income inequality and poverty are also addressed. A section of money, banking, interest rates and monetary policy concludes the course.

Economics 120 (EKN 120)

Module credits 10.00

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 EKN 110 GS or EKN 113 GS and at least 4 (50-59%) in Mathematics in the Grade 12 examination or 60% in STK 113 and concurrently registered for STK 123

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

Language of tuition Module is presented in English

Department Economics

Period of presentation Semester 2

Module content

This module deals with the core principles of economics, especially macroeconomic measurement the private and public sectors of the South African economy receive attention, while basic macroeconomic relationships and the measurement of domestic output and national income are discussed. Aggregate demand and supply analysis stands core to this course which is also used to introduce students to the analysis of economic growth, unemployment and inflation. The microeconomics of government is addressed in a separate section, followed by a section on international economics, focusing on international trade, exchange rates and the balance of payments. The economics of developing countries and South Africa in the global economy conclude the course.

Financial management 112 (FBS 112)

Module credits 10.00

NQF Level 05

Service modules Faculty of Natural and Agricultural Sciences

Prerequisites At least 6 (70-79%) in Mathematics in the Grade 12 examination or WTW 135 (60%), WTW 143 (60%), WST 133 (60%) and WST 143 (60%).

Contact time 3 lectures per week

Language of tuition Module is presented in English

Department Financial Management

Period of presentation Semester 1

Module content

*Only for students in BSc (Actuarial and Financial Mathematics), BSc (Mathematics), BSc (Applied Mathematics), BSc (Mathematical Statistics), BSc Extended programme – Mathematical Sciences and BCom (Statistics) who comply with the set prerequisites.

Key principles of financial management. Company ownership. Taxation. Introduction to financial statements. Structure of financial statements. Depreciation and reserves. Preparing financial statements. Group financial statements and insurance company financial statements. Interpretation of financial statements. Limitation of financial statements. Issue of share capital.

Financial accounting 111 (FRK 111)

Module credits 10.00

NQF Level 05

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

Prerequisites No prerequisites.

Contact time 4 lectures per week

Language of tuition Module is presented in English

Department Accounting

Period of presentation Semester 1

Module content

The nature and function of accounting; the development of accounting; financial position; financial result; the recording process; processing of accounting data; treatment of VAT; elementary income statement and balance sheet; flow of documents; accounting systems; introduction to internal control and internal control measures; bank reconciliations; control accounts; adjustments; financial statements of a sole proprietorship; the accounting framework.

Informatics 183 (INF 183)

Module credits 3.00

NQF Level 05

Prerequisites No prerequisites.

Contact time 1 practical per week

Language of tuition Module is presented in English

Department Informatics

Period of presentation Year

Module content

Computer processing of accounting information.

Business management 114 (OBS 114)

Module credits 10.00

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 May not be included in the same curriculum as OBS 155

Contact time 3 lectures per week

Language of tuition Module is presented in English

Department Business Management

Period of presentation Semester 1

Module content

The entrepreneurial mind-set; managers and managing; values, attitudes, emotions, and culture: the manager as a person; ethics and social responsibility; decision making; leadership and responsible leadership; effective groups and teams; managing organizational structure and culture inclusive of the different functions of a generic organisation and how they interact (marketing; finance; operations; human resources and general management); contextualising Sustainable Development Goals (SDG) in each of the topics.

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.

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.

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.

Curriculum: Year 3

Minimum credits: 132

Core = 84

Elective = 48

Additional information:

Choose electives according to the following combinations with a view to pursuing specialisation in the relevant field:

- **Physics:** PHY 255 & PHY 263 (48 credits)
- **Chemistry:** CMY 282, CMY 283, CMY 284 & CMY 285 (48 credits)
- **Economics:** EKN 214, EKN 224 & EKN 234 (48 credits)
- **Mathematical Statistics:** WST 211, WST 212 & WST 221 (60 credits)
- **Computer Science:** COS 210, COS 212, COS 214 and any one of COS 216, COS 221, COS 284 (56 credits).
Consult the Department of Computer Science for guidance on which of the additional modules is appropriate for you. Students wishing to continue with COS 332 in the third year of study should select COS 216. Students wishing to continue with COS 326 in the third year of study should select COS 221.

