SCHOOL OF NATURAL AND APPLIED SCIENCES

POSTGRADUATE PROGRAMME RULES AND INFORMATION

2021

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1. CONTACT DETAILS

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WELCOME MESSAGE

Welcome! The staff of the School of Natural and Applied Sciences (NAS) welcome you and appreciate your interest in our Postgraduate programmes. We look forward to getting to know you, working with you in the various programme modules and sharing our excitement with the many facets of the qualifications. The School has suitably qualified and dedicated academics who are ready and eager to guide you in your respective studies.

We hold our students dearly in our hearts and we are very proud of them. We believe that you are about to embark on a journey filled with excitement and educational experience that will leave a lasting impression for many years to come in your future careers. We trust that you will have a rewarding time. Enjoy your studies and have fun while doing it.

Head of School

A NOTE TO STUDENTS

It is the responsibility of all students to familiarize themselves with all rules and information as detailed in the General Rules and Information Book of the University, as well as the School of Natural and Applied Sciences Postgraduate Programme Rules and Information Book. Ignorance of the applicable regulations, rules and procedures, or the wrong interpretation thereof will not be accepted as an excuse for not complying with the stipulations of such regulations, rules and procedures.

2. GENERAL RULES

2.1 Admission Requirements

(a) The General Rules of Sol Plaatje University in respect of admission to Bachelor Honours Degrees (aligned with the Higher Education Qualification Sub-Framework: HEQSF) are applicable to this degree.

(b) To be admitted to the Bachelor of Science (Honours) programme, a student must be in possession of an acknowledged Bachelor qualification at NQF Level 7 or cognate qualification, with an average of at least 60% in the final year exit modules.

(c) The formal university's Recognition of Prior Learning (RPL) Policy may be applied in instances where applicants do not meet the minimum admission requirements for entry into the Honours Degree.

2.2 Articulation

Graduates in possession of the Bachelor of Science (Honours) Degree, will be eligible for further studies on a Master's Degree (at NQF Level 9) programme in the same or a cognate discipline, subject to meeting the minimum entry requirements.

2.3 Duration of Study

(a) The General Rules of SPU in respect of the period of study are applicable to this qualification.

(b) The study duration of the Bachelor of Science (Honours) Degree is minimum one year of full-time study or two years of part-time study.

(c) In order to satisfy the qualification requirements, students

must take and pass at least 120 credits.

2.4 **Programme Delivery**

(a) The Department (HoD) is responsible for scheduling of lecture timetable.

(b) Minimum number of students: The School reserves the right to set a minimum number of students required for a programme to run.

(c) Minimum class attendance: In order to qualify to sit for an examination of each module, minimum class attendance is at least 80%, provided all other requirements are satisfied.

2.5 **Assessment**

(a) The Rules of the University in respect of assessment as portrayed in the SPU Assessment Policy, SPU Research Policy and procedure, SPU Research Ethics Policy and Procedures, SPU Post Graduate Supervision Policy and SPU Postgraduate Research Assessment and Supervision Guide, are applicable to this degree.

(b) Each module in this programme includes formative and examination assessment opportunities.

(c) A minimum module mark of 50% must be obtained in order to be eligible to write the final module examination.

(d) In order to pass, a student shall obtain a minimum of 50% in every required module in the programme.

(e) When calculating the final mark following an examination assessment, the differential contribution of the formative and the examination assessment marks are 50% and 50% respectively.

(f) There are no supplementary examinations for this qualification. However, a special examination may be granted to students who have at least one module remaining to complete the qualification, provided all the other assessment conditions for the module in question are satisfied.

(g) In the case of the Research Project module, assessment tasks will include, inter alia, the drafting of a research proposal, a literature review, the design of research instrument and the writing of research mini-dissertation.

(h) Submission and assessment of Honours Research Project reports will be concluded before the stipulated date in the year of enrolment for the degree, unless otherwise specified by the Department.

(i) The Research Project module will be undertaken under the guidance of an academic supervisor (*see SPU Postgraduate Supervision Policy and Procedure).*

(j) Assessment activities will be internally and externally moderated.

2.6 **Exclusion**

Students who fail more than 50% of the total qualification credits, or who fail a module twice, will be excluded from the programme.

2.7 **Academic Integrity**

Plagiarism is dealt with in terms of the plagiarism policy of the university. Students should read, understand and heed the SPU *Policy on Plagiarism*.

3. PROGRAMMES OFFERED

The following postgraduate programmes are offered in the School of Natural and Applied Sciences:

Name of Qualification	Minimum duration of study
1. Bachelor of Science (Honours) in Biological Sciences	1 year
2. Bachelor of Science (Honours) in Computer Science	1 year
3. Bachelor of Science (Honours) in Data Science	1 year
4. Bachelor of Science (Honours) in Mathematical Sciences	1 year
5. Bachelor of Science (Honours) in Physical Sciences	1 year

3.1 Bachelor of Science (Honours) in Biological Sciences

3.1.1 Purpose of the Programme

The programme is designed to respond to skills development needs of South Africa and the world at large. The program is designed to develop highly qualified students who are analytical and independent thinkers with knowledge of how to model, evaluate and solve both quantitative and qualitative problems in science and technology. The programme also provides a sound theoretical and practical base and exposure to Biological Sciences' disciplines.

Students engage with the necessary theory and practice that will broaden, deepen and intensify their scope of theoretical concepts and expertise in particular areas associated with the mathematical sciences. This qualification also includes a research component which aims at providing students with professional research skills that will enable them to embark on a career as a researcher. Upon successful completion of an Honours in Biological Sciences, graduates may articulate to a master's degree in a related field. The qualifying learners can also be employed in many industries including: finance, economics, engineering, public health, education, and medicine. In all these areas, mathematical scientists work closely with other scientists and researchers to develop mathematical techniques, adapt existing techniques, design experiments, simulations and direct analyses of surveys and retrospective studies.

3.1.2 Programme Structure

The length of the program is one year on a full-time basis and two years on a part-time basis, with 120 credits allocated as 67% of course work and 33% as a compulsory research project. The modules in the programme have no rules of progression. The curriculum is developed for two fields of

specialization in Biological Sciences, namely:

(i) Botany and

(ii) Zoology

Bachelor of Science (Honours) in Biological Sciences (Botany): BOT800		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NBLG84040	Research Project	40
First Semester (Compulsory)		
NBLG84320	Enabling Skills in Biological Sciences	20
NBLG84520	Arid Zone Biodiversity	20
Second Semester (Choose any two electives)		
NBLG84220	Plant Systematics	20
NBOT84420	Ecophysiology of Plants	20
NBOT84620	Evolutionary Ecology of Plants	20
NBOT84820	Ethnobotany	20
TOTAL CREDITS FOR QUALIFICATION		**120**

Bachelor of Science (Honours) in Biological Sciences (Zoology):ZOO800		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NBLG84040	Research Project	40
First Semester (Compulsory)		
NBLG84320	Enabling Skills in Biological Sciences	20
NBLG84520	Arid Zone Biodiversity	20
Second Semester (Choose any two electives)		
NZOO84220	Ornithology	20
NZOO84420	Parasitology	20
NZOO84620	Applied Entomology	20
NZOO84820	Animal Behaviour	20
TOTAL CREDITS FOR QUALIFICATION		**120**

3.1.3 **Module Information**

Module Code	NBLG84040
Module Name	Research Project
Module Description	This module will be a year module where the student will select a biological project together with an appropriate supervisor and conduct research during the course of the programme. The student will write a project proposal, present it to the School, collect field data, analyse the data, present the results in the form of a mini-thesis and give a presentation on the project at an Honours seminar at the end of the year. Under appropriate supervision, students will take responsibility for their research and be guided to research methodologies and skills to equip them for work in the biodiversity sector, or continuation to Masters level.
Module Content	• Proposal writing • Seminar presentation of proposal • Data collection • Analyses of data and interpretation of results • Dissertation write up • Seminar presentation of final result
Learning Outcomes	At the end of the module, the student is expected to: • Collect, analyse and evaluate relevant biological data • Integrate theoretical knowledge with practical skills to address problems • Develop independent and critical thought pattern • Communicate effectively in the form of written and oral reports.

Module Code	NBLG84520
Module Name	Arid Zone Biodiversity
Module Description	Given the Northern Cape's large arid zone, this module is one of the focal modules in the programme that will provide students with an in-depth look at the ecology of animals and plants in arid environments and the associated physiological adaptations these organisms employ to survive in these harsh landscapes. It will also address global change, its impact on landscapes, biodiversity and communities and how conservation planning methodologies effectively prioritise biodiversity conservation in changing environments. Students will use published studies and other resources to investigate abiotic properties and biotic patterns and processes of animals and plants of coping in hot, dry environments and integrate global change aspects into landscape conservation approaches.
Module Content	• Formation and location of arid zones globally • Causes of aridity (what characterizes arid zones) • Ecological processes in arid zones, including the pulse-resource model, the two-phase resource pulse hypothesis and the advancing Karoo hypothesis • Water balance and thermoregulatory challenges • Adaptations of plants and animals in arid zones (morphological, physiological, behavioural) • Body size, shape and colour • Ectothermy versus endothermy in arid zones • Behavioural strategies to beat the heat • Reproductive strategies in arid zones

	• Climate change impacts on arid zone biodiversity • Niche-modelling tools in assessing changes in species distribution using R-based methods and DIVA-GIS (mapping tools) • Threats to deserts and conservation planning approaches in arid zones (biodiversity assessments)
Learning Outcomes	At the end of the module the learner is expected to be able to understand, explore, discuss and analyse: • Desert biomes around the world with an emphasis on the arid biomes of the Northern Cape Province; • Biodiversity of the Northern Cape based on different biomes/vegetation, which includes species richness, endemism, restricted range species and Red Data Species • Ecological processes and drivers in arid systems particularly within South Africa's desert biomes; • Eco-physiological adaptations of animals and plants in arid regions, with a special emphasis on species in the Northern Cape and other southern African deserts • The effects of climate and landscape changes on biodiversity; • The applications of niche-based modelling techniques in understanding changes to the climatic enevelope for species and the resulting shits in species distributions that could occur;

	• The threats facing arid zones globally and in the Northern Cape, and conservation approaches and planning to deal with these threats.
Module Code	NBLG84220
Module Name	Plant Systematics
Module Description	The module is designed to be hands-on in its essence. It introduces students to the principles of phylogenetics and demonstrates its importance in modern biology. Topics include what a phylogenetic tree represents; gene tree versus species trees; trait evolution; concepts of molecular homology; species concepts; how to read/interpret an evolutionary tree; logic of inferring evolutionary trees; phylogenetic inference with molecular and morphological data; plant biogeography; some applications of phylogenetics in biodiversity conservation, forensics and ecology. On the practical side, students will learn how to acquire DNA sequence data from GenBank; editing and alignment of sequences, estimation and evaluation of phylogeny based on parsimony, maximum likelihood and Bayesian approaches. Students will be exposed to a suite of current softwares for phylogenetic analyses (including but not limited to MEGA, BEAST, MrBayes, PAUP and R). A key aspect to this module is that students will engage with the primary literature addressing contemporary issues in plant systematics.
Module Content	• Plant systematics and phylogenetic principles • Philosophical foundations of biological systematics • Species concepts and their implication for plant conservation

	• Molecular and morphological sources of plant systematic data • Phylogeny reconstruction using DNA and morphology • Divergence times estimation and molecular clock debates • Plant rait evolution within a phylogenetic framework • Plant classification and nomenclature • Introduction to plant biogeography and conservation.
Learning Outcomes	At the end of the module the learner is expected to be able to: • Critique the literature of plant systematics. • Discuss species concepts and situate themselves confidently in the species debate. • Acquire DNA sequence data from public databases. • Perform accurate sequence editing and alignment. • Perform phylogenetic analyses using parsimony and model-based approaches. • Interpret phylogenetic trees and use them to trace evolutionary history of traits. Be able to produce high quality phylogenetic trees. • Apply the various molecular clock approaches to date phylogenies. • Apply the outcome of phylogenetic analyses to plant classification.

