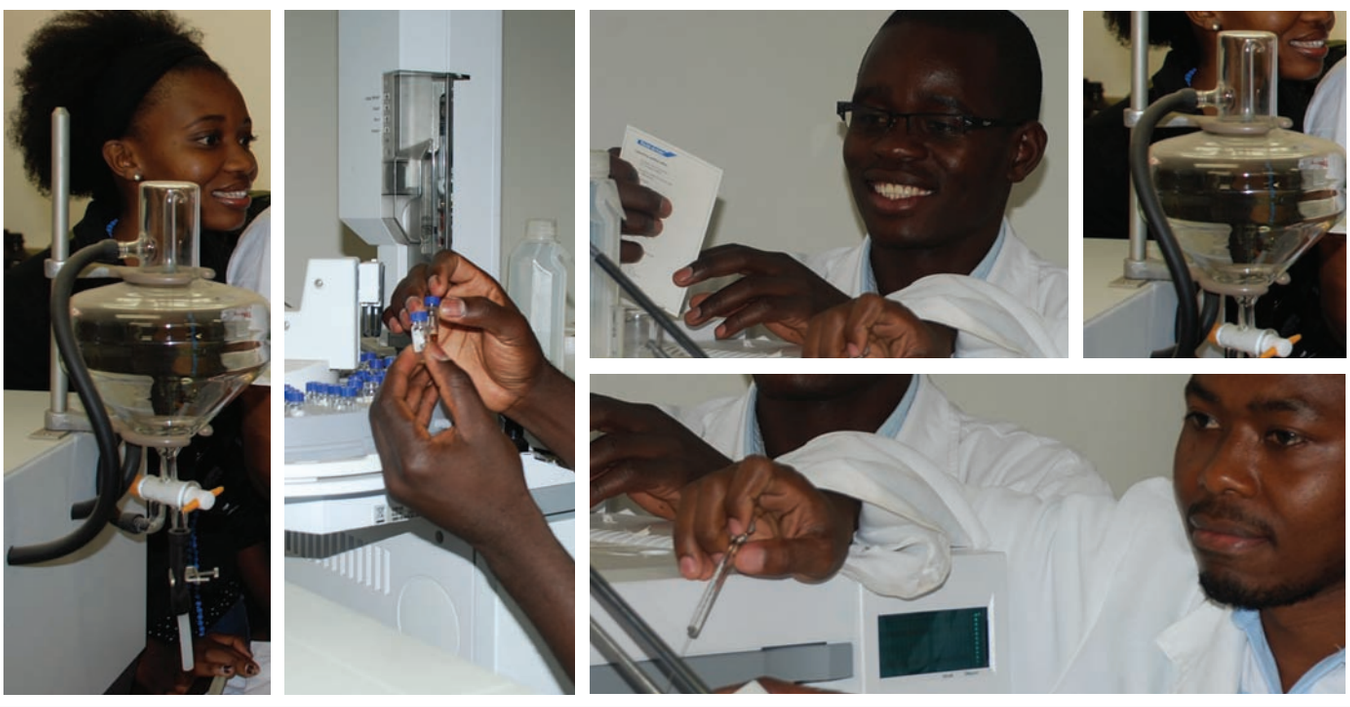
FACULTY OF
SCIENCE

BIOLOGICAL SCIENCES CHEMISTRY COMPUTER SCIENCE ENVIRONMENTAL SCIENCE MATHEMATICS GEOLOGY



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DEPARTMENT OF BIOLOGICAL SCIENCES

Bachelor of Science (Biological Sciences)

General Provisions
Subject to the provisions of the General Academic Regulations and the Faculty of Science Special Regulations, the following Departmental Regulations shall apply.

Programmes and Titles of Degrees
The Department of Biological Sciences offers the following programmes leading to the award of the mentioned degrees:

(i) Single Major programme leading to the award of the degree of Bachelor of Science (Biological Sciences, Single Major); B.Sc. (Biological Sciences).

(ii) Combined degree (Major/Minor) programme with Biological Sciences as the Major leading to the award of the degree of Bachelor of Science (B.Sc.).

(iii) Combined degree (Major/Major) programme with Biological Sciences and another Science subject leading to the award of the degree of Bachelor of Science (B.Sc.).

(iv) Combined degree (Minor/Major) programme with Biological Sciences as the Minor leading to the award of the degree of Bachelor of Science (B.Sc.).

Entrance Requirements
Admission to the Biological Sciences shall be as specified in the Faculty of Science Special Regulations. Entrance requirements specific to particular programmes shall be as specified under the specific programmes below.

Structure of the Programme
The Department of Biological Sciences shall:
(i) Offer courses at levels 100 to 400 for the undergraduate programme

(ii) From time to time, design and offer courses for specific needs of other Departments in the University provided there are no suitable courses already on offer.

(iii) Contribute to General Education Courses offered through the Faculty of Science.

(iv) Offer a Single Major Degree programme as per Departmental Special Regulations 2.1.

(v) Offer a Combined Degree Major/Minor programme as per Departmental Special Regulations 2.2.

(vi) Offer a Combined Degree Major/Major programme as per Departmental Special Regulations 2.3.