Students who want to take other electives must consult the Undergraduate Programme Coordinator in the Department of Mathematics and Applied Mathematics.

Core modules

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 \mathbb{R}^n . 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
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Prerequisites	WTW 114 and WTW 124
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Contact time	1 tutorial per week, 2 lectures per week
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Language of tuition	Module is presented in English
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Department	Mathematics and Applied Mathematics
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Period of presentation	Semester 1
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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
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NQF Level	06
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Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
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Prerequisites	WTW 114 and WTW 124, WTW 211 and WTW 218
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Contact time	1 tutorial per week, 2 lectures per week
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Language of tuition	Module is presented in English
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Department	Mathematics and Applied Mathematics
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Period of presentation	Semester 2
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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.

Linear algebra 221 (WTW 221)

Module credits	12.00
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NQF Level	06
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Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
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Prerequisites	WTW 211 and WTW 218
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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 2

Module content

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

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.

Discrete structures 285 (WTW 285)

Module credits 12.00

NQF Level 06

Service modules Faculty of Engineering, Built Environment and Information Technology

Prerequisites WTW 115

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 2

Module content

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



Differential equations 286 (WTW 286)

Module credits	12.00
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.

Elective modules

Physical chemistry 282 (CMY 282)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Education
Prerequisites	CMY 117 and CMY 127
Contact time	2 practicals every other week, 1 tutorial every other week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 1

Module content

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

Analytical chemistry 283 (CMY 283)

Module credits	12.00
NQF Level	06
Service modules	Faculty of Education
Prerequisites	CMY 117 and CMY 127
Contact time	2 lectures per week, 2 practicals every other week, 1 tutorial every other week



Language of tuition Module is presented in English

Department Chemistry

Period of presentation Semester 2

Module content

Statistical evaluation of data in line with ethical practice, gravimetric analysis, aqueous solution chemistry, chemical equilibrium, precipitation-, neutralisation- and complex formation titrations, redox titrations, potentiometric methods, introduction to electrochemistry. Examples throughout the course demonstrate the relevance of the theory to meeting the sustainable development goals of clean water and clean, affordable energy.

Organic chemistry 284 (CMY 284)

Module credits 12.00

NQF Level 06

Service modules Faculty of Education

Prerequisites CMY 117 and CMY 127

Contact time 2 practicals every other week, 1 tutorial every other week, 2 lectures per week

Language of tuition Module is presented in English

Department Chemistry

Period of presentation Semester 1

Module content

Resonance, conjugation and aromaticity. Acidity and basicity. Introduction to ^{13}C NMR spectroscopy. Electrophilic addition: alkenes. Nucleophilic substitution, elimination, addition: alkyl halides, alcohols, ethers, epoxides, carbonyl compounds: ketones, aldehydes, carboxylic acids and their derivatives Training in an ethical approach to safety that protects self, others and the environment is integral to the practical component of the course.

Inorganic chemistry 285 (CMY 285)

Module credits 12.00

NQF Level 06

Service modules Faculty of Education

Prerequisites CMY 117 and CMY 127

Contact time 1 tutorial every other week, 2 practicals every other week, 2 lectures per week

Language of tuition Module is presented in English

Department Chemistry

Period of presentation Semester 2

Module content

Atomic structure, structure of solids (ionic model). Coordination chemistry of transition metals: Oxidation states of transition metals, ligands, stereochemistry, crystal field theory, consequences of d-orbital splitting, electrochemical properties of transition metals in aqueous solution. Fundamentals of spectroscopy and introduction to IR spectroscopy. During practical training students learn to acquire and report data ethically. Practical training also deals with the misuse of chemicals and appropriate waste disposal to protect the environment and meet the UN sustainable development goals.