	• Link the distribution of plants to evolutionary and ecological histories.
Module Code	NBLG84320
Module Name	Enabling Skills in Biological Sciences
Module Description	The aim of this module is to provide skills for identifying and addressing research questions in the biological sciences. It introduces students to the planning, implementation, analyses and interpretation of research within the broader domain of biology. The skills acquired will help students in achieving success in their research project module. It also serves as a platform on which they can build a career or advanced qualifications, should they wish to further their studies. The module closely integrates with students' research projects and teaches statistics using R and other statistical softwares, GIS, sampling techniques and critical interrogation of scientific evidence.
Module Content	• Introduction to the philosophy of science, with a focus on biology (10%) • Experimental design in biology and ecology (10%) • Biostatistics with R (25%) • Advanced biological statistics (multivariate techniques) (25%) • Scientific communication (reading, scientific writing and oral presentation) (20%) • GIS (10%)
Learning Outcomes	At the end of the module the learner is expected to be able to:

	• Retrieve data and literature from online databases/search engines • Identify knowledge gap in a field of enquiry through literature review • Engage with published literature in a critical manner • Formulate testable research hypothesis (or hypotheses) • Design experiments to collect relevant data and test hypotheses • Perform appropriate statistical analyses • Interpret and organize results in a coherent way • Discuss the wider implications and potential applications of scientific findings.
Module Code	NBOT84420
Module Name	Ecophysiology of Plants
Module Description	The course provides a broad introduction to the research discipline of plant eco-physiology, which studies how plants are affected by and adapt to the surrounding environment. The course focuses on developing a greater depth of understanding of compromises that plants make in balancing resource use and stress tolerance in a variable environment, and how different strategies of stress tolerance become expressed across scales in function, from plant parts, to whole plants, communities and ecosystems. The course will consolidate and extend knowledge of the processes involved in the acquisition and transport of resources by plants, and use this knowledge to examine the ways plants have adapted to a range of environments, some of which can be considered as extreme. A good overview

	and understanding of chemical and physical variables that restrict and affect various physiological mechanisms will be given. Particular emphasis will also be placed on anthropogenic factors that contribute to plant stress. Interactions with other organisms will also be examined including mycorrhizas and parasitic plants. Field and laboratory work will give students a solid grounding in plant identification and evaluation of physiological traits in an evolutionary and environmental context.
Module Content	• Plant nutrient acquisition, use and deficiency • Plant-water relations and leaf vascular networks • Abiotic stress: signalling and reactions • Biotic interactions - symbiosis, tri-trophic interactions, pathogenic relations & herbivory • Plants in a changing world • New tools and technical developments (genetic engineering etc.) • Pollution stress (air and heavy metals)
Learning Outcomes	On successful completion of this course students should be able to: • Explain the concepts of plant resource acquisition, plant energy budgets and plant-water relations, plant-symbionts and plant-parasite interactions. • Understand the key environmental influences on plants. • Explain how photosynthesis, stomatal conductance, transpiration, water relations, and below ground processes are influenced by environmental variability

	• Understand the adaptation of plants to environmental stress, focusing on the Northern Cape • Critically discuss the current and future impact of global change and understand how this may affect plants and the environments in which they live. • Collect, analyse and present experimental ecophysiology data in the correct scientific formats. • Describe how physiological processes scale up from the functioning of complex structures such as stems, roots and leaves to whole plants and plant communities
Module Code	NBOT84620
Module Name	Evolutionary Ecology of Plants
Module Description	Evolution and ecology are intimately linked, with ecology ultimately driving evolutionary change, and evolution determining the nature of species interactions. Evolutionary ecology of plants module will focus on how plants have evolved and adapted to the environments in which they live. The topics in this module will range from; introduction to plant evolution, plant ecology, natural selection of plants, inheritance and genetics of plants, ecology of plants at community level, population and individuals' levels, plant life histories and plant interactions. The course ends with an introduction to the biomes of South Africa, highlighting the diversity, evolution as well as the ecological processes that have shaped the vegetation in different parts of the country with a particular emphasis on the ecology and evolution

	of the Cape Floristic Region. The module will comprise of formal lectures, critical discussion of papers from the primary literature, seminar presentations on the topics as well a compulsory field trip, which will introduce students to the field of plant ecology and equip them with the necessary ecological skills.
Module Content	• Advanced plant evolution • Plant ecology, • Natural selection of plants, • Inheritance and genetics of plants, • Ecology of plants at individual, population and community levels, • Animal-plant interactions • Evolution of SA biomes (CFR with a special focus of the NC province)
Learning Outcomes	At the end of the module the learner is expected to be able to: • Describe the theory of plant evolution • Explain the fundamental processes of plant evolution via natural selection with particular reference to plant life history evolution; • Describe the principles of plant speciation and plant species concepts • Outline the genetic basis of plant evolution, and the associated fundamental principles and approaches of plant evolutionary genetics; • Describe major types of plant genetic variation, and demonstrate an appreciation of how they may be applied to estimating major features of plant population biology;

	• Identify and explain the relationship between different types of plant genetic variation and the fitness and function of individuals; • Review and explain the theoretical and observed relationships between plant evolutionary genetic variation and extinction risk of populations, and describe the avenues by which evolutionary principles can be used to promote survival of populations and species in a changing and uncertain world; • Read, understand, communicate and critique the primary research literature from a range of topics in plant evolutionary ecology in oral and written formats.
Module Code	NBOT84820
Module Name	Ethnobotany
Module Description	This module will focus on studying the interrelationships between people and plants, historically and cross-culturally. Students will acquire knowledge on the use of plants in the context of their cultural, social and economic significance. Economics of innovative plant-based businesses will be explored. The module will also focus on the state of ethnobotany in southern Africa with a special emphasis on the native flora of South Africa. Students will also acquire a basic understanding of chemical structure and function of medicinally active plant compounds. This knowledge, will enable students to discern how and why plants produce primary and secondary compounds and learn how humans have made use of these compounds. Focus will also be on how modern scientific approaches to ethnobotanical

	investigation are revealing new and exciting applications of plants. Where applicable, case studies will be presented that elucidate the importance of traditional/indigenous knowledge to Western culture. On the practical side, students will gain a basic understanding of ethnobotanical methods of plant collection and will participate in the collection of ethnobotanically relevant plants from their local region.
Module Content	The module will include the following: • Interwoven history of people and plant • Foundations of ethnobotany • Folk classification • Agriculture and the domestication of plants • Native plant use for food and medicine • South African medicinal plants and their chemistry • Contemporary issues in ethnobotany (e.g. intellectual property rights; impacts of over harvesting; conservation; protected plants etc) • Indigenous ethnobotanical knowledge • The economics, ethics and politics around ethnobotany • Plant collection, identification and conservation
Learning Outcomes	At the end of the module, the learner is expected to gain understanding and knowledge of: • The general principles of ethnobotany, including its history and importance in traditional and modern culture

	• Specific topics in ethnobotany such as plant conservation, medical ethnobotany, economics of ethnobotany • The state of ethnobotanical research in Africa with a focus on South Africa • Plant-based business operations in SA, especially in the Northern Cape. • South African medicinal plants from a chemical perspective and their uses. • Different approaches to ethnobotanical research. • Application and blending of traditional/indigenous knowledge with Western scientific knowledge in conservation and management of plant resources. • Application of ethics, including intellectual property rights in the handling, promotion and use of plant genetic resources, including plant indigenous knowledge systems. • The skills and methods used to collect, classify and preserve plant materials
Module Code	NZOO84220
Module Name	Ornithology
Module Description	This module will introduce students to fundamental concepts in ornithology and include topics such as bird classification, bird morphology and structure, adaptations for flight, bird respiration and bird migration. Students will also cover topics in bird diversity and distribution, bird pollination, population regulation and birds and people. In addition, students will familiarise themselves with concepts and processes linked to bird conservation, with

	an emphasis on programmes in South Africa and the Northern Cape. An applied component will include bird ringing and bird monitoring sessions at nearby localities around Kimberley to equip students with appropriate ornithological field techniques.
Module Content	The module will include the following: • Bird classification, diversity and biogeography • Morphology and structure of birds • Flight mechanics and adaptations to flight • Physiology of bird respiration • Understanding bird migration • Role of birds in pollination • Population ecology of birds • Birds, people and conservation • Field techniques for bird study
Learning Outcomes	At the end of the module the learner is expected to be able to understand: • Classification systems of birds and biogeography of bird families, with an emphasis on Southern African bird families • External morphology and internal systems of birds • The key adaptations that make birds perfectly adapted for flight, and understanding the mechanics of flight • The ecological reasons for migration, the navigational systems used by birds when migrating and the different migration strategies employed by different groups.

	• The unique two-cycle respiration process in birds and its adaptations for flight and contributions to the groups' success in the animal kingdom • The role of bird as pollinators and the morphological, physiological and behavioural adaptations for this in different groups • Ecological factors contributing to population regulation in birds, including mortality, fecundity, predation and competition • Threats to birds and conservation measures employed to ensure their protection; there will be a focus on programmes that are relevant to South Africa The practicals/field excursions will give students experience in bird census techniques and tools such as catching and marking birds.
Module Code	NZOO84420
Module Name	Parasitology
Module Description	This module introduces students to the world of Parasites. Apart from their economic importance, an understanding of parasitic diseases is of considerable practical importance. Although the widest possible scope of parasites is dealt with, the emphasis will mostly be on parasites of freshwater fish and livestock The course will focus on the following parasitic groups with reference to morphology (form and function), biology and economic importance: Protista, Platyhelminthes, Aschelminthes, Arthropoda, Minor groups (e.g. Acanthocephala, Pentastomida, etc). Applicable research techniques will be illustrated for different groups.