(vii) Offer a Combined Degree Minor/Major programme as per Departmental Special Regulations 2.4.

SINGLE MAJOR (Biological Sciences)
To be admitted into the Single Major (Biological Sciences) programme, a student must have obtained at least Grade C (GPA: 2.5) in both BIO111 and BIO112.

Semesters 1 and 2
All students who wish to pursue the Biological Sciences programme as Single Major should, in addition to BIO111 and BIO112, take CHE101 and CHE102.

COURSE SYNOPSES

BIO111 Principles of Biology
Course Summary
The following major biological principles and processes will be covered: Origin and early history of life, hierarchical organisation, scientific method, unifying principles, the cell theory, prokaryotes and eukaryotes, taxonomy, hereditary material and genetic diversity: mitosis and meiosis, the species concept, mechanism of speciation, evolution and natural selection, adaptation.

BIO112 Diversity of Plants and Animals
Course Summary
This course will be in two parts. The first part is a survey of the Kingdom Plantae. It covers classification, general structure, reproduction and life cycles of the different divisions or phyla of the kingdom. The second part focuses on animals and lays a foundation for the study of zoology by highlighting the major adaptations that facilitated a move from aquatic to terrestrial habitats for animals in order to better understand the evolutionary relationships of the animal phyla.

BIO120 Introductory Biochemistry
Course Summary

In this course, students are introduced to the structures and functions of various biological molecules. Water, Proteins, Carbohydrates, Lipids and Nucleic Acids will be discussed. Emphasis is placed on the structural/functional relationships of these molecules.

BIO122 Introductory Biochemistry, Anatomy and Physiology
Course Summary
This course introduces the biological molecules that are present and the chemical reactions that take place in living cells. Metabolism; structures and functions of cells and systems of the human body are discussed.

BIO123 Introductory Microbiology and Stored Product Entomology
Course Summary
The course deals with the microbiology and entomology of foods and stored products. It covers the major features of micro-organisms and those of insects of economic importance associated with foods, the conditions that favour their growth in/on foods and stored products and the risks associated with them. It also explores different modes of control measures as aspects of safety.

BIO211 Cell Biology
Course Summary
The eukaryotic cell is the fundamental structural building block of multicellular organisms and the centre for many biochemical processes. In this course you will be introduced to both the structure and function of cells. A dialectical, not a reductionist approach to cell biology is emphasised. All cellular processes have to be seen in a totality, not isolated from another. A cell is introduced as a dynamic entity, not as a static unit.
The course introduces the basic biomolecules and then gives a broad overview over the inner organisation of the cell covering membrane structure, membrane transport, cell compartmentalization, protein sorting and intracellular vesicle transport. The dynamic organisation of the cell is then related to cell communication, signalling, cell viability and death, cell movement, cell cycle and cell division.

BIO212 Genetics
Course Summary
Genetics is introduced as a discipline of biological science that has a profound impact on how we understand human nature and life processes. Mendelian genetics is discussed as a valid basis to understand specific patterns of genetic transmission, but it is outlined that more complex systems require various extensions, further developments of Mendelian genetics and/or other models. A broad overview over prokaryotic, eukaryotic and human genetics is given, including gene variation, gene regulation, genetic linkage and advances in cloning. Population genetics is introduced, as well as inheritance of complex traits. Genetics of cancer will be discussed as an example of the dialectic relation between genes and environment.

BIO213 Plant Structure and Function
Objectives
The course will deal with plant structure and development in relation to function; drawing attention to the ways in which the structure and arrangement of tissues in the plant body makes a structural and functional unit. Emphasis will be placed on flowering plants, although examples from other plant groups will also be used. Differences between monocotyledons and dicotyledons will be highlighted.

BIO 214 Mammalian Physiology
Objectives
The theme of this course is homeostasis and its importance to the survival of the individual mammal. Specific themes that will be tackled are the need for and acquisition of energy, the

maintenance systems of the body, coordination and reproduction. The mechanisms of function of the major systems of the body responsible for the functions outlined above and their controls will be emphasized.

BIO215 Principles of Ecology
Objectives
This course will introduce basic concepts in ecology. It will develop the basic principles of population and community ecology. The individual organism as the basic unit of study will be emphasized. Specific topics will include factors influencing how organisms are distributed in nature; the dynamics of populations and their regulation; community structure and organization; and topical issues in ecology.

BIO216 General Microbiology
Objectives
Developments of microbiology as a scientific discipline; methods of studying microorganisms; review of the microbial world with emphasis with unique features; modes of growth and reproduction; highlights in cellular and molecular biology of microorganisms; aspects of applied microbiology.

BIO217 Animal Diversity
Objectives
The animal kingdom includes variety of animals ranging from unicellular to multicellular. There is a link between the simplest to most complex animal. Animals may live in water or on the land. Different habitats have an implication on the structure and adaptations of the animal group. This course introduces the student to animal diversity. It deals with the structure adaptation and position of the animal in the animal kingdom.

BIO 218 Biology of Flowering Plants
Objectives
This is an introductory course on plant biology. It provides the basis upon which higher levels of botany build on. It deals with the morphology, classification, physiology, reproduction and evolution of plants focusing mainly on flowering plants on which our lives depend.