Theoretical computer science 210 (COS 210)

Module credits	8.00
NQF Level	06
Prerequisites	COS 110 and COS 151, admission to relevant programme
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

This module introduces students to a framework for investigating both computability and complexity of problems. Topics include, but are not limited to: finite-state machines, regular expressions and their application in a language such as awk, the Halting problem, context-free grammars, P vs NP problem, NP-complete class, reduction techniques, regular languages, DFAs and NFAs, Lattices, Church-Turing thesis.

Data structures and algorithms 212 (COS 212)

Module credits	16.00
NQF Level	06
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	COS 110, admission to relevant programme
Contact time	4 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

Data abstraction is a fundamental concept in the design and implementation of correct and efficient software. In prior modules, students are introduced to the basic data structures of lists, stacks and queues. This module continues with advanced data structures such as trees, hash tables, heaps and graphs, and goes into depth with the algorithms needed to manipulate them efficiently. Classical algorithms for sorting, searching, traversing, packing and game playing are included, with an emphasis on comparative implementations and efficiency. At the end of this module, students will be able to identify and recognise all the classical data structures; implement them in different ways; know how to measure the efficiency of implementations and algorithms; and have further developed their programming skills, especially with recursion and polymorphism.

Software modelling 214 (COS 214)

Module credits	16.00
NQF Level	06
Prerequisites	COS 212, admission to relevant programme
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 2

Module content

The module will introduce the concepts of model-driven analysis and design as a mechanism to develop and evaluate complex software systems. Systems will be decomposed into known entities, such as design patterns, classes, relationships, execution loops and process flow, in order to model the semantic aspects of the system in terms of structure and behaviour. An appropriate tool will be used to support the software modelling. The role of the software model in the enterprise will be highlighted. Students who successfully complete this module will be able to conceptualise and analyse problems and abstract a solution.

Netcentric computer systems 216 (COS 216)

Module credits	16.00
NQF Level	06
Prerequisites	COS 110, admission to relevant programme
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

This module will introduce the student to netcentric systems by focusing on the development of systems for the web, mobile devices and the cloud. To lay the foundation on which the rest of the module can follow, traditional web-based programming languages such as HTML5, JavaScript, CSS and Python will be covered differentiating between client-side and server-side computation. Persistence of web-based data will be included for both client and server-based computation. These technologies will be extended and applied to mobile platforms where the availability of a connection, location-services and mobile device limitations play a role. For cloud platforms, aspects relating to task partitioning, security, virtualisation, cloud storage and access to the shared data stores, data synchronisation, partitioning and replication are considered. In order to practically demonstrate that a student has reached these outcomes, students will be required to use, integrate and maintain the necessary software and hardware by completing a number of smaller practical assignments where after integrating all these technologies into a comprehensive and practical programming project is required.

Introduction to database systems 221 (COS 221)

Module credits	16.00
NQF Level	06
Prerequisites	COS 110
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

This module will expose students to the evolution of databases systems. They will be able to model data conceptually, in terms of models such as conceptual, relational, object oriented, graph-based and network and the mapping between models, in particular between the conceptual and relational model. Foundational concepts relating to the relational model will be considered, such as: entity and referential integrity, relational algebra and calculus, functional dependency, normal forms, Indexing of database systems and transaction processing will also form an integral part of the curriculum. The physical data representation of the databases system both in memory and within the file system of the operating system will be considered.

Computer organisation and architecture 284 (COS 284)

Module credits	16.00
NQF Level	06
Prerequisites	COS 212 GS, admission to relevant programme
Contact time	4 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 2

Module content

This module provides the foundations on which other modules build by enabling a deeper understanding of how software interacts with hardware. It will teach the design and operation of modern digital computers by studying each of the components that make up a digital computer and the interaction between these components.

Specific areas of interest, but not limited to, are: representation of data on the machine-level; organisation of the machine on the assembly level; the architecture and organisation of memory; inter- and intra-component interfacing and communication; data paths and control; and parallelism. Topic-level detail and learning outcomes for each of these areas are given by the first 6 units of 'Architecture and Organisation' knowledge area as specified by the ACM/IEEE Computer Science Curriculum 2013.