Module Content	• The internal and external parasites • Contagious stock diseases and their prevention • Arthropod vectors • DDT dilemma in malaria control • The use of GIS in control programme planning • Aerobiology • Infection processes • Host-parasite interactions
Learning Outcomes	At the end of the module the learner is expected to be able to: • Understand the basic concepts of parasitology • Be able to distinguish between internal and external parasites, using relevant examples. • Understand and explain livestock diseases and their control, prevention and treatment. • Be able to apply GIS in the planning and designing of disease control programmes. • Able to understand, explain and differentiate the nature of host-parasite interactions for both external and internal parasites. • Give a detailed discussion of the impact of DDT fauna, why it was stopped, and provide alternatives used today and explain why the alternatives are better.
Module Code	NZOO84620
Module Name	Applied Entomology
Module Description	This module will introduce students to basic insect morphology; higher classification of the class Insecta; designing sampling protocols; collecting and recording insects; biodiversity and assemblages; insect-plant

	interactions; pest outbreak and pest management; economic significance of insect pollinators and current threats to their survival and health; The diverse strategies and counter-strategies that have evolved at the interface between herbivory and plant defences.
Module Content	• Impact of insects on economies • Impacts of insects on human health and well-being • protection of crops from insect herbivores through monitoring • Monitoring of insect outbreaks
Learning Outcomes	At the end of the module the learner is expected to be able to understand: • the basic morphology of insects • the role of insects in economy • different sampling techniques of insects • factors that made insects to be evolutionary successful • different insecticides and their role in insect diversity insects and plants interactions
Module Code	NZOO84820
Module Name	Animal Behaviour
Module Description	In this module students will be introduced to the fundamentals of the scientific study of animal behavior and in particular how behaviour is shaped by the evolutionary forces of natural and sexual selection. Students will assess the scientific rigour of studies used to test behavioural theory, and focus on the research methods used to understand animal behaviour. The module will draw on examples from across the animal

	kingdom to provide illustrations of the often complex mechanisms underlying adaptations, and will be complemented with natural history videos that highlight key concepts. The cost of living and maintenance; reproductive costs. Trade-offs and their measurements
Module Content	The module will cover the following topics: • Scientific methods in studying animal behaviour • Cues, signals and communication • Resource acquisition • Avoiding enemies • Mate choice • Sexual conflict • Parental care • Social behavior • Roles of genes, environments and learning in regulating behavioural diversity
Learning Outcomes	At the end of the module the learner is expected to be able to understand: • The scientific methods used in the study of animal behavior • The communication channels used by different animals • How animals source food • How animals avoid predation • How animals find mates • How animals deal with sexual conflicts • How animals look after their young • How animals interact socially • The genetic basis and environmental factors that shape and regulate animal behaviour

3.2 Bachelor of Science (Honours) in Computer Science

3.2.1 Purpose of the programme

The programme is designed to respond to skills development needs of South Africa and the world at large. It is designed to support enhanced productivity in the development of environment-specific tailored ICT solutions for the industry, commerce, and education. BSc Honours in Computer Science programme supports the development of research skills and creative interventions in the fields of software engineering, design and analyses of algorithms, security and cryptography, and machine learning. Excellency in these fields is heavily integrated in the development of most largescale enterprise systems in demand today. It is, thus, important that more computer scientists be trained by way of a BSc Honours in Computer Science

Two aims that broadly characterize the BSc Honours in Computer Science programme are:

(a) To provide students with enhanced skills and excellency required for advanced application of software engineering methodologies towards ICT solutions in which data management and manipulation is based on creative design and analyses of algorithms, enhanced computer security, and feasible machine learning models. Students should demonstrate an informed understanding of key software engineering methodologies, main machine learning models, computer security, as well as data structures and algorithms useful for tackling the challenges envisioned in today's 4th industrial revolution.

(b) To provide students with a solid foundation for researches into theories, ontologies, frameworks, and practices aimed at advancing knowledge and application of software engineering methodologies in ICT solutions design, advancing knowledge

in the design and analyses of algorithms, machine learning, and security and cryptography. Students should develop substantial research skills useful in higher degree studies e.g. MSc or PhD.

3.2.2 **Programme Structure**

In order to satisfy the qualification requirements, students must take and pass at least 120 credits. The BSc.Hons in Computer Science comprises of five compulsory modules.

Bachelor of Science (Honours) in Computer Science CSC800		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NCOS84040	Research Project	40
First Semester		
NCOS84120	Advanced Algorithm Analysis & Application	20
NCOS84320	Software Engineering	20
Second Semester		
NCOS84220	Computer Security	20
NCOS84420	Machine Learning	20
TOTAL CREDITS FOR QUALIFICATION		**120**

3.2.3 **Module Information**

Module Code	NCOS84040
Module Name	Research Project
Module Description	The research methods and project is a core module of the programme. It introduces students to research, mainly focusing on topics related to research planning, proposal and abstract writing. It gives details regarding how to introduce a research topic, how to state the statement of the problem, how to provide grounds and background to a research topic, as well as how to motivate and justify the worthiness of a topics. Approaches to conducting valuable literature reviews, giving the important parts of literature reviews, elucidating on referencing styles, and how to filter relevant literature towards pinpointing gaps in the body of knowledge are discussed.)
Module Content	• Introduction to research methods • Topic choosing and supervisor relationship • Research project management • Scientific and technical writing • Conducting an electronic based literature search • Ethics of research: Honesty and integrity • Data analysis using statistical software • Publication of research output
Learning Outcomes	Upon completion of this module, students should be able to: Select a topic, plan, and develop a research project proposal for the topic. • Introduce a research topic, clearly stating the statement of the problem, giving sound background, motivation, and envisioned contributions of the work.

	• Filter and present relevant literature, culminating the review with a gap to fill. • Select and justify an appropriate research methodology, choosing a suitable paradigm, valid data collection strategy, participants, and relevant statistics. • Develop good experiment designs for evaluating and testing selected strategies. • Make informed ethical considerations before and during the study. • Demonstrate research competencies by completing the independent research assignment in time, using proper referencing and writing styles, with the aim of possible publication of the research output.
Module Code	NCOS84120
Module Name	Advanced Algorithms Analysis and Application
Module Description	This course introduces students to advanced techniques for the design, analysis and evaluation of algorithms, and explores a variety of areas of applications of the same skills. It discusses different methodologies used to solve real world problems, exposing students to a variety of algorithms and computational resources available in the literature, critically analyzing apparent limitations on solving problems efficiently. The course seeks to develop in students, appropriate mathematical skills for algorithm design, analysis, and evaluation, as well as to develop skills to design and implement efficient programming solutions to various problems.
Module Content	• Asymptotic notations, recurrences, algorithm analysis

	• Divide and conquer algorithms • Greedy algorithms • Dynamic programming algorithms • Amortized analysis • Graph algorithms, • Network Flow: steepest assent, Edmonds-Karp, matching: • Number-Theoretic Algorithms • NP-Completeness
Module Code	NCOS84220
Module Name	Computer Security
Module Description	The module, mainly, investigates policies, standards, protocols, algorithms, services, and mechanism used for detecting, preventing, and reversing computer security attacks in order to ensure confidentiality, integrity, and availability/accessibility/accountability/authenticity of data. It covers aspects of computer security from a wide perspective, including language-based security, network security, and operating systems security using technical mechanisms. Graduates of this module should particularly demonstrate an informed understanding of the number theories applied in cryptography, including the divisibility and division algorithms, uses of greatest common divisors, Euclidean algorithms, modular arithmetic, prime numbers, Fermat's and Euler's Theorems, Chinese remainder theorem, as well as testing entries for primality.
Module Content	• Computer security environment • Cryptography fundamentals • Protection mechanisms for computer systems

	• Authentication and inside attacks • Various system attacks and defensive mechanism • Non-technical Aspects: Administration of security systems; policies; physical security; economics of security; legal and ethical issues
Module Code	NCOS84320
Module Name	Software Engineering
Module Description	This module introduces students to software engineering and its key concepts, practice, standards, and models used for planning, managing, designing, analyzing, and evaluating software projects. It focuses on describing software development life cycle activities required to ensure that software products are developed and delivered on time and within the budget. Students should acquire sufficient software engineering skills, methods, practices, and appropriately apply these skills in the development of environment-specific tailored ICT solutions for the industry, commerce, and education.
Module Content	• Software process • Software modelling • Design and implementation • Software testing strategies • Software security and dependability • Professional software practices and ethics • Advanced topics in software engineering • Software management (project, process and configuration management)
Learning Outcomes	At the end of the module, students are expected to be able to: • Describe the software engineering process, stating

	why it requires management attention, the challenges related to risk management, human resources management, and its impact on productivity and quality. • Describe the various types of software systems, different software engineering techniques, and ethical and professional issues important to software engineers. • Discuss the processes involved in discovering and documenting systems requirements, including user and system requirements, functional and non-functional requirements. • Describe agile software development, including an understanding of the rationale for agile software development methods, the agile manifesto, and the differences between agile and plan-driven development. • Describe graphical models for presenting software systems, including the fundamental system modelling perspectives of context, interaction, structure, and behaviour. • Describe the concepts of software architecture and architectural design, indicating their importance, and the decisions associated with the architectural design processes and architectural patterns. • Describe the principles underlying object-oriented thinking and the methods used to accomplish object-oriented analysis and design. • Explain software security and dependability, in relation to system errors, acknowledging that change is inevitable if systems are to remain relevant.

	• Describe strategies and tactics for software testing and test case design. Students should demonstrate an understanding of the stages of testing (from testing during development to acceptance testing). They should be able to identify those techniques that help them choose test cases geared to discovering program defects using test-first development. • Describe changeover approaches, maintenance, and the costs involved.
Module Code	NCOS84420
Module Name	Machine Learning
Module Description	The module equips the students with knowledge of machine learning concepts to enable them design, test, implement and evaluate general purpose algorithms that facilitates how machines perceive the environment characterized by data. The technical aspect of the course provides students with mathematical concepts and software tools to use machines (computers) to learn to discriminate behavior of interest from the rest and be able to take reasonable decisions. The module emphasizes on the concept of learning, data models and learning approaches, as well as on mathematical underpinnings of learning algorithms.
Module Content	• Concept of learning, data models and learning approaches • Mathematical underpinnings of learning algorithms • Classification, association, regression and clustering methods • Design and analyze machine learning algorithms • Implement various machine learning algorithms in a range of real-world applications

Learning Outcomes	At the end of the module, students are expected to be able to: • Demonstrate an understanding of the theoretical mathematical foundations of machine learning concepts. • Demonstrate a good understanding of the fundamental issues and challenges of machine learning, including, but not limited to, data, model selection, model complexity. • Show an understanding of popular machine learning paradigms and approaches • Analyze, design and evaluate learning systems in unfamiliar problem domains. • Implement real-world ICT solutions using machine learning algorithms.

3.3 **Bachelor of Science (Honours) in Data Science**

3.3.1 **Purpose of the Programme**

The purpose of the qualification is to provide students with a knowledge base, theory and practice of Data Science with specific reference to data collection, analytics and visualization coupled with respective algorithm development. The programme has been designed to specifically focus on computing structures that support "Big Data" challenges. Graduates will contribute immensely in solving analytically complex problems in real life settings such as in industry, Government and other forms of organisations at national and international level. This Honours programme is designed to address challenges of digital transformation that can be attributed to lack of skills and knowledge to efficiently transform data science and its technologies.

3.3.2 **Programme Structure**

The Bachelor of Science Honours in Data Science is a postgraduate qualification at NQF Level 8 and consists of at least 120 Credits.The BSc.Hons in Data Science comprises of seven compulsory modules and one elective module. The Elective Module offered is prescribed by the Head of Department, pursuant to relevant staff, resources and current topic of interest considerations.