BIO223 Parasitology for Health Sciences
Objectives
The course deals with human parasites, their effects on the host, and prevalence of parasitic infections world wide with emphasis on Botswana. Transfer of these parasites in other hosts; development in man, clinical aspects and laboratory diagnosis will also be dealt with; together with their treatment, prevention and control.

BIO225 Human Physiology and the Environment
Objectives
The course will provide basic knowledge of human physiology. Emphasis will be placed on the concept of homeostasis and on the integrative aspects of physiology. A general introduction to some of the health problems stemming from the contamination of air, water, food, workplace and other special environments will also be provided to illustrate the effects of disrupting homeostasis of human body function.

BIO 231 Human Anatomy
Objectives
The course will focus on structure of the human body including cells, tissues, organs and organ systems. Major systems to be covered are the digestive system, cardiovascular system, respiratory system, nervous system, excretory system, and the reproductive system. Attention will be given to special organs associated with these systems.

BIO 232 Human Physiology
Objectives
This course focuses on the functions of the human body and its systems discussed in BIO231 Human Anatomy. Emphasis will be given to normal functions of tissues, organs and organ systems of the human body. The functions of important body parts in normal and abnormal condition will also be considered as well. The course is designed to enrich the knowledge base of nursing professionals about the functions of the human body.

BIO301 Quantitative Biology
Objectives
This course covers generation, handling and presentation of biological data, descriptive statistics, the scientific method of design and implementation of biological investigations, hypothesis formulation and testing.

BIO305 Insect Pest/Vector Control
Objectives
The course deals with insect pests/vectors of medical, veterinary and agricultural importance and their control in Botswana. Emphasis will be placed on principles and practices of pest/vector management in the tropical environment. At the end of the course, students are expected to able to identify insect pests/vectors and to apply the principles for pests/vectors control. They will also be expected to carry out field and laboratory practicals on the pests/vectors in Botswana. Collection of insect pests/vectors forms part of the student assessment.

BIO306 Developmental Biology
Objectives
The course is a study of the changes in form and structure of organisms in the course of their development. This will include processes such as fertilization, growth, cell and organ differentiation, morphogenesis, pattern formation and embryonic development in plants and animals. Attention will be given to environmental, the genetic, hormonal, cellular and molecular mechanisms governing these processes. Also to be discussed are abnormal development, biology of aging and senescence, regeneration and repair.

BIO307 Biochemistry
Objectives
Key principles about enzymes, mechanisms of enzyme action, enzyme kinetics, enzyme inhibition, and bioenergetics will be discussed. The course will highlight the importance of central metabolism (glycolysis, gluconeogenesis, TCA cycle, electron transport chain, and fatty acid metabolism) in living organisms. The role of hormones in the regulation of carbohydrate metabolism in the liver and muscles will also be explored along with some inborn errors of metabolism. Photosynthesis will also be discussed.

BIO308 Molecular Biology
Objectives
Molecular genetics concepts will be developed from principles to cover DNA structure and replication, genomics and the molecular organization of the genome, gene expression and its regulation in prokaryotes and eukaryotes (including the genetic control of development) and mechanisms of genetic change (mutation, recombination and transposition). The theory and practise of various general and specific DNA and RNA techniques will be covered, including methods of isolation, characterisation, sequencing, analysis and modification of polynucleotides. The application of molecular Biology will be briefly reviewed.

BIO309 Mycology
Objectives
The course will provide students with knowledge of the biology and taxonomy of the main groups of fungi; skills to isolate, identify and classify the main groups of fungi; a basic understanding of the roles of fungi in the environment; an overall understanding of detrimental and positive associations of fungi with humans and other organisms; using examples of economically important fungi, information on the literature and other media available for studying mycology.

BIO310 Bacteriology
Objectives
The course introduces basic concepts and principles in biodiversity, growth, physiology, taxonomy and interactions in bacteria and archaea. It includes strategies in culturing and control measures of these prokaryotes. Bacterial structure-function

relationships; cultivation, isolation, growth and reproduction of bacteria; genetic recombination in bacteria; conventional and molecular techniques in taxonomy; control strategies and mode of action of antimicrobials. Selected topics in applied bacteriology will also be discussed.

BIO311 Plant Systematics
Objectives
The course deals with the principles and practices of plant systematics. It unravels the fascinating differences among species of plants, and uses various sources of evidence to develop a framework upon which classifications can be developed. A general survey of selected flowering plant families in the Botswana flora will be made. It also covers sources of systematic evidence such as morphology, anatomy, cytology, and chemosystematics. Computerised methods (Numerical taxonomy) will be used to highlight the concepts of phenetics and cladistics. Pattern creation phenomena such as variation, hybridization and speciation are also covered. Collection and identification of local flowering plants are an important component of the course.

BIO 312 Virology
Objectives
This course will deal with basic virology concepts. Structure and composition of viruses. Classification, nomenclature, cultivation and essay of viruses. Viral replication, viral genetics and evolution; pathogenesis; virus induced changes in cells, infection and spread of viruses in the body; mechanisms of disease production, tumorigenesis, laboratory diagnosis and viral diseases; epidemiology of viral infections; surveillance, control and eradication of viral diseases, selected viruses of plants, animals and man.