The concepts presented in the theory lectures will be reinforced during the practical sessions by requiring design and implementation of the concepts in simulators and assembly language using an open source operating system.

Economics 214 (EKN 214)

Module credits 16.00

NQF Level 06

Service modules

Faculty of Engineering, Built Environment and Information Technology
Faculty of Education
Faculty of Humanities
Faculty of Natural and Agricultural Sciences

Prerequisites

EKN 110 GS & EKN 120 OR EKN 113 GS & EKN 123; & STK 110 GS OR STK 113 & STK 123 & STK 120/121 or concurrently registered for STK 120/121 OR WST 111 & WST121 are prerequisites instead of STK 120/121 or WST 111 and concurrently registered for WST 121.

Contact time 3 lectures per week

Language of tuition Module is presented in English

Department Economics

Period of presentation Semester 1

Module content

Macroeconomics

From Wall and Bay Street to Diagonal Street: a thorough understanding of the mechanisms and theories explaining the workings of the economy is essential. Macroeconomic insight is provided on the real market, the money market, two market equilibrium, monetarism, growth theory, cyclical analysis, inflation, Keynesian general equilibrium analysis and fiscal and monetary policy issues.

Economics 224 (EKN 224)

Module credits 16.00

NQF Level 06

Service modules

Faculty of Education
Faculty of Humanities
Faculty of Natural and Agricultural Sciences

Prerequisites	[EKN 110 GS & EKN 120] OR [EKN 113 GS & EKN 123 & BME 120 GS or STK 110 GS or (STK 113 & STK 123 & STK 120/121) or STK120/121# OR WST 111 & WST 121 are prerequisites instead of STK 120/121 or WST 111 and WST 121#.
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Department	Economics
Period of presentation	Semester 1

Module content

Microeconomics

Microeconomic insight is provided into: consumer and producer theory, general microeconomic equilibrium, Pareto-optimality and optimality of the price mechanism, welfare economics, market forms and the production structure of South Africa. Statistic and econometric analysis of microeconomic issues.

Economics 234 (EKN 234)

Module credits	16.00
NQF Level	06
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	EKN 110, EKN 120 and STK 120/121 and STC 122 or WST 121 OR concurrently registered for STK 120/121 or WST 121.
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Department	Economics
Period of presentation	Semester 2

Module content

Macroeconomics

Application of the principles learned in EKN 214 on the world we live in. We look at international markets and dynamic macroeconomic models, and familiarise the students with the current macroeconomic policy debates. We also take a look at the latest macroeconomic research in the world. The course includes topics of the mathematical and econometric analysis of macroeconomic issues.

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

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.

Curriculum: Final year

Minimum credits: 132

Core = 72

Elective = 72

Additional information:

Students may choose modules from Physics, Chemistry, Economics, Mathematical Statistics, Applied Mathematics, Financial Mathematics and Computer Science. Students must consult the relevant yearbook entries for admission requirements for the different honours degrees listed below.

- Students who wish to pursue an honours degree in **Physics** should take PHY 356 & PHY 364.
- Students who wish to pursue an honours degree in **Chemistry** should take CMY 382, CMY 383, CMY 384 & CMY 385.
- Students who wish to pursue an honours degree in **Economics** should take EKN 310, EKN 320, EKN 325 & WTW 383.
- Students who wish to pursue an honours degree in **Mathematical Statistics** should take WST 311, WST 312, WST 321, WST 322 & STK 353.
- Students who wish to pursue an honours degree in **Applied Mathematics** should take WTW 382, WTW 386, WTW 383 & WTW 387.
- Students who wish to pursue an honours degree in **Financial Engineering** should take WTW 354 & WTW 364, and two modules from WST 311, WST 312, WST 321 & WST 322.
- Students who wish to pursue an honours degree in **Mathematics of Finance** should take WTW 354 & WTW 364, and two modules from WST 311, WST 312, WST 321, WST 322, WTW 383 & WTW 386.
- Students who wish to pursue an honours degree in **Computer Science** should take COS 301 and any three of COS 314, COS 326, COS 330, COS 332, COS 333, COS 341 and COS 344.