Bachelor of Science (Honours) in Data Science		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NPRJ840	Research Project	36
First Semester		
The following 4 modules are **Compulsory**		
NHPC84112	High Performance Computing	12
NCSD84112	Computer Systems for Big Data	12
NLSO84112	Large Scale Optimization	12
NAML84112	Advanced Machine Learning	12
Second Semester		
The following 2 modules are Compulsory		
NDEV84212	Data Exploration and Visualization	12
NDSC84212	Data Security and Cryptographic Systems	12
Choose 1 from the following two Electives		
NMSP84212	Multidimensional Signal Processing	12
NSTD84212	Special Topics in Data Science	12
TOTAL CREDITS FOR THE QUALIFICATION		**120**

3.3.3 **Module Information**

Module Code	NRPJ840
Module Name	Research Project
Module Description	The module is about exploring real world data science challenges and applying relevant research ethics, language and processes such as quantitative or qualitative approaches to address problems.
Module Content	Students will take full responsibility of work and use appropriate resources where necessary. This module is the research project of the programme
Learning Outcomes	At the end of the module the students will be expected to demonstrate knowledge in the application of research methodologies, frameworks and research skills acquired from the programme to engage Data Science challenges emanating for industry, government and other organisations.
Module Code	NCSD841
Module Name	Computer systems for big data
Module Description	The module is an introduction to large-scale distributed systems with an emphasis on big-data processing and storage infrastructures. This course focuses on the computer systems aspects and how various parts of a big data computer system (hardware, system software, and applications) are put together, what are the appropriate

	approaches to realize high performance, scalability, and reliability in practical big data computer systems.
Module Content	Content include fundamental tradeoffs in distributed systems, techniques for exploiting parallelism, big-data computation and storage models, design and implementation of various well-known distributed systems infrastructures, and concrete exposure to programming big-data applications on top popular, open-source infrastructures for data processing and storage systems.
Learning Outcomes	At the end the module, students are expected to synthesis and anayse large scale-data problems emanating from distributed infrastructures for application to real-life scenarios.
Module Code	NLSO841
Module Name	Large scale optimization
Module Description	This module focuses on optimization techniques used to find solutions of large-scale problems that typically appear in statistical learning / data analysis tasks with big data.
Module Content	Content include projected gradient methods, accelerated first order algorithms, conjugate gradient methods, quasi-Newton methods, block coordinate descent, proximal point methods, stochastic sub-gradient algorithms, alternating direction method of multipliers, semi-definite programming, interior-point algorithms for conic optimization, interior-point algorithms for conic optimization, Conic optimization and Barrier functions

Learning Outcomes	At the end of the module the students will be able to conceptualize and synthesize modern optimization techniques suitable for large-scale/big-data problems and be able to apply, and/or modify efficient methods for their own scientific/research problems.
Module Code	NAML841
Module Name	Advanced Machine Learning
Module Description	The module provides students with advanced machine learning techniques necessary for computational analysis that support various learning algorithms such as those used in robotics, data mining, computer vision, text and web data processing.
Module Content	Content include Statistical Theory: Maximum likelihood; Bayes, minimax, parametric versus non-parametric methods; Mathematical Underpinning of theories; Utilization of Models; Deep Learning and Comparative analysis
Learning Outcomes	At the end of the module students are expected to be able to: • Conceptualise principles and theory of machine learning for algorithmic design. • Problematise models for supervised, unsupervised, and reinforcement machine learning for analysis of strength and weakness of respective models. • Interpretation and solve mathematical equations from Linear Algebra, Statistics, and Probability Theory used in these machine learning models. • Design test procedures in order to evaluate a model

	• Experiment several models in order to gain better results • Analyse and make choices for modelling new machine learning tasks based on reasoned argument.
Module Code	NHPC841
Module Name	High Performance Computing
Module Description	This module introduces students to the architecture of several types of high performance computers and their implications on the performance of algorithms on these architectures in order to design and implement efficient algorithms for high-performance computers.
Module Content	The content include High-performance computer architecture, enhancement of performance on single and multi-processor computers, parallelization overheads; performance evaluation; introduction to parallel algorithms.
Learning Outcomes	At the end of the module the students will be expected to synthesize and demonstrate theoretical knowledge of the architecture of several types of high performance computers and be able to design and apply efficient algorithms on such architectures. Further students would be able to conceptualize the current state-of-the art in parallel programming environments, portable software libraries and program development.
Module Code	NDEV842
Module Name	Data Exploration and Visualization
Module Description	The module is to provide students with advanced concepts and roles of data exploration and visualization through use of techniques such as data mining.

Module Content	• Introduction to Upstream exploratory analysis • Machine learning and Clusters • Introduction to Scala • Spark Applications • Configuration of Spark Nodes • Machine learning and Spark • Working with Distributed Datasets • Streaming
Learning Outcomes	At the end of the module students are expected to be able to: • Investigate and synthesize a data-oriented problem area • Apply specialist knowledge through use of specialized architectures and operations. • Experiment, perform data analysis and demonstrate results through use of upstream programs such as Spark. • Application of log mining, textual entity recognition and collaborative filtering techniques to real-world data questions
Module Code	NDSC842
Module Name	Data Security and Cryptographic Systems
Module Description	The module introduces students to the theoretical and practical aspects of data security and cryptographic algorithms and protocols.
Module Content	Content include classical cryptography techniques; mathematical foundations; secret key cryptography; public

	key cryptography; authentication and digital signature; network cryptographic protocols.
Learning Outcomes	At the end of the module the student is expected to be able to synthesize theoretical aspects of data security and cryptographic algorithms and protocols and further be able to design and apply techniques, algorithms, architectures and tools used for data security and cryptography in the data science project environments.
Module Code	NMSP842
Module Name	Multidimensional Signal Processing
Module Description	This module is based introduces students to theory and practical tools used in processing large scale data arising from problems in engineering and computer science.
Module Content	The content includes processing algorithms suitable for large-scale data tasks involving sparse signals as the Sparse Fourier transform. Other introductory topics in the module are the extension of classical signal processing on data indexed by graphs (discrete signal processing on graphs, DSPG). At the end of each topic, illustrative examples with their respective application scenarios, either PYTHON language or in MATLAB, are provided.
Learning Outcomes	At the end of the module the students will be expected to synthesize and demonstrate theoretical knowledge in the application of tools and modelling used in processing large scale data arising from problems in engineering and computer science.

Module Code	NSTD842
Module Name	Special Topics in Data Science
Module Description	Special Topics in Data Science is a unique module based on various emerging technologies of data science. The topics are taught in the last semester of the programme and selected from recent developments and trends in data science or big data technology. The module introduces new or emerging data science or big data technology, and showcase the advanced tool currently used in the industry.
Module Content	Topics covered in module vary and are based on different fields of data science, some include, Astro-informatics, Advanced Big Data Analytics, Advanced Distributed systems, Statistical Machine Learning, Advance R and Python programming languages, SAS programming environment, Data Mining tools, Internet of Things (IoT), New SQL Database Management Systems, Cloud Computing and Data center Networking, etc.
Learning Outcomes	At the end of the module the students will be expected to have exposure with current advances of technical industry based tools used in Data science.

3.4 Bachelor of Science (Honours) in Mathematical Sciences

3.4.1 Purpose of the Programme

The programme is designed to respond to skills development needs of South Africa and the world at large. The program is designed to develop highly qualified students who are analytical and independent thinkers with knowledge of how to model, evaluate and solve both quantitative and qualitative problems in science and technology. The programme also provides a sound theoretical and practical base and exposure to mathematical sciences' disciplines.

Students engage with the necessary theory and practice that will broaden, deepen and intensify their scope of theoretical concepts and expertise in particular areas associated with the mathematical sciences. This qualification also includes a research component which aims at providing students with professional research skills that will enable them to embark on a career as a researcher. Upon successful completion of an honours in mathematical sciences, graduates may articulate to a master's degree in a related field.

The qualifying learners can also be employed in many industries including: finance, economics, engineering, public health, education, and medicine. In all these areas, mathematical scientists work closely with other scientists and researchers to develop mathematical techniques, adapt existing techniques, design experiments, simulations and direct analyses of surveys and retrospective studies.

3.4.2 **Programme Structure**

The length of the program is one year on a full-time basis and two years on a part-time basis, with 120 credits allocated as 75% of course work and 25% as a compulsory research project. The modules in the programme have no rules of progression. The curriculum is developed for three fields of specializations in Mathematical Sciences, namely:

i. Applied Mathematics
ii. Mathematics
iii. Statistics

Bachelor of Science (Honours) in Mathematical Sciences (Applied Mathematics)		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NAPM84030	Research Project	30
First Semester		
NAPM84115	Numerical Linear Algebra	15
NAPM84315	Differential Equations	15
NAPM84515	Advanced Mathematical Programming	15
Second Semester		
NAPM84215	Finite Element Analysis	15
Electives (Choose any two)		
NAPM84415	Differential Geometry	15
NAPM84615	Calculus of Variations	15
NAPM84815	Dynamical Systems	15
TOTAL CREDITS FOR QUALIFICATION		**120**

Bachelor of Science (Honours) in Mathematical Sciences (Statistics)		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NSTA84030	Research Project	30
First Semester		
NSTA84115	Advanced Generalized Linear Models	15
NSTA84315	Multivariate Analysis	15
NSTA84515	Bayesian Analysis	15
Second Semester		
NSTA84215	Advanced Time Series Analysis	15
Electives **(Choose any two)**		
NSTA84415	Stochastic Processes	15
NSTA84615	Spatial Statistics	15
NSTA84815	Operations Research Techniques	15
TOTAL CREDITS FOR QUALIFICATION		**120**

Bachelor of Science (Honours) in Mathematical Sciences (Mathematics)		
Module Code	**Module Name**	**SAQA Credits**
Year Module		
NMAT84030	Pure Mathematics Research Project	30
First Semester		
NMAT84120	Discrete Algebra	20
NMAT84320	Introduction to Functional Analysis	20
Second Semester		
NMAT84220	Group Theory	20
Electives (Choose any two)		
NMAT84615	Graph Theory	15
NMAT84415	Topology	15
NMAT84815	Set Theory	15
TOTAL CREDITS FOR QUALIFICATION		**120**

3.4.3 **Module Information**

Module Code	NAPM84030
Module Name	Applied Mathematics Research Project
Module Description	The purpose of this module is to enable students to gain comprehensive knowledge and skills in literature search, different aspects of research/computational techniques, analysis and interpretation of data and presentation of scientific information in the form of research proposals and written reports based on their computational results. The Honours Research Project incorporates a Research Methodology component, a Mini-Research project and/or practical work conducted under the supervision of an applied mathematics staff member.
Module Content	• Correctly carry out literature search • Compile an applied mathematics research proposal • Write mathematical codes in Matlab, analyze and interpret results • Write a mini dissertation and/or peer reviewed publication under the guidance of a supervisor. • Give an oral presentation to the department of Mathematical Sciences.
Learning Outcomes	At the end of the module learner is expected to be able to: • Write mathematical codes in Matlab and other mathematical software • Analyse and interpret computational results • Write scientific documents using Latex

Module Code	NAPM84115
Module Name	Numerical Linear Algebra
Module Description	The course is a follow up to the basic course of Linear Algebra. Numerical Linear Algebra extends the standard techniques of basic linear algebra. The course introduces iterative methods for solving systems of linear equations and eigenvalue problems of large dimensions. For more moderate size problems matrix factorization methods and their implementation are introduced. It provides analysis (convergence, stability, efficiency) of the problems together with the algorithms used to solve the problems. The course also uses Matlab and other numerical software as a tool for expressing and implementing algorithms and describes some of the key ideas used in developing high performance linear algebra codes.
Module Content	• Linear algebra basics: operation counts, blocks, matrix norms and sensitivity • Matrix Factorizations • Sparse and banded linear systems and iterative methods • Linear least squares problem • Eigenvalue problem
Learning Outcomes	At the end of the module the student is expected to be able to: • Model a real-world problem as a problem in numerical linear algebra • Analyse and discuss the computational efficiency of numerical linear algebra methods for solving systems of linear equations

	• Identify the need of numerical linear algebra techniques, design a method and implement the method in Matlab • Discuss the limitations of the methods • Analyse and discuss the computational efficiency of numerical linear algebra methods for solving eigenvalue problems
Module Code	NAPM84215
Module Name	Finite Element Analysis
Module Description	Finite element methods provide a general and powerful framework for solving ordinary and partial differential equations. This course builds up on the fundamental theory of the finite element method as a general tool for numerically solving differential equations for a wide range of mathematical sciences problems.
Module Content	• Weak formulations of PDEs and formulation of the finite element method. • One and two dimensional applications • Development of finite element codes in Matlab • Finite element methods for the diffusion equation • Finite element methods for the convection-diffusion equation • A priori and a posteriori error bounds
Learning Outcomes	At the end of the module learner is expected to be able to: • Formulate the finite element method and apply it to basic differential equations • Implement the finite element efficiently in order to solve a differential equation • Perform finite element simulations • Extract and interpret results of the numerical simulations