BIO313 Dynamics of Savanna Ecosystems
Objectives
This course will develop the theoretical framework of the dynamics of savanna ecosystems. It will address the processes that operate at the ecosystem level, emphasizing the functional components, ecological determinants, and responses of savannas to disturbance.

BIO315 Invertebrate Zoology
Objectives
The course will deal with systematic survey of invertebrates noting that the incredible array of living group is the product of hundreds of millions of evolution. They are surviving descendants of successful lineages, which today inhabit virtually every environment on earth. The characteristics, which unite phyla and also separate them from other groups, will be explained. Emphasis will be placed on important relationship between structure and function (i.e. Bauplan). The distribution and the rich variety of ways in which invertebrates cope with the problems of survival and reproduction in the environment will be investigated.

BIO316 Plant Physiology
Objectives
The course deals with the physiology of higher plants in relation to plant growth regulators, vernalisation, germination and dormancy, photomorphogenesis and phytochrome, senescence and abscission, phloem translocation, photosynthesis, water relations of plants, uptake of ions by plant roots.

BIO317 Comparative Vertebrate Physiology
Objectives
In this course the adaptation of vertebrate animals to survive in different environments will be explored. Oxygen and nutrient acquisition, energy metabolism, water and salt regulation, temperature regulation, nitrogen excretion and reproductive strategies will be highlighted.

BIO318 Chordates
Objectives
This course deals with the origin of the Chordates from simple forms, and their evolution into specialized forms. The following will be covered during the course; position and relationship of the different groups within the Chordates, and adaptation of the different groups to their type of environment. The evolution of Chordates, their theories of origin, general characteristics, structure, life history and classification of the Chordates will be highlighted.

BIO403 Applied Botany
Objectives
This course will deal with the utilization of plants and plant products for food, fibre, medicinal and other purposes, including the management and conservation of plant germplasm through conventional and modern techniques. Botswana as a center of genetic diversity for some crop plants will be highlighted.

BIO408 Wildlife Biology of Southern Africa
Objectives
The course deals with the relationship between wildlife populations and their habitats. The focus will be on species that are rare or endangered, and those that are economically or ecologically important. Specific topics will include: adaptations, wildlife population dynamics, harvesting wildlife, sustainable use of wildlife resources, practical manipulation of abundance, indices of health, current problems affecting wildlife populations of southern Africa. Special attention will be given to wildlife of Botswana.

BIO409 Life-History Strategies
Objectives
This course presents analyses of various life strategies and traits in both plants and animals. Topics include: reproductive allocation, reproductive effort, natural selection, fitness, adaptation, plasticity, r- & K-strategies, R-, C- and S-strategies, seed development, seed dormancy, seed dispersal, seed banks, semelparity, iteroparity, scaling effects, life span, ageing.

BIO411 Wetlands Ecology and Management
Objectives
This course deals with the ecological characteristics and peculiarities of wetland ecosystems. Adaptation of plants and animals to water logging and anoxia will be discussed. Inventories and distributions of wetland ecosystems in Botswana and in southern Africa will be highlighted. The need to conserve and manage, and the methods of managing wetlands will be focused on using case study examples. Approaches to wetland management – the wise use concept.

BIO412 Aquatic Biology
Objectives
This course introduces concepts in aquatic biology with particular focus on freshwaters. The course will have an ecological approach aimed at understanding how different life forms cope with living in water. The broad concepts include (i) water as a habitat, (ii) how the structure, anatomy and physiology of different and/or illustrative life forms are adapted to living in an aquatic habitat, (iii) diversity of aquatic habitats and diversity of life forms living therein. Human influences on aquatic ecology will be highlighted to include both positive and negative aspects of such human interventions. While the course is global in scope, effort will be made to highlight examples relevant to Africa in general and Southern Africa in particular.

BIO416 Immunology
Objectives
Introduction to the molecular and cellular basis of the immune response; topics include anatomy of the lymphoid system, lymphocyte biology, nature of antigens and antigenicity, antibodies and immunoglobulins, cellular basis of antibody formation, thymus and T development, structure and role of the major histocompatibility complex, T-cell receptor structure and function, regulation of the immune response, hypersensitivity and inflammation, complement and cell mediated lysis, microbial and autoimmunity, transplantation and immunology and the scientific world.

BIO417 Biotechnology
Objectives
Biotechnology is comprised of a continuum of technologies, ranging from traditional biotechnology to modern biotechnology. In this context, biotechnology is defined as any technique that uses living organisms, or substances from those organisms, to make or modify a product, improve plants or animals, or to develop organisms for specific uses.

BIO418 Food Microbiology
Objectives

The course provides students with knowledge and skills in the following areas: intrinsic and extrinsic factors which are responsible for microbial association with foods; identifying hazards in foods; principles of safe food production; examine foods for spoilage and food borne pathogens including emerging pathogens; management aspects of control of pathogenic microorganisms in foods with special reference to HACCP systems; desirable microorganisms which amend our foods.

BIO419 Medical Microbiology
Objectives
Host- parasite relationships with emphasis on microorganisms associated with man; systematic study of microorganisms of medical importance; epidemiology of diseases; methods in diagnosis and treatment.