Students who want to take other electives must consult the Undergraduate Programme Coordinator in the Department of Mathematics and Applied Mathematics.

Core modules

Analysis 310 (WTW 310)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 220
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

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

Complex analysis 320 (WTW 320)

Module credits 18.00

NQF Level 07

Service modules Faculty of Education

Prerequisites WTW 218 and WTW 220

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

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

Algebra 381 (WTW 381)

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
Faculty of Humanities

Prerequisites WTW 114 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 1

Module content

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

Geometry 389 (WTW 389)

Module credits 18.00

NQF Level	07
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities
Prerequisites	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

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

Elective modules

Physical chemistry 382 (CMY 382)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	2 practicals every other week, 2 lectures per week, 1 discussion classes every other week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 1

Module content

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

Analytical chemistry 383 (CMY 383)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285

Contact time	2 practicals every other week, 1 tutorial every other week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 2

Module content

Separation methods: Extraction, multiple extraction, chromatographic systems. Spectroscopy: Construction of instruments, atomic absorption and atomic emission spectrometry, surface analysis techniques. Mass spectrometry. These techniques are discussed in terms of their use in environmental analysis and the value they contribute to meeting the UN sustainable development goals (#3,6 & 11). Instrumental electrochemistry. The relevance of electrochemistry to providing affordable and clean energy (UN SDG#7) is addressed.

Organic chemistry 384 (CMY 384)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	2 lectures per week, 2 practicals every other week, 1 tutorial every other week
Language of tuition	Module is presented in English
Department	Chemistry
Period of presentation	Semester 2

Module content

Theory: NMR spectroscopy: applications. Aromatic chemistry, Synthetic methodology in organic chemistry. Carbon-carbon bond formation: alkylation at nucleophilic carbon sites, aldol and related condensations, Wittig and related reactions, acylation of carbanions (Claisen condensation). Practical: Laboratory sessions are designed to develop the rational thinking behind the design of organic chemistry experiments. An industrial project specifically prepares students for work in SA industry context and honours projects. As part of this practical programme the UN sustainable development goals must be considered in evaluating the best industrial process.

Inorganic chemistry 385 (CMY 385)

Module credits	18.00
NQF Level	07
Service modules	Faculty of Education
Prerequisites	CMY 282, CMY 283, CMY 284 and CMY 285
Contact time	1 tutorial every other week, 2 practicals every other week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Chemistry



Period of presentation Semester 1

Module content

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

Software engineering 301 (COS 301)

Module credits 27.00

NQF Level 07

Prerequisites COS 212 and COS 214

Contact time 1 practical per week, 2 lectures per week

Language of tuition Module is presented in English

Department Computer Science

Period of presentation Year

Module content

The module exposes students to problems associated with software development on an industrial scale. Overall goals of the module are: to become familiar with the latest trends in software engineering; to understand the software engineering process and to appreciate its complexity; to be exposed to a variety of methodologies for tackling different stages of the software lifecycle; to understand and apply the concepts of systems administration and maintenance; to complete the development of a fairly large object orientation-based software product. The focus of the module is on a project that lasts the whole year. The project is completed in groups of approximately four (4) students and teaches students to take responsibility for a variety of roles within a group, and to understand the different requirements for these; to experience the advantages and problems of working in a group; professionalism with regards to particularly colleagues and clients.

After the successful completion of this module, the student will be able to: understand the psychology of a client; work in groups; and have an appreciation for planning, designing, implementing and maintaining large projects. These qualities should place the students in a position in which they are able to handle software development in the corporate environment.