Module Code	NAPM84315
Module Name	Differential Equations
Module Description	The application of Lie groups of transformations to ordinary differential equations (ODEs) is studied. Some of the points addressed are the basic theory of invariance, Lie point symmetries of ODEs, reducing the order of an ODE using a Lie point symmetry, the use of a two-dimensional Lie algebra to solve second-order ODEs, solvable Lie algebras and their use in reducing the order of ODEs, invariant solutions, separatrices and envelope solutions.
Module Content	• Infinitesimal transformations and local groups • First order partial differential equations • Symmetries of differential equations • Integration of first order ODEs using symmetries • Integration of second order ODEs using symmetries
Learning Outcomes	At the end of the module learner is expected to be able to: • Calculate the symmetries for ODEs • Reduce the order of an ODE using Lie point symmetries • Find the invariant solution • Linearize the ODE and system of ODEs using point symmetries • Compute symmetries of ODEs by using computer packages
Module Code	NAPM84515
Module Name	Advanced Mathematical Programming
Module Description	Mathematical programming involves techniques for finding an optimal value of some objective function subject to a set of constraints. Problems of this nature arise as models of decision processes in many areas of Mathematical Sciences. This course covers advanced topics in mathematical programming with particular

	emphasis on optimization problems with a nonlinear objective function and/or nonlinear constraints.
Module Content	• Convex analysis • Optimality conditions for unconstrained and constrained optimization • Nonlinear duality theory • Computational methods for nonlinear programming • Interior point methods for linear programming
Learning Outcomes	At the end of the module the student is expected to be able to: • Interpret and analyse the optimality conditions in optimization • Recognise when to apply optimality conditions for practical problem solving • Learn and apply algorithmic and computational techniques for solving mathematical programs • Use interior point methods to solve linear programming problems
Module Code	NAPM84615
Module Name	Calculus of Variations
Module Description	Calculus of variations deals with problems that are governed by maximum or minimum principles. It can be viewed as a generalization of finding extremal problems in calculus where the variables, instead of being finite dimensional as in ordinary calculus, are functions. This course is an introduction to the classic ideas and techniques of the calculus of variations, with emphasis on its applications in several scientific fields.
Module Content	• Convex analysis

	• Optimality conditions for unconstrained and constrained optimization • Nonlinear duality theory • Computational methods for nonlinear programming • Interior point methods for linear programming
Learning Outcomes	At the end of the module the student is expected to be able to: • Interpret and analyse the optimality conditions in optimization • Recognise when to apply optimality conditions for practical problem solving • Learn and apply algorithmic and computational techniques for solving mathematical programs • Use interior point methods to solve linear programming problems
Module Code	NAPM84815
Module Name	Dynamical Systems
Module Description	Dynamical systems are systems whose state evolves with time over a state space according to a fixed rule. Differential equations model systems throughout science and engineering and display rich dynamical behaviour. This courses focuses on dynamical systems generated by ordinary differential equations. However, the ideas developed in this course are central to all types of dynamical systems. The course will teach the student how to compute the behavior of differential equations as parameters vary.
Module Content	• Linear dynamical systems. • Nonlinear dynamical systems. • Linearization methods for mon-linear dynamical systems.

	• Lyapunov stability theory for nonlinear dynamical systems. • Lagrangian and nonlinear Hamiltonian systems. • Local bifurcations.
Learning Outcomes	At the end of the module the student is expected to be able to: • Describe the main features of dynamical systems and their realisation as systems of ordinary differential equations • Identify fixed points of simple dynamical systems, and study the local dynamics around these fixed points, in particular to discuss their stability and bifurcations • Use a range of specialised analytical techniques which are required in the study of dynamical systems • Describe dynamical systems geometrically and represent them graphically via phase plane analysis • Understand and predict the occurrence and consequences of bifurcations • Explain and prove special properties of finite-dimensional Hamiltonian systems • Understand the statements of the stable and center manifold theorems

Module Code	NMAT84030
Module Name	Pure Mathematics Research Project
Content / Description	To equip a student with the required skills to conduct a literature survey on a chosen mathematical topic and to integrate the knowledge so gathered into a research report as a coherent whole. It enables students to gain comprehensive knowledge and skills in literature search, different aspects of research/computational techniques, analysis and interpretation of data and presentation of scientific information in the form of research proposals and written reports based on their computational results. The Honours Research Project incorporates a Research Methodology component, a Mini-Research project and/or practical work conducted under the supervision of a pure mathematics staff member.
Learning Outcomes	At the end of the module learner is expected to be able to: • Compile a pure mathematics research proposal • Correctly carry out literature search • Write scientific documents using Latex • Write a mini dissertation and/or peer reviewed publication under the guidance of a supervisor. • Give an oral presentation to the department of Mathematical Sciences.
Module Code	NMAT84120
Module Name	Discrete Algebra
Content / Description	The main purpose of this module is to conduct a comprehensive study of the concepts, principles and theories involved in abstract algebra. Furthermore, students are prepared for research orientated problem solving.
Learning Outcomes	On completion of this module, the student should be able to:

	• Do some calculations, analyse and solve problems in the topics covered. • Synthesize their knowledge in essays about the topics covered
Module Code	NMAT84220
Module Name	Group Theory
Content / Description	An introduction to the establishment of a group as a discrete algebraic structure.
Learning Outcomes	On completion of this module, the student should be able to: • Grasp and apply the theory of groups, homomorphisms and factor groups, advanced group theory, rings and fields.
Module Code	NMAT84320
Module Name	Introduction to Functional Analysis
Content / Description	To equip students with a coherent and critical understanding of the basic concepts, principles and methods of Functional Analysis. The module forms the foundation for advanced topics in Functional Analysis and is one of the most important areas in mathematics.
Learning Outcomes	On completion of this module, the student should be able to: • Discuss and define the basic notions of metric, normed and inner product spaces. • Relate inner product spaces and normed spaces to special spaces considered at undergraduate level. • Assemble a basic knowledge of the theory of bounded linear operators defined on normed and inner product spaces, with emphasis placed on dual spaces.

Module Code	NMAT84415
Module Name	Topology
Content / Description	Topology is a universal language used by analysts to solve problems in mathematics and industry. At the end of this module students will be able to define and explain all notions in general topology. They will also be able to apply the principles of topology to solve problems in general topology and related mathematical fields.
Learning Outcomes	On completion of this module, the student should be able to: • Define and give examples of metric and topological spaces. • Investigate the different properties of topological spaces and the relationships between them. • Construct new topological spaces from existing spaces using subspaces, finite and infinite products.
Module Code	NMAT84615
Module Name	Graph Theory
Content / Description	To familiarize and equip students with the basic concepts, principles and methods of Graph Theory. This knowledge will be a basis for further topics in advanced Graph theory.
Learning Outcomes	On completion of this module, the student should be able to: • Formulate core concepts of the introduced topics in Graph Theory. • Prove selected major theorems of the topics introduced. • Apply integrated knowledge on these topics to solve problems.
Module Code	NMAT84815
Module Name	Set Theory
Content / Description	A comprehensive study of the concepts, principles and theories involved in set theory and its relationship with

	respect to other mathematical fields. The knowledge achieved in this module should enable the students to solve algebraic intra and extra-discipline problems.
Learning Outcomes	On completion of this module, the student should be able to: • Define, describe, explain and apply the concepts of set theory. • Demonstrate the knowledge that set-theoretical results are developed mainly from definitions, axioms and mathematical logic. • Describe the construction of sets of numbers from a set-theoretical point of view. • Prove set-theoretical results. • Apply set theory in solving set-theoretical problems.
Module Code	NSTA84030
Module Name	Statistics Project
Module Description	The purpose of this module is to enable students to gain comprehensive knowledge and skills in literature search, different aspects of research/computational techniques, analysis and interpretation of data and presentation of scientific information in the form of research proposals and written reports based on their computational results. The Honours Research Project incorporates a Research Methodology component, a Mini-Research project and/or practical work conducted under the supervision of a Statistics staff member.
Module Content	• Correctly carry out literature search • Compile a Statistics research proposal • Use appropriate Statistical software package to analyze data and interpret results

	• Write a mini dissertation and/or peer reviewed publication under the guidance of a supervisor. • Give an oral presentation to the department of Mathematical Sciences.
Learning Outcomes	At the end of the module learner is expected to be able to: • Use appropriate Statistical software package like SAS, SPSS, R to analyze data and interpret results • Analyse and interpret computational results
Module Code	NSTA84115
Module Name	Advanced Generalized Linear Models
Module Description	To provide the student with a thorough understanding of generalized linear models and to expose the student to a range of practical problems in that area.
Module Content	• The principles of model fitting. Exponential family of distributions and generalized linear models. • Estimation and inference for generalized linear models. Binary responses and logistic regression. • The Poisson regression model. Contingency tables and log-linear models. • A miscellany of additional topics in generalized linear models.
Learning Outcomes	At the end of the module learner is expected to be able to: • Apply the principles of model fitting. • Apply the Poisson regression model. • Use the contingency tables and log-linear models.
Module Code	NSTA84215
Module Name	Advanced Times Series Analysis
Module Description	The objective of this course is to learn and apply statistical methods for the analysis of data that have been observed over time. Our challenge in this course is to account for the

	correlation between measurements that are close in time. The course will provide a thorough understanding of the theory and computer applications of time series techniques.
Module Content	• Box-Jenkins ARIMA and SARIMA models. • Intervention Models • Smoothing and Decomposition Models • Garch and Arch Models. • Transfer Function Models Spectral Analysis • State Space Models.
Learning Outcomes	At the end of the module the student is expected to be able to: • Appreciate the important features that describe a time series, and perform simple analysis and computations on series. • Appreciate and apply key concepts of estimation and forecasting in a time series context. • Understand and apply the theory and methodology of the analysis of time series in the frequency domain. • Describe the key time—domain features of bivariate time series.
Module Code	NSTA84315
Module Name	Multivariate Analysis
Module Description	To acquaint the student with the principles, techniques and applications of methods of the statistical analysis of multivariate data. Again this module aims to provide students with the expertise to confidently come to the right conclusions when analysing multivariate data.
Module Content	• The matrix normal distribution, correlation structures and inference of covariance matrices.

	• Discriminant analysis. Principal component analysis. The biplot. • Multidimensional scaling. Exploratory factor analysis. Confirmatory Factor analysis and structural equation models.
Learning Outcomes	At the end of the module learner is expected to be able to: • Describe and apply the principles and techniques of a variety of multivariate statistical techniques, both in their inferential and data analysis aspects.
Module Code	NSTA84415
Module Name	Stochastic Processes
Module Description	The course is an introduction to Stochastic Processes. It focuses on Markov chains, Poisson Process, Renewal Process and Wiener Process
Module Content	• Random Variables and Random Vectors • Generating Functions and their Applications • Markov Chains • Convergence of Random Variables • Poisson Processes • Renewal Processes • Wiener Processes
Learning Outcomes	At the end of the module learner is expected to be able to: • State the defining properties of various stochastic process models • Identify appropriate Stochastic process models for a given problem • Apply the theory of Stochastic process to real life problems

Module Code	NSTA84515
Module Name	Bayesian Analysis
Module Description	This module introduces the philosophy and methods of Bayesian analysis. The module covers important concepts of Bayesian analysis with wide applications to real life problems.
Module Content	• The philosophy of Bayesian analysis • Introduction to Concepts of Bayesian analysis • The Bayesian approach to Hypothesis testing • The Bayesian Inference • Bayes Estimations • Bayes Estimators (Loss functions)
Learning Outcomes	At the end of the module learner is expected to be able to: • Understand the philosophy of Bayesian analysis • Carry out Hypothesis testing using the Bayesian approach • Solve real life problems in Bayesian inference • Perform estimations using a Bayesian approach
Module Code	NSTA84615
Module Name	Spatial Statistics
Module Description	This course provides the student with an understanding of the modelling and analysis of data which are spatially distributed, and in which the correlation between two observations is a function of the distance between them.
Module Content	• Introduction to spatial random variables and spatial data • Definition of the variogram and its properties; models for the variogram and its estimation, either non-parametrically or via maximum likelihood; spatial prediction and kriging.