BIO420 Plant Pathology
Objectives
The course will provide students with a basic knowledge of plant diseases, the causal organisms and the concepts relating to plant pathology. Disease classification and symptomatology, the relationship between the host, pathogen and environment, disease cycle, epidemiology disease resistance, disease control with an emphasis on integrated disease management, etiologic agents (fungi, bacteria, viruses, nematodes), environmental diseases, case studies of host-pathogen interactions.

BIO421 Entomology
Objectives
The course covers a survey of the structure and physiology, life history, classification and evolution of insects. Topics include insect anatomy, physiology, behaviour, the relative numbers of species and the limits to the geographic distribution, the kinds of place in which they live and the food they eat.

BIO422 Applied Entomology
Objectives
The course deals with the biology, recognition and control of Arthropod pests of agronomic and vegetable crops, stored products, rangeland, livestock and poultry; and vectors of medical and veterinary importance. The basic tenets of the principles and practice of integrated pest management will be covered, with emphasis on ecological principles, integration of cultural, physical, chemical and biological tactics into an overall strategy for the ecosystem. The life history, nature of injury and control of major pests of field crops and stored products, as well as vectors of medical and veterinary importance will be covered.

BIO423 Exercise Physiology
Objectives
The course will cover the energetics, integrative and adaptive mechanisms in human body function. The responses of the cardiovascular, respiratory and muscular systems to acute and chronic exercise will be discussed. The assessment of fitness will be highlighted in the laboratory exercises.

BIO424 Vertebrate Structure
Objectives
The course explores the development and structure of the main organs of vertebrates especially mammals. The course explores the development and structure of the main organs of vertebrates especially mammals. The following will be covered during the course; development of the organs from organogamy to the adult form and the structure (histology) and function of the vertebrates. This will include, development, the muscular system and the endocrine system

BIO425 Parasitology
Objectives
The course covers the study of parasites of medical importance in the Southern African region. The following will be covered during the course; the study of the relationship between parasites and their hosts, pathology, treatment and control of parasites. Emphasis will be on parasites of medical and veterinary importance in Botswana.

BIO426 Behavioural Ecology
Objectives
This course will introduce patterns, processes and evolution of behaviour in animals. It will address the ecology of survival value of various behaviours in: finding a place to live, feeding behaviour, social behaviour, sexual selection and mating systems, and the physiological basis of behaviour.

BIO427 Evolution
Objectives
This course will provide a broad coverage of evolutionary biology, commencing with a catalogue of the evidence for evolution, hypotheses for the origin of life and an overview of the history of life. Evolutionary processes will be examined at the microevolutionary and macroevolutionary levels with detailed coverage of concepts such as natural selection, adaptation, sexual selection, speciation and coevolution. Approaches to the reconstruction of evolutionary history will be introduced and applied to the evolution of man.

BIO429 Ecological Impact Assessment
Objectives
Environmental Impact Assessment has become mandatory in most human developments efforts. While environmental impact assessment is a multidisciplinary concept involving ecological, social, legal, economic and other concerns, this course as its name implies, will only focus on the ecological aspects of the process of impact assessment.

BIO430 Post Harvest Physiology
Objectives
The deterioration of food crops during storage is a matter of concern for all those involved in agriculture and the food industry. This course will, therefore focus on post-harvest physiological and biochemical changes of crops with more emphasis on selected fruits and seeds. Furthermore, examples of the practical applications of physiological principles to extend storage life and reduce losses will be discussed.

BIO431 Plant Responses to Environmental Stress
Objectives
Semesters 3 and 4
Students must take BIO211, BIO214, BIO217 and BIO218 in Semester 3. Students must take BIO212, BIO213, BIO215 and BIO216 in Semester 4. The following courses are offered in both semesters: BIO211, BIO212 & BIO216. Students are also advised to take as electives CHE211 & CHE213 (Analytical Chemistry), CHE232 & CHE234 (Organic Chemistry) and CHE242 & CHE244 (Physical Chemistry).

Semesters 5 and 6
Students must take BIO301, BIO307 and at least two Optional Courses in Semester 5. Students must take BIO306, BIO308 and at least two Optional Courses in Semester 6.

Semesters 7 and 8
Students must take BIO453 and at least 3 Optional Courses in semester 7. Students must take BIO454 and at least 3 Optional Courses in semester 8.

Level, Semester & Core Courses
All courses are worth 3 credits each except BIO111, BIO112 and BIO454 (worth 4 credits each) and BIO453 (which is worth 2 credits). Students who wish to pursue Single Major, Major/Minor or Major/Major in Biological Sciences must take and pass BIO111 & BIO112.