Artificial intelligence 314 (COS 314)

Module credits 18.00

NQF Level 07

Prerequisites COS 110, admission to relevant programme

Contact time 2 lectures per week, 1 practical per week

Language of tuition Module is presented in English

Department Computer Science

Period of presentation Semester 1

Module content

The main objective of this module is to introduce a selection of topics from artificial intelligence (AI), and to provide the student with the background to implement AI techniques for solving complex problems. This module will cover topics from classical AI, as well as more recent AI paradigms. These topics include: search methods, game playing, knowledge representation and reasoning, machine learning, neural networks, genetic algorithms, artificial life, planning methods, and intelligent agents. In the practical part of this module, students will get experience in implementing

- (1) game trees and evolving game-playing agents;
- (2) a neural network and applying it to solve a real-world problem; and
- (3) a genetic algorithm and applying it to solve a real-world problem.

Database systems 326 (COS 326)

Module credits	18.00
NQF Level	07
Prerequisites	COS 221, admission to relevant programme
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 2

Module content

This module builds on a prior introductory module on database technology and provides more advanced theoretical and practical study material for managing large volumes of data, for example, noSQL database systems and MapReduce. The module will consider file system models, for example Hadoop, relevant for big data storage, manipulation at scale, mining and visualisation. Basic knowledge of parallel decomposition concepts will be included.

Computer security and ethics 330 (COS 330)

Module credits	18.00
NQF Level	07
Prerequisites	COS 110, admission to relevant programme
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 2

Module content

This module develops an appreciation of the fundamentals and design principles for information assurance and security. Students will develop a clear understanding of the basic information security services and mechanisms, enabling them to design and evaluate the integration of solutions into the user application environment.

Emphasis will be placed on services such as authorisation and confidentiality. Students will acquire knowledge and skills of Security Models such as the Bell-LaPadula, Harrison-Ruzzo Ullman and Chinese Wall Model. Students will develop a detailed understanding of the confidentiality service by focusing on cryptology and the practical implementation thereof. The student will be introduced to professional and philosophical ethics. At the end of the module students will be able to engage in a debate regarding the impact (local and global) of computers on individuals, organisations and society. The professionalism of IT staff will be discussed against national and international codes of practices such as those of the CSSA, ACM and IEEE.

Computer networks 332 (COS 332)

Module credits	18.00
NQF Level	07
Prerequisites	COS 216, admission to relevant programme
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

The objective of this module is to acquaint the student with the terminology of communication systems and to establish a thorough understanding of exactly how data is transferred in such communication networks, as well as applications that can be found in such environments. The study material includes: concepts and terminology, the hierarchy of protocols according to the OSI and TCP/IP models, protocols on the data level, physical level and network level as well as higher level protocols. The practical component of the module involves programming TCP/IP sockets using a high level language. The emphasis throughout is on the technical aspects underlying the operation of networks, rather than the application of networks.

Programming languages 333 (COS 333)

Module credits	18.00
NQF Level	07
Prerequisites	COS 110, admission to relevant programme
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

Programming languages are the backbone for software development. Each language has its own different syntax and semantics, but there are many common concepts that can be studied and then illustrated through the languages. The module concentrates on issues of object orientation, including delegation, iteration and polymorphism. It surveys how languages provide the basic building blocks for data and control, as well as exception handling and concurrency. At the end of the module, students will be able to appreciate the rich history behind programming languages, leading to independent principles that evolve over time. They will be skilled at using a variety of programming languages, including new paradigms such as functional, logical and scripting, and will know how to learn a new language with ease. From this experience, they will be able to apply evaluation criteria for choosing an appropriate programming language in a given scenario.

Compiler construction 341 (COS 341)

Module credits	18.00
NQF Level	07
Prerequisites	COS 210 and COS 212, admission to relevant programme
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 2

Module content

This module will introduce the student to the fundamentals of compiler construction. These include: the structural difference between a high-level and a von-Neumann language, the meaning of syntax and semantics and what semantics-preserving correctness means; the concepts of regular expressions, finite automata, context-free grammars in the context of programming languages; the need to construct parse-trees for given programmes; the application of data structures and algorithms for the purpose of code-analysis, code-optimisation and register-allocation; and the limits of code-analysis in terms of undecideability and the halting problem.

After successful completion of the module, the student will have an understanding of the importance of compilers and will understand how to implement a compiler, in terms of its components, the scanner, parser, type checker and code-generator for a given grammar.