	• Simple and ordinary kriging; change of support and block kriging; co-kriging and universal kriging.
Learning Outcomes	At the end of the module learner is expected to be able to: • Draw conclusions from spatial data • Interpret the results of spatial statistical analysis • Select appropriate methods of spatial statistics
Module Code	NSTA84815
Module Name	Operations Research Techniques
Module Description	The purpose of this module is to empower learners with a sound understanding of advanced concepts in Operations Research and equip them with the necessary techniques that are applied in solving real life problems that are normally faced in industry and commerce:
Module Content	• Model formulations. Transportation: Initial feasible solution methods—North-West Corner, Least Cost, Vogel's Approximation. • Balanced and unbalanced problems, unacceptable routes, degeneracy, Transshipment problems, Assignment problems. • Integer Programming: model formulation. Solution methods: graphical, branch and bound method, cutting plane algorithm, implicit enumeration method. Goal programming: model formulation. • Decision Theory and Decision Tree Analysis. • Game Theory. Goal programming algorithms—the weighting and pre-emptive methods.
Learning Outcomes	At the end of the module the student is expected to be able to: • Understand the different types of models and identify the relevant models to solve real life problems

	• Optimise costs (min/max) when solving real life problems • Optimise the allocation of scarce resources • Select the best among several decisions through a proper evaluation of the parameters of each decision environment • Model and solve real life problems using software packages

3.5 Bachelor of Science Honours in Physical Science

3.5.1 Purpose of the Programme

Bachelor of Science Honours in Physical Science is a postgraduate qualification at NQF Level 8 and consists of at least 120 Credits.

The purpose of the BSc (Hons) programme is to equip graduates with a vast knowledge in physical sciences which comprises of advance topics in chemistry, physics and geography and an incorporation of a research project. The knowledge and skills gained by graduates will serve as a foundation for further studies in higher degrees of sciences. Graduates in this programme will contribute meaningfully to the rapid development of new technologies which over the years created a growing demand in academia, the public sector, the private sector and industry for suitably trained scientists for the required global competencies.

This Honours programme is developed to critically solve the scientific problems effectively using scientific methods and related societal challenges confronting many ordinary citizens of the World and be able to communicate advanced scientific knowledge and research findings. Furthermore, this qualification also includes a research project which primarily aims at introducing students to the postgraduate level experience with required set of skills and knowledge creation that will facilitate the students journey as professional researchers/scientists and academics.

3.5.2 **Programme Structure**

In order to satisfy the qualification requirements, students must take and pass at least 120 credits. The BSc.Hons in Physical Science comprises of at least five or six compulsory modules and elective modules **(Choose ONE with 16 credits OR TWO with 8 credits)**. The qualification is presented over one year on a full-time basis and two years on a part-time basis. The curriculum is developed for three fields of specializations in Physical Sciences, namely:

(i) Chemistry
(ii) Geography
(iii) Physics

Bachelor of Science (Honours) in Physical Science: Chemistry Stream		
1st Semester		
Module Code	**Module Name**	**SAQA Credits**
NCHM84116	Advanced Organic Chemistry	16
NCHM84316	Advanced Inorganic Chemistry	16
NCHM84516	Polymer Chemistry / Nanotechnology	16
Total Credits for Semester 1 Modules		**48**
2nd Semester		
NCHM84216	Advanced Physical Chemistry	16
NCHM84416	Advanced Analytical Chemistry	16
Total Credits for Semester 2 Modules		**32**
Year Module		
NCHM84040	Chemistry Research Project	40
TOTAL CREDITS FOR QUALIFICATION		**120**

Bachelor of Science (Honours) in Physical Science: Geography Stream		
1st Semester		
Module Code	**Module Name**	**SAQA Credits**
NGEO84120	Advanced GIS & Remote Sensing	20
NGEO84320	Applied Urban Geography	20
Total Credits for Semester 1 Modules		**40**
2nd Semester		
NGEO84220	Applied Geomorphology	20
NGEO84420	Environmental change	20
Total Credits for Semester 2 Modules		**40**
Year Module		
NGEO84040	Research Project	40
TOTAL CREDITS FOR QUALIFICATION		**120**

Bachelor of Science (Honours) in Physical Science: Physics Stream		
1st Semester		
Module Code	**Module Name**	**SAQA Credits**
NPHY84116	Classical Mechanics and Statistical Physics	16
NPHY84316	Quantum Mechanics	16
NPHY84516	Classical Field Theory	16
Total Credits for Semester 1 Modules		**48**
2nd Semester		
NPHY84216	Solid State Physics	16
Elective Modules (Choose ONE with 16 credits OR TWO with 8 credits)		
NPHY84416	Mathematical and Computational Physics	16
NPHY84608	Nuclear Physics	08
NPHY84808	Astrophysics	08
Total Credits for Semester 2 Modules		**32**
Year Module		
NPHY84040	Research Project	40
TOTAL CREDITS FOR QUALIFICATION		**120**

Bachelor of Science (Honours) in Physical Science: Physics Stream		
1st Semester		
Module Code	**Module Name**	**SAQA Credits**
NPHY841	Classical Mechanics and Statistical Physics	16
NPHY843	Quantum Mechanics	16
2nd Semester		
NPHY844	Mathematical and Computational Physics	16
NPHY846	Nuclear Physics	08
NPHY848	Astrophysics	08
Total Credits for Semester 2 Modules		32
Year Module		
NPHY840	Research Project	40
TOTAL CREDITS FOR QUALIFICATION		**120**

3.5.3 **Module Information**

Module Code	NCHM84116
Module Name	Advanced Organic Chemistry
Module Description	An extensive part of this module will be devoted to the design of syntheses of moderately complex molecules using the disconnection approach as an aid in synthetic planning. The aim is to promote a critical awareness of what constitutes good synthetic strategy, while at the same time allowing ample opportunity for the student to display his/her own creativity. Analysis of published synthetic routes to target molecules will also be used to illustrate the principles of synthetic design. In the spectroscopy section, students will be required to solve problems in a tutorial format. The aim will be to provide a working knowledge of a number of methods used in the determination of molecular structure, the emphasis being on the interpretation of spectra rather than the theory of nuclear magnetism.
Module Content	• Functional Group Interconversion. • Retrosynthetic analysis • Advanced Organic Synthesis: Strategy and Control • Advanced Organic Spectroscopy.
Learning Outcomes	• Students should have an understanding of the use in organic synthesis of a range of chemical transformations which exploit reactions involving main group elements and transition metal complexes and be able to device syntheses of molecules of varying structural complexity using this knowledge. • Design strategies for the efficient synthesis of a range of organic molecules, including the use of suitable reagents to effect chemo-, regio- and stereoselective reactions.

	• Know the principles that govern chemical reactivity and use them to make predictions about the mechanisms and outcomes of chemical reactions. • Determine molecular structures from Nuclear Magnetic Resonance (NMR) and other organic spectroscopic techniques.
Module Code	NCHM84316
Module Name	Advanced Inorganic Chemistry
Module Description	To provide students with advanced disciplinary knowledge in transition metal chemistry. The modules will focus on the chemistry of transition metal and study the electronic properties of the metal complexes. The topic will further discus the how transition metals are used in the transformation of reactants into high valuable compounds by focus on organometallic chemistry and homogeneous catalysis.
Module Content	• This course covers aspects of advanced main group coordination chemistry; • Electronic structure and bonding in transition metal complexes • Electronic spectra of transition metal complexes • Introduction to bioinorganic chemistry • Reaction mechanisms of Inorganic reactions • Organometallic Chemistry • Homogeneous catalysis
Learning Outcomes	• Interpret and analyse vibrational and electronic spectroscopic data for transition metal complexes. • Rationalize electronic structure and bonding in d-metal complexes. • Describe reactivity principles of organometallic and coordination complexes

	• Describe the application of transition metal complexes in catalysis and bioinorganic chemistry
Module Code	NCHM84516
Module Name	Polymer Chemistry / Nanotechnology
Module Description	This course will introduce certain aspect of applied chemistry in the nanoscience. This topic deals with the fundamentals of fabrication and characterization of two-dimensional structures at the nanoscale. Two approaches of fabrication are discussed, namely the 'top-down' approach and the 'bottom-up' approach. Synthesis and Characterization of nanomaterials. The techniques of making and characterizing two-dimensional structures on the nanoscale will be extensively covered. These will help students to appreciate the special properties and novel nano-scopic phenomena that these structures might have. Students will also be introduced to theories of more advanced instrumental techniques and how these are used to characterize particular types of nanomaterials and structures. Furthermore, application of nanomaterials in different industries will be discussed.
Module Content	**Introduction to Nanotechnology** **Synthesis Techniques to produce nanomaterials** • Differentiate between top-down and bottom-up approach, green chemistry, film growth and vacuum science, physical vapour deposition (PVD), chemical vapour deposition (CVD) and atomic layer deposition (ALD), self-assembly, patterning and lithography, molecular imprinting methodologies and applications. • Synthesis of carbon nano-allotropes (Carbon nanotubes/spheres/graphene), modification for different applications • Synthesis of quantum dots, rods, etc.

	Characterization of Nanomaterials • Atomic force microscopy (AFM) and scanning microscopes, scanning tunneling microscopy (SEM)/Scanning electron microscopy (SEM)/ transmission electron microscopy (TEM), Surface Fourier Transform Infrared (FTIR) and Raman spectroscopy, **Application of Nanomaterials** • The use of nanomaterials in environmental friendly processes • Energy applications (i.e. solar cells) • Fuel production processes • Biomedical applications (e.g. Drug delivery)
Learning Outcomes	• Demonstrate knowledge of surface properties in various sizes of stricture • Fabrication two-dimensional structures at the nanoscale • Carry out various approaches required synthesis different types of nanomaterials • Apply methods used to characterise nanomaterials • Demonstrate how nanomaterials are used in various aspects of science.
Module Code	NCHM84216
Module Name	Advanced Physical Chemistry
Module Description	To provide students with the qualities and transferable skills necessary for employment requiring: the exercise of initiative and personal responsibility; decision-making in complex and unpredictable contexts; and, the learning ability needed to undertake appropriate further training of a professional or equivalent nature. The principles and techniques of modern and advance physical chemistry are applied to the study of the surface interface. The observation of macroscopic behaviour is

	linked to processes on the molecular scale at the interface. The considerations amongst others include applications in energy storage, pollution control and fuel cells.
Module Content	• Adhesion and coatings chemistry • Surface and interfacial processes • Electrochemical energy conversion and storage • Polymer thermodynamics • Chemical Kinetics/Photochemistry • Solid state reactions Quantum theory and molecular materials
Learning Outcomes	Having successfully completed this module you will be able to: • Be fully conversant with major aspects of physical chemistry related to chemical kinetics, surface science, and reactions at interfaces • Demonstrate a systematic understanding of fundamental physicochemical principles with the ability to apply that knowledge to the solution of theoretical problems related to chemistry at interfaces • Develop an awareness of issues within chemistry that overlap with other related subjects including environmental impact, sustainability and climate change, in the context electrochemical energy conversion and storage • Read and engage with scientific literature
Module Code	NCHM84416
Module Name	Advanced Analytical Chemistry
Module Description	The purpose of this module is to equip learners with a sound understanding of further concepts on the sample pre-treatment and instrumental analysis techniques and how they could be applied in solving real life problems. Students who have

	completed this module can explain concepts on the sample pre-treatment and instrumental analytical techniques and apply them in solving real life problems. They can prepare real samples for analysis, select suitable sample pre-treatment and instrumental methods of analysis to generate quality creditable data. The students are expected to apply the acquired skills in solving qualitative and quantitative analytical problems. Sample-pretreatment techniques, molecular and atomic spectroscopy, analytical separations including gas-liquid chromatography and high performance liquid chromatography; electroanalytical methods and their applications are covered.
Module Content	• Signal and Noise • Spectrometric Methods: Atomic absorption and atomic emission, Surface analysis techniques, Mass Spectrometry, Molecular spectroscopy • Separation Methods: Extraction, chromatographic systems • Sample preparation
Learning Outcomes	At the end of the module the student is expected to be able to: • Investigate fundamental interactions between analyte and energy source (e.g. electromagnetic, electrical, mechanical, nuclear) in generating an analytical response • Critically appraise and compare suitable molecular and atomic spectroscopy techniques for the solution of a given analytical problem • Demonstrate an understanding of mass spectrometry as an analytical tool • Explain and appraise the principles and applications of separation techniques