Semester 1
BIO111 Principles of Biology (pre-req. to Single Major,Major/Minor and Major/Major) (4)
BIO122 Anatomy, Physiology and Biochemistry (3)

Semester 2
BIO112 Diversity of Animals and Plants (pre-req. to Single Major, Major/ Minor and Major/Major) (4)
BIO120 Introductory Biochemistry (3)
BIO123 Introduction to Microbiology and Stored Products Entomology

Semester 3
BIO211 Cell Biology (pre-req. to BIO307) (3) (also offered in sem.4)
BIO212 Genetics (pre-req. to BIO308) (3) (also offered in sem.4)
BIO214 Intro. to Mammalian Physiology (pre-req.to BIO317) (3)
BIO216 General Microbiology (pre-req.to BIO309, BIO310, BIO312, BIO416, BIO418, BIO419, BIO420, BIO436) (3)(also offered in sem.4)
BIO217 Animal Diversity (pre-req. toBIO315) (3)
BIO218 Biology of Flowering Plants (3)
BIO223 Parasitology for Health Sciences (3)
BIO231 Human Anatomy (3)

Semester 4
BIO211 Cell Biology (3) (also offered in sem.3)
BIO212 Genetics (3) (also offered in sem.3)
BIO213 Plant Structure and Function (pre-req. to BIO316) (3)
BIO215 Principles of Ecology (pre-req. to BIO313, BIO314, BIO408, BIO409, BIO411, BIO412, BIO426, BIO429, BIO434) (3)
BIO216 General Microbiology (pre-req. to BIO309, BIO310, BIO312, BIO416, BIO418, BIO419, **BIO420**, BIO436) (3) (also offered in sem.3)
BIO225 Human Physiology and the Environment (3)
BIO232 Human Physiology (3)

Semester 5
BIO301 Quantitative Biology (3)
BIO307 Biochemistry (pre-req. to BIO417) (3)
BIO309 Mycology (pre-req. BIO216) (3)
BIO313 Dynamics of Savannah Ecosystems (pre-req. BIO215) (3)
BIO315 Invertebrate Zoology (3)
BIO316 Plant Physiology (pre-req. BIO213) (3)
BIO317 Comparative Vertebrate Physiology (pre-req. to BIO214) (3)

Semester 6
BIO305 Insect Pest/Vector Control (3)
BIO306 Developmental Biology (3)
BIO308 Molecular Biology (pre-req. to BIO417) (3)
BIO310 Bacteriology (pre-req. BIO216) (3)
BIO311 Plant Systematics (3)
BIO312 Virology (pre-req. BIO216) (3)
BIO314 Conservation Biology (pre-req. BIO215) (3)
BIO318 Chordates (3)

Semester 7
BIO403 Applied Botany (3)
BIO409 Life History Strategies (pre-req. BIO215) (3)
BIO412 Aquatic Biology (pre-req. BIO215) (3)
BIO417 Biotechnology (pre-req. BIO307 & BIO308) (3)
BIO419 Medical Microbiology (pre-req.BIO216) (3)
BIO421 Entomology (3)
BIO423 Exercise Physiology (3)
BIO425 Parasitology (3)
BIO427 Evolution (3)
BIO431 Plant Responses to Environmental Stress (3)
BIO432 Plant Tissue Culture (3)
BIO436 Environmental Microbiology (pre-req. BIO216) (3)
BIO437 Micro techniques in Biology (3)
BIO453 Research Proposal Writing BIO 453 (2)

Semester 8
BIO408 Wildlife Biology of Southern Africa (pre-req. BIO215) (3)
BIO411 Wetlands Ecology and Management (pre-req. BIO215) (3)
BIO416 Immunology (pre-req. BIO216) (3)
BIO418 Food Microbiology (pre-req.BIO216) (3)
BIO420 Plant Pathology (pre-req. BIO216) (3)
BIO422 Applied Entomology (pre-req. BIO315 or BIO421) (3)
BIO424 Vertebrate Structure (3)
BIO426 Behavioural Ecology (pre-req. BIO215) (3)
BIO429 Ecological Impact Assessment (pre-req. BIO215) (3)
BIO430 Post-harvest Physiology (3)
BIO434 Plant Ecology (pre-req.BIO215) (3)
BIO454 Research Project BIO 454 (pre-req BIO453) (4)

Bachelor of Education (B.Ed) Degree
B.Ed students can take any of the courses in Biological Sciences as prescribed by the Faculty of Education as long as they satisfy course pre-req.

Service Courses

Bachelor of Environmental Health
BIO225 Human Physiology and the Environment (3)
BIO305 Insect Pest/Vector Control (3)

Bachelor of Nursing Education
BIO120 Introductory Biochemistry (3)
BIO223 Parasitology for Health Sciences (3)
BIO231 Human Anatomy (3)
BIO232 Human Physiology (3)

Home Economics Education
Courses for the Bachelor of Education in Home Economics Education shall be specified by the Department of Home Economics. Two such courses are:

BIO122 Anatomy, Physiology and Biochemistry (3)
BIO123 Introduction to Microbiology and Stored Products Entomology

Assessment
(a) All courses except BIO453 & BIO454 shall normally (unless otherwise stated) be assessed on the basis of continuous assessment and one final examination in the ratio of 2:3 (CA:Exam). Continuous Assessment shall be comprised of at least one written test, one practical and one assignment.

(b) There shall be no written examination in BIO453 and BIO454. The course shall be assessed as follows: Project Proposal (including proposal seminar presentation) 20%, Experimental Work 10%, Final Seminar Presentation 15% and Final Report 55%.

Progression from Semester to Semester
Progression from semester to semester shall be as specified in Faculty Regulations 23.6 and General Regulations 00.92.