Computer graphics 344 (COS 344)

Module credits	18.00
NQF Level	07
Prerequisites	COS 110 and WTW 124 or WTW 146, admission to relevant programme
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1

Module content

The aim of this module is to acquire a sound knowledge of the basic theory of interactive computer graphics and basic computer graphics programming techniques. The theory will cover graphics systems and models, graphics programming, input and interaction, geometric objects and transformations, viewing in 3D, shading, rendering techniques, and introduce advanced concepts, such as object-oriented computer graphics and discrete techniques. The module includes a practical component that enables students to apply and test their knowledge in computer graphics. The OpenGL graphics library and the C programming language will be used for this purpose.

Economics 310 (EKN 310)

Module credits 20.00

NQF Level 07

Service modules

Faculty of Engineering, Built Environment and Information Technology
Faculty of Education
Faculty of Humanities
Faculty of Natural and Agricultural Sciences

Prerequisites Any two of EKN 214; EKN 234; EKN 224 or EKN 244.

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

Language of tuition Module is presented in English

Department Economics

Period of presentation Semester 1

Module content

Public finance

Role of government in the economy. Welfare economics and theory of optimality. Ways of correcting market failures. Government expenditure theories, models and programmes. Government revenue. Models on taxation, effects of taxation on the economy. Assessment of taxation from an optimality and efficiency point of view. South African perspective on public finance.

Economics 320 (EKN 320)

Module credits 20.00

NQF Level 07

Service modules

Faculty of Engineering, Built Environment and Information Technology
Faculty of Education
Faculty of Humanities
Faculty of Natural and Agricultural Sciences

Prerequisites Any two of EKN 214; EKN 234; EKN 224 or EKN 244.

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

Language of tuition Module is presented in English

Department Economics

Period of presentation Semester 2

Module content

Economic analyses

Identification, collection and interpretation process of relevant economic data; the national accounts (i.e. income and production accounts, the national financial account, the balance of payments and input-output tables); economic growth; inflation; employment, unemployment, wages, productivity and income distribution; business cycles; financial indicators; fiscal indicators; social indicators; international comparisons; relationships between economic time series - regression analysis; long-term future studies and scenario analysis; overall assessment of the South African economy from 1994 onwards.

Economics 325 (EKN 325)

Module credits 20.00

NQF Level 07

Service modules Faculty of Humanities
Faculty of Natural and Agricultural Sciences

Prerequisites Any two of EKN 214; EKN 234; EKN 224 or EKN 244.

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

Language of tuition Module is presented in English

Department Economics

Period of presentation Semester 2

Module content

Economic policy and development: Capita select

The course provides an introduction to growth economics and also to some topics on development economics. Firstly, historical evidence is covered and then the canonical Solow growth model and some of its empirical applications (human capital and convergence). Secondly, the new growth theory (the AK and the Romer models of endogenous growth) are covered. Some of the development topics to be covered include technology transfer, social infrastructure and natural resources.

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.

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.

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.

Stochastic processes 312 (WST 312)

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

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

Time-series analysis 321 (WST 321)

Module credits 18.00

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.

Actuarial statistics 322 (WST 322)

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 2

Module content

Bayes estimation. Loss distributions. Reinsurance. Risk models. Ruin theory. Credibility theory. Extreme value theory. Copulas. Practical statistical modelling and analysis using statistical computer packages.

Financial engineering 354 (WTW 354)

Module credits 18.00

NQF Level 07

Service modules Faculty of Engineering, Built Environment and Information Technology
Faculty of Economic and Management Sciences

Prerequisites WST 211, WTW 211 and WTW 218

Contact time 1 tutorial per week, 2 lectures per week

Language of tuition Module is presented in English

Department Mathematics and Applied Mathematics

Period of presentation Semester 1

Module content

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

Financial engineering 364 (WTW 364)

Module credits 18.00

NQF Level 07

Service modules Faculty of Economic and Management Sciences

Prerequisites WST 211, WTW 124, 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 2

Module content

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

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.

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.