	• Explain and appraise the principles and applications of sample pre-treatment techniques
Module Code	NCHM84040
Module Name	Chemistry Research Project
Module Description	The purpose of this module is to enable students to gain comprehensive knowledge and skills in literature search, different aspects of research/experimental techniques, analysis and interpretation of data and presentation of scientific information in the form of research proposals and written reports based on their laboratory work. The Honours Research Project incorporates a Research Methodology component, a Mini-Research project and/or practical work conducted under the supervision of a chemistry staff member for each chemistry sub-discipline.
Module Content	• Correctly carry out literature search • Compile a chemistry research proposal • Conduct experimental research, collect data, analyze and interpret results • Write a mini dissertation and/or peer reviewed publication under the guidance of a supervisor. • Give an oral presentation to the department of Physical Sciences.
Learning Outcomes	• Identify and apply a range of methodologies to conduct a research problem that conforms to safety requirements. pertinent to good laboratory practice in the physical sciences. • Produce a research project in a scientific format within the context of the physical sciences. • Communicate advanced scientific knowledge and research findings both orally and in written form.

Module Code	NGEO84120
Module Name	Advanced GIS & Remote Sensing
Module Description	The aim of the module is to provide knowledge and understanding of image analysis and information extraction methods in GIS and remote sensing. The significance is on providing students with knowledge and skills essential to process imagery to obtain varied biophysical and geospatial information. The teaching consists of brief lectures, followed by discussions and practical exercises.
Module Content	• Visual Interpretation of remotely sensed images; Image pre-processing; Image enhancement; Image transformations; Image classifications; Multispectral analysis; Hyperspectral analysis; Landcover classification • Review in utilising GIS for fundamentals; basic and advanced analysis techniques in GIS.
Learning Outcomes	At the end of the module the student is expected to be able to: • Demonstrate a sound knowledge and understanding of the use and application of geospatial technologies • Process satellite images in the spatial, spectral, and temporal spheres (filtering, time series analyses, classification, pattern recognition) Use remotely sensed data and GIS techniques for various applications such as planning, environmental monitoring and natural resource management
Module Code	NGEO84220
Module Name	Applied Geomorphology
Module Description	This course aims at providing an in depth knowledge of the geomorphologic processes responsible for the creation of the morphology in fluvial and arid environments. It deals with the

	study of geomorphologic processes through explanation of the interrelationships between environmental conditions, rock/sediment properties, transport agents and landscape forms. Focus is put on quantifying and modeling geomorphologic processes in order to understand the behavior of complex geomorphologic systems.
Module Content	• Introduction to applied geomorphology and natural hazards • Contribution of geomorphology in the development of environmental studies • South Africa geomorphological hazards • Geomorphological mapping • Geomorphological analysis
Learning Outcomes	• Knowledge of societal importance of applied geomorphology • Provide a reasoned account of the nature and variety of geomorphological form and process. • Give a detailed explanation of geomorphological processes in a variety of environments • Ability to identify, map, investigate and monitor natural and man-made geomorphological hazards.
Module Code	NGEO84320
Module Name	Applied Urban Geography
Module Description	Geography of everyday living is an important concept considered by contemporary human geographers as a way of thinking about the places in which we live and the spaces we move through on a daily basis. Students also examine the numerous geographical problems related to how resource use and environmental change can influence the quality of life in various circumstances.

Module Content	• Urban morphology and change • The administrative structure and functions of African cities • Squatter settlements in developing countries • Migration as an urban phenomenon in South Africa
Learning Outcomes	• Analyse the spatial inequalities in a residential landscape • Examine philosophies and methodologies and principles relating to geography of everyday living • Analyse problems and prospects of micro-enterprises in the South African urban economy
Module Code	NGEO84420
Module Name	Environmental change
Module Description	This module offers an introduction to the major issues in the study of environmental change. Environmental degradation and change has become an increasingly evident occurrence, especially with the increase in greenhouse gas emissions, increasing frequency of extreme weather events which may be linked to climate change, biodiversity loss, and other critical challenges. Case studies are drawn from key regions that are vulnerable to environmental change and others that are driving environmental change and assisting with solutions.
Module Content	• The changing biosphere • Past, present and future climate • Human evolution Human impacts on environments
Learning Outcomes	• Understand environmental change and the mechanisms underpinning current changes to the climate system • Acknowledge the spatio-temporal patterns and interrelationships of natural and anthropogenically-induced phenomena

	Understand landscape responses to environmental change and how these responses impact the natural and built environments
Module Code	NGEO84040
Module Name	Research project
Module Description	The Geography Research Project is designed for students to develop advanced skills in carrying out independent and sustained research in Geography.
Module Content	• The thesis should demonstrate a critical application of specialist knowledge and make an independent contribution to existing scholarship in the area of research.
Learning Outcomes	Students who complete this subject will • produce a thesis on a research project dealing with an area of Geography; • demonstrate an ability to present, argue and demonstrate a coherent hypothesis on an issue in Geography, supported by research and analysis; and • demonstrate an aptitude for original research
Module Code	NPHY84116
Module Name	Classical Mechanics and Statistical Physics
Module Description	The Classical Mechanics part aims to provide students with an opportunity to develop knowledge and understanding of the key principles and applications of classical mechanics, and their relevance to current developments in physics. The mathematical framework developed in this course will consist of advanced mathematical and numerical techniques that will provide a solid mathematical background used in all modern physics.

	The Statistical Physics part aims to provide students with an opportunity to develop knowledge and understanding of the key principles and applications of Statistical Physics, and their relevance to current developments in physics. The module builds on the theoretical foundations, give light, it introduces the dealing with interaction among particles. The module opens the world on phase transitions from a microscopic point of view and their descriptions. Investigation how systems of large numbers of particles behave when disturbed from equilibrium. The module also provides tools and opens door to the study of matter from the collective point of view.
Module Content	• Lagrangian Mechanics - Constraints, configuration space, D'Alembert's principle, and a variational approach to mechanics, • Noether's theorem and symmetry, • Hamiltonian Mechanics - Hamilton's equations of motion, Dynamical systems and their geometry, • Poisson brackets and canonical transformations, Integrable systems, • Statistical ensemble theory • Phase transitions and critical phenomena • Mayer cluster expansion method • The role of interactions is further investigated by the study of phase transitions using mainly the Ising model as a prototype and scaling laws, • Approximations methods • Statistical Physics • Simulations methods • Langevin dynamics, the fluctuation-dissipation

	• Boltzmann's H-theorem are treated as an introduction to nonequilibrium statistical mechanics • Stochastic differential equations (Fokker-Planck equations).
Learning Outcomes	At the end of the module the student is expected to be able to: • Apply advanced Newtonian methods to complex motion problems, • Demonstrate an intermediate knowledge of oscillatory motion, • Describe and model the oscillations of damped and undamped systems, • Apply Lagrangian and Hamiltonian methods to complex motion problems, • Apply advanced methods to complex central-force motion problems, • Understanding of both the formal aspects of statistical mechanics and of applying these in order to understand real systems. • Understanding and demonstrate the concept of scaling in phase transitions, • The student will also develop skills in the most important approximation methods in statistical physics
Module Code	NPHY84316
Module Name	Quantum Mechanics
Module Description	To provide students with an opportunity to develop knowledge and understanding of the key principles and applications of quantum mechanics, and their relevance to current developments in physics. The mathematical framework developed in this course will consist of advanced mathematical

	and numerical techniques that will provide a solid mathematical background used in all modern physics.
Module Content	• Fundamental - Bra and ket spaces, state vectors and basis states. Matrix representations and change of basis. Dynamical variables, their operators and the simultaneous measurement of different variables. Continuous bases with application to the position and momentum bases and their mutual transformations. • Quantum dynamics - Time development of states, the time-dependent Schrödinger equation and the energy-time uncertainty relation. The Heisenberg picture, Heisenberg equation of motion and applications. • Angular momentum - The rotation operator in terms of the angular momentum operator J and the characteristic non-commuting property of the components of J. Eigenvalues and eigenvectors. The coupling of angular momenta and the calculations of Clebsch-Gordan coefficients. • Time dependent perturbation theory Time dependent potentials, the interaction picture and time dependent perturbation theory with applications. • Scattering theory - The Lippmann-Schwinger equation, Born approximation, phase shifts and the optical theorem.
Learning Outcomes	At the end of the module the student is expected to be able to: • Develop a knowledge and understanding of the concept that quantum states live in a vector space, • Develop a knowledge and understanding of the meaning of measurement, • Develop a knowledge and understanding of perturbation theory, level splitting, and radiative transitions,

	• Develop a knowledge and understanding of the scattering matrix and partial wave analysis.
Module Code	NPHY84416
Module Name	Mathematical and Computational Physics
Module Description	This module builds on the essential mathematics module to develop further mathematical and computational skills as an aid to understanding and exploring physics concepts. The computational part of the course consists of a series of assessed exercises, with classroom support, which develop computational problem solving skills, and link in with the mathematics covered elsewhere in the module.
Module Content	• Finite-dimensional vector spaces, infinite-dimensional vector spaces, • Complex variables and contour integration, • Tensor analysis, • Partial differential equations of physics, special functions, and their application to physics. • Laplace transforms, Fourier Transforms, Generalized Functions and Green's Functions, • Basic numerical methods and programming, • Computational solution of partial differential equations in physics, • Computational analysis and visualisation of data in physics.
Learning Outcomes	At the end of the module the student is expected to be able to: • Test numerical and functional series for their convergence properties, • Be able to solve simple first- and second-order ordinary differential equations. • Be able to compute and manipulate partial derivatives,

	• Be able to use matrices to represent and solve sets of linear equations, • Independently program computers using leading-edge tools • Be able to use computational techniques to solve unseen problems in mathematics and physics, confidently using appropriate syntax and algorithm design, • Demonstrate skills in debugging and in graphical presentation, • Formulate and computationally solve a selection of problems in physics
Module Code	NPHY84608
Module Name	Nuclear Physics
Module Description	The Nuclear physics part of the module equips students with knowledge of nuclear structure, properties, reactions mechanisms and detection on a post graduate level. The course features both theoretical and practical aspects of nuclear physics and forms the basis for more advanced courses in nuclear physics and postgraduate nuclear physics research.
Module Content	• Nuclear forces: the laws of invariance. • Boson field theories and phenomenological potentials. • Few-nucleon systems. • The theory of nuclear structure: nuclear systematics. • Nuclear reactions and Scattering. • Nucleon-nucleon scattering. • Nuclear properties. • Nuclear models. • Nuclear decay • Applications in nuclear and particle physics

Learning Outcomes	By the end of the course students will be able to: • demonstrate a knowledge and broad understanding of nuclear physics. • describe and analyse both qualitatively and quantitatively processes, physical laws, relationships and techniques relevant to the topics included in the course outline, • apply nuclear physics based ideas and techniques to solve practical and theoretical problems which may include straightforward unseen elements. • apply acquired concepts and skills to develop insight into subatomic physics and nuclear technology.
Module Code	NPHY84808
Module Name	Astrophysics
Module Description	The purpose of this module is to enable students to be familiar with basic radiation physics in the astrophysical context. The module will feature fundamentals of radiative transfer.
Module Content	• Basic theory of radiation fields • Radiation from moving charges • Relativistic covariance and kinematics • Bremsstrahlung • Synchrotron radiation • Compton scattering • Atomic structure • Radiative transitions.
Learning Outcomes	• Develop understanding of basic processes responsible for electromagnetic radiation from astrophysical sources. • Formulate and discuss models for astrophysical sources and environment of the radiative zones.