Award of a Degree
To be awarded a degree, a student must satisfy requirements set in Faculty Regulations 23.7 and General Academic Regulations 00.851

DEPARTMENT OF CHEMISTRY

Departmental Regulations for Undergraduate Courses
The Department has a curriculum that will enable undergraduates to qualify for a Bachelors Degree in the single subject of Chemistry, and a Bachelors Degree with a Major in Chemistry and a Major or a Minor in one other Science subject. The Department also offers a Minor programme in Chemistry. The Department offers the following programmes:
•Single Major programme leading to a Bachelor of Science Degree in Chemistry
•A Combined Degree with a Major in Chemistry and a Major or Minor in another
Science subject leading to a Combined Bachelor of Science Degree

1.1 Entry Requirements
To enter into any of the Chemistry programmes, in addition to fulfilling the faculty requirements for progression from Year One to Year Two, students must also have the following:

(a) For entry into the SINGLE MAJOR PROGRAMME, a student must obtain a minimum of C+ average in the level 200 chemistry courses including lab courses with no less than a C grade in any of these courses.
(b) For entry into the CHEMISTRY MAJOR PROGRAMME, a student must obtain a minimum of C average in the level 200 chemistry courses including lab courses with no less than a C- grade in any of these courses.

1.2 Programme Outlines and Structures
(a) Common First Year Programme
Two general Chemistry courses, CHE101 and CHE102, each consisting of 3-credit lectures and a 1-credit lab, will be offered to the common programme for first year Science students. For a student to be awarded a grade for level 100 chemistry course he/ she must have completed the practical component.

(b) Single Major Programme (Entry to single major programme is by application to HOD)
In the Single Major programme, students take 85 credits of core courses, 20 credits of General Education courses, and will have opportunities to select more credits from a range of optional and elective courses. Eleven (11) credits of each of Mathematics and Physics courses, are included in the core credits.

(c) Combined Degree Programme (Chemistry Major)
Students in the Combined Degree programme with a Major in Chemistry, in addition to the 34 credits taken in Year One, must complete a minimum of 47 credits in Chemistry, a minimum of 3 credits each in Mathematics and Physics, and 12 credits in General

Education courses. Students must also meet the requirements for the second Major or Minor as specified by the appropriate department.

(d) Combined Degree (Major/ Minor) Programme (Chemistry Minor)
Students in the Combined Degree (Major/Minor) programme with a Minor in Chemistry, in addition to the 34 credits taken in Year One, must complete 18 credits in Chemistry core courses consisting of 12 core credits in Year Two, 4 core credits in Year Three, and 2 credits of Year Three practicals.

COMMON FIRST YEAR PROGRAMME

Semester 1

CHE101 General Chemistry I (4 credits)
MAT111 Introductory Mathematics I (4 credits)
PHY112 Geometrical optics and Mechanics, Vibrations and Waves (4 credits)
COM141 Introduction to Communication and Academic Literacy Skills (Science) (3)
ICT121 Computing Skills Fundamentals 1 (2)

Service Courses

CHE107 Chemistry Applied to Home Economics (3 credits)
CHE109 Introductory Chemistry for BNS (3 credits)

Recommended Electives

ECO111 Basic Microeconomics (3 credits)
MGT100 Principles of Management (3 credits)

Semester 2

CHE102 General Chemistry II (4 credits) (Pre-req CHE101)
MAT122 Introductory Mathematics II (4 credits)
PHY122 Electricity, Magnetism and Elements of Modern Physics (3 credits)
COM142 Academic and Professional Communication (Science) (3)
ICT122 Computing Skills Fundamentals 2 (2)

Recommended Electives

ACC100 Introduction. to Accounting (3 credits)
ECO112 Basic Macroeconomics (3 credits)
MKT100 Principles of Marketing (3 credits)
ICT122 Computing Skills Fundamentals 2 (2)

CHEMISTRY AS SINGLE MAJOR PROGRAMME

Semester 3

Core Courses

CHE211 Introduction to Analytical Chemistry (2 credits) (Pre-req CHE 101 & CHE102)
CHE213 Analytical Chemistry Laboratory I (1 credit) (Pre - req CHE 101 & CHE 102; Co-req CHE211)
CHE232 Structure and Survey of Functional Groups I (2 credits) (Pre-req CHE 101 & CHE102)
CHE234 Organic Chem. Lab I (1 credit) (Pre-req CHE 101 and CHE 102; co-req CHE 232)
MAT291 Engineering Mathematics I (3 credits)
PHY231 Mechanics & Physical Optics (2 credits)
PHY239 Physics Practicals 2.1 (1 credit)

Semester 4

Core Courses

CHE221 Atomic Structure, Bonding and Main Group Chemistry (2 credits) (Pre-req CHE 101 & CHE102)
CHE223 Inorganic Chemistry Laboratory I (1 credit) (CHE 101 & CHE 102; Co-req CHE221)
CHE242 Introductory Physical Chemistry (2 credits) (Pre-req CHE 101 & CHE102, MAT122)
CHE244 Physical Chemistry Laboratory I (1 credit) (Pre-req CHE 101 & CHE 102 ; Co-req CHE242)

Semester 5

Core Courses

CHE311 Separation Techniques (3 credits) (Pre-req CHE211)
CHE321 Coordination Chemistry (2 credits) (Pre-req CHE221)
CHE323 Inorganic Chemistry Laboratory II 1 credit) (Pre req CHE 223; Co-req CHE321)
CHE331 Structure and Survey of Functional Groups II (3 credits) (Pre-req CHE232)
CHE341 Applications of Thermodynamic and Electrochemistry (2 credits) (Pre-req CHE 242)
CHE343 Physical Chemistry Laboratory II (1 credit) (Pre-req CHE242 & CHE 244)
CHE351 Chemical Informatics (1 credit)

Recommended Electives

BIO307 Biochemistry (3 credits)
PHY353 Mathematical Methods for Physical Sciences (3 credits)

Semester 6

CHE312 Analytical Spectroscopy (2 credits) (Pre-req CHE311)
CHE314 Analytical Chemistry Laboratory II (1 credit) (Pre-req CHE 311; Co req CHE 312)
CHE322 Group Theory and Organometallic Chemistry (3 credits) (Pre-req CHE321)
CHE332 Physical Organic Chemistry (2 credits) (Pre-req CHE232 & CHE 331)
CHE334 Organic Chemistry Laboratory II (1 credit) (Pre-req CHE234 & CHE 331)
CHE342 Quantum Chemistry & its Applications (3 credits) (Pre-req CHE242)
CHE352 Literature Project (1 credit) ((Pre-req CHE351+ all 200 level courses + at least one section at 300 level in which student intends to carry out the literature survey) (For Chemistry major only)

Semester 7

Core Courses

CHE411 Advanced Analytical Techniques (3 credits) (Pre-req CHE311& CHE312)
CHE421 Advanced Transition Metal Chemistry (3 credits) (Pre-req CHE322)
CHE431 Heterocyclic Chemistry, Synthetic Reactions and Design of Organic Synthesis (3 credits) (Pre- req CHE331 & CHE 332)
CHE441 Advanced Physical Chemistry I (3 credits) (Pre-req CHE341)

Optional Courses: Take at least ONE course from the following

CHE413 Advanced Analytical Chemistry Laboratory (2 credits) (Pre-req CHE311 & CHE312)
CHE423 Advanced Inorganic Laboratory (2 credits) (Pre req CHE 323; Co-req CHE421)
CHE433 Advanced Organic Chemistry Laboratory (2 credits) (Pre-req CHE334)
CHE443 Physical Chemistry Laboratory III (2 credits) (Pre-req CHE343)
CHE446 Special Topics in Physical Chemistry (2 credits) (Pre-req CHE341 & CHE342)

Recommended Elective

PHY472 Statistical Mechanics (3 credits)
PHY 473 Solid State Physics (3 credits)

Semester 8

Core Course

CHE452 Student Research Project (3 credits) (Pre-req CHE352)

Optional Courses: Take at least 9 Credits from the following

CHE412 Sample Handling & Biochemical Analysis (3 credits) (Pre-req CHE311& CHE312)
CHE416 Environmental Chemistry (2 credits) (Pre-req CHE311 and CHE312 Co-req CHE412)
CHE418 Special Topics in Analytical Chemistry (2 credits) (Pre-req CHE311 &CHE312)
CHE422 Advanced Organo-metallic and Solid State Chemistry (3 credits) (Pre-req CHE322)
CHE426 Special Topics in Inorganic Chemistry (2 credits) (Pre-req CHE322)
CHE432 Secondary Metabolites and Biomolecules (3 credits) (Pre-req CHE331& CHE 332)
CHE436 Special Topics in Organic Chemistry (2 credits) (Pre-req CHE331)
CHE442 Advanced Physical Chemistry II (3 credits) (Pre-req CHE341)
CHE470 Excited State Chemistry (2 credits)

CHEMISTRY AS MAJOR SUBJECT IN COMBINED DEGREE

Semester 3

Core Courses

CHE211 Introduction to Analytical Chemistry (2 credits) (Pre-req CHE 101 & CHE102)
CHE213 Analytical Chemistry Laboratory I (1 credit) (Pre - req CHE 101 & CHE 102; Co-req CHE211)
CHE232 Structure and Survey of Functional Groups I (2 credits) (Pre-req CHE 101 & CHE102)
CHE234 Organic Chem. Lab I (1 credit) (Pre-req CHE 101 and CHE 102; co-req CHE 232)
MAT291 Engineering Mathematics I (3 credits)
PHY231 Mechanics & Physical Optics (2 credits)
PHY239 Physics Practicals 2.1 (1 credit)

Semester 4

Core Courses

CHE221 Atomic Structure, Bonding and Main Group Chemistry (2 credits) (Pre-req CHE 101 & CHE102)
CHE223 Inorganic Chemistry Laboratory I (1 credit) (CHE 101 & CHE 102; Co-req CHE221)
CHE242 Introductory Physical Chemistry (2 credits) (Pre-req CHE 101 & CHE102, MAT122)
CHE244 Physical Chemistry Laboratory I (1 credit) (Pre-req CHE 101 & CHE 102 ; Co-req CHE242)

Semester 5
Core Courses
CHE311 Separation Techniques (3 credits) (Pre-req CHE211)
CHE321 Coordination Chemistry