	Discuss and explain astrophysical data over the electromagnetic spectrum, as collected by space- and ground-based instruments.
Module Code	NPHY84516
Module Name	Classical Field Theory
Module Description	The Electrodynamics module builds on the electromagnetism and aims at exposing student to a deeper and more advanced understanding of Maxwell's equations, their physical consequences and applications. Firstly, it consolidates the student's knowledge and skills base through a review of Electricity and Magnetism, Electromagnetism and Electrodynamics. It then proceeds to more advanced applications of Maxwell's equations with the eventual aim of equipping students with the necessary knowledge and skills base to apply Maxwell's equations in a variety of physical systems and to appreciate the physical consequences of these equations. It prepares theory and experimental physics students for various advanced modules using concepts from electromagnetism.
Module Content	• Electrostatics and applications to boundary value problems • Electric multipoles and electric fields in media • Magnetostatics • Time-dependent fields • Gauge transformations • Electromagnetic waves, their absorption in and transition between different media • Relativity and electromagnetism • Theory of radiation
Learning Outcomes	At the end of the module the student is expected to be able to:

	• Exposing student to deeper and more advanced understanding of Maxwell's equations, their physical consequences and applications. • Consolidates the student knowledge and skill base through a brief review of undergraduate material. • Interpret and apply the laws, techniques and methods of electrodynamics.
Module Code	NCHM84216
Module Name	Solid State Physics
Module Description	The Solid Sate course is intended to introduce fundamental concepts and techniques for describing matter in its solid state. Students who complete the course will be familiar with the basic physical principles underlying a variety of fundamental phenomena in the solid state. The module will cover standard approximations, models and methods concerning this discipline. Important applications in current-day technology, industry, and research will be introduced as well.
Module Content	• Electronic band structure, • Vibration properties of solids, • Electronic properties of defects, • Electric transport, • Optical properties, • Quantum confinement.
Learning Outcomes	At the end of the module the student is expected to be able to: • apply the basics of modern theory of crystals • to apply experimental methods to study crystals and know the important electronic properties of metals and semiconductors • do literature searches in related subjects and to know the main research tools in the field

Module Code	NPHY84040
Module Name	Research project
Module Description	The purpose of this module is to enable students to gain comprehensive knowledge and skills in literature search, different aspects of research/experimental techniques, analysis and interpretation of data and presentation of scientific information in the form of research proposals and written reports based on their laboratory work. The Honours research project incorporates a research methodology component, a mini-research project and/or practical work conducted under the supervision of a physics staff member for each sub-discipline.
Module Content	• Correctly carry out literature search • Compile a physic research proposal • Conduct experimental research, collect data, analyze and interpret results • Write a mini dissertation and/or peer reviewed publication under the guidance of a supervisor. • Give an oral presentation to the department of physical sciences.
Learning Outcomes	• Identify and apply a range of methodologies to conduct a research problem that conforms to safety requirements pertinent to good laboratory practice in the physical sciences. • Produce a research project in a scientific format within the context of the physical sciences. • Communicate advanced scientific knowledge and research findings both orally and in written form

4. STAFF INFORMATION

Members of Staff

Administrative Staff		
Head of School	**Gelebe AC, Prof**	PhD, MSc (RU), BSc Hons, BSc (UNIVEN)
School Registrar	**Mathimba N, Ms**	B Admin (Hons), PGDip (UFH), BTech, N Dipl. (WSU)
Officer	**Mqongwana U, Ms**	BTech, N Dipl (WSU)
Senior School Administrator	**Sediti A, Ms**	Dipl (NC TVET)
School Administrator	**Lesiba K, Mrs**	
Academic Staff (*Head of Department)		
Department of Biological and Agricultural Sciences		
Senior Lecturers	***Harebottle DM**, **Dr** (Zoology)	PhD (UCT), MSc, BSc Hons, BSc (UKZN)
	Musvuugwa T, Dr (Botany)	PhD (SU), MSc (UCT), BSc Hons (NUST, Zimbabwe)
	Shadung KG, Dr (Plant Production)	PhD, MSc, BSc (UL)
Lecturers	**Bopape MA, Ms** (Agriculture)	MTech, BTech (TUT)
	Modiba RV, Mr (Zoology)	MSc, BSc Hons, BSc (UNIVEN)

	Nenzhelele E, Ms (Botany)	MSc (UCT), BSc Hons, BSc (UNIVEN)
Laboratory Technician	**Digashu M, Ms** (Biology/Zoology)	BSc Hons, BSc (UFS)
	Letebele PK, Ms (Biology/Botany)	BSc Hons, BSc (UFS)
Department of Computer Science and Information Technology		
Associate Professors	**Oluwagbemi O, Prof** (Computer Science)	PhD (CU, Nigeria), MSc (UI, Nigeria), BSc (UI, Nigeria)
Senior Lecturers	**Arasomwan MA, Dr** (Computer Science)	PhD (UKZN), MSc, BSc Hons, Dip (UNIBEN, Nigeria)
	Gundu T, Dr (Information Systems)	PhD, MCom, BSc Hons, BSc (UFH), Diploma (BCE, UK)
	Obagbuwa IC, Dr (Computer Science)	PhD (UKZN) Msc (UNIPORT, Nigeria), BSC.HONS (UNILORIN, Nigeria)
	Olusanya MO, Dr (Computer Science)	PhD (UKZN), M.Sc.(ATBU, Nigeria)
	Tuyikeze T, Dr (Information Technology)	PhD (UFH), MIT (NMMU), BTech (NMMU), N. Dipl. (WSU)
Lecturers	***Baitshenyetsi T, Mr** (Computer Science)	MSc, BSc Hons, BSc (NWU)
	Matsebula FT, Ms (Information Systems)	MTech (TUT)
	Makhoere ETC, Mr (Information Systems)	MCom, BCom Hons, BCom (NWU)
	Mpofu N, Ms (Computer Science)	MSc (Zimbabwe)

	Mwanza AJ, Dr (Computer Science)	DEd (WSU), MSc (NUST,Zimbabwe), BSc (UNZA, Zambia), PGDE (UCT), CCAI (CISCO)
	Modiba N, Mrs (Information Technology)	MTech, BTech (TUT)
	Mokeresete M, Mrs (Computer Science)	MSc, BSc Hons (NWU), BSc (Amity, India)
	Serutla LS, Mr (Computer Science)	MSc (Sherfield, UK), BSc (NUL, Lesotho)
	Verkijika S, Dr (Computer Science)	PhD (UFS); MSc (UFS); BSc (UFS)
	Madzima K, Mr (Computer Science)	MSc Computer Science (NUST, Zimbabwe), BSc Mathematics & Computer Science (Enrique Jose Varona, Cuba), PGDip(HE) (Rhodes)
Junior Lecturers	**Mamabolo E, Mrs** (Information Technology)	MTech, BTech (TUT), BSc (Vista)

Department of Mathematical Sciences		
Senior Lecturers	***Sikwila ST, Dr** (Applied Mathematics)	PhD (Univ. Limerick, Ireland), BSc Hons (UZ)
	Mothibi D, Dr (Applied Mathematics)	PhD (NWU), MSc (SU), BSc Hons, BSc (NWU)
	Devi M, Dr (Mathematics)	Postdoc (UKZN), PhD (JUIT), MSc, BSc (HPU)
	Inyangala EB, Dr (Mathematics)	PhD (UCT), M.Phil (Moi University), B.Ed (Kenyatta University)
Lecturers	**Antwi A, Mr** (Statistics)	MTech (TUT), MSc (Unven), BSc. Hons, MTech (TUT) , BSc. (Kwame Nkrumah UST), Dipl Basic Education (Univ. of Cape Coast)
	Bappoo R, Mr (Operations Research)	MPhil (NUST, Zimbabwe), BA Hons (Delhi University, India), PG Dip (Higher Education) (RU), Ed Planning & Admin (New Delhi), ACE (UKZN)
	Nkonkobe S, Dr (Mathematics)	PhD (RU), MSc, BSc Hons, BSc (UFH)
	Mabokgole MI, Mr (Mathematical Statistics)	MSc (UFS)
	Chaka L, Mr (Statistics)	MSc, BSc Hons (UNISA), BSc (ZOU)
	Whata A, Mr (Statistics)	MSc, BSc Hons, BSc (UZ)
	Shozi ZB, Mr (Mathematics)	MSc (SU), BSc Hons, BSc (UniZulu)

Department of Physical and Earth Sciences		
Associate Professor	**Chaukura N, Prof** (Chemistry)	PhD (UOM), MA (UOS), MSc, BSc Hons (UZ)
Senior Lecturers	***Sefadi JS, Dr** (Chemistry)	PhD, MSc, BSc Hons, BSc (UFS)
	Kabanda TH, Dr (Geography)	PhD, MSc, BSc Hons (NWU), BSc (UNIVEN)
	Manjoro M, Dr (Geography)	PhD (NMMU), MSc (UNAH, Cuba), BSc Hons (UFH), BSc Ed (ISP-EJV, Cuba)
Lecturers	**Tshabalala TE, Dr** (Chemistry)	PhD, MSc, BSc Hons, BSc (WITS)
	Mthembu ST, Dr (Chemistry)	PhD, MSc, BSc Hons, BSc (WITS)
	Mokoena PP, Dr (Physics)	PhD, MSc, BSc Hons, BSc (UFS)
	Mashile TR, Mr (Chemistry)	MSc (UP), BSc Hons, BSc (UL)
	Tshipi JT, Mr (Physics)	MSc, BSc(Hons), BSc (UP)
	Gopane IM, Mr (Physics)	MSc, BSc(Hons), BSc (UP)
	Hlatywayo J, Mr (Geography)	MSc, MCom (UKZN), BSc Hons, Dip. Education (UZ)
	Phungula KV, Ms (Chemistry)	MSc, BSc Hons, BSc (UFS)
Laboratory Technicians	**Mabuza MPJ, Ms** (Chemistry)	BSc Hons, BSc (UFS)
	Hunt AT, Mr (Chemistry)	BSc Hons, BSc (UFS)
	Nepfumbada D, Ms (Geology)	BSc Hons, BSc (UFS)
	Amanda Masana, Mr (Geography)	BSc Hons, BSc (NWU)
	Buthelezi MD, Mr (Physics)	BSc Hons, BSc (UKZN)
	Seleise LL, Mr (Physics)	BSc Hons, BSc (UL)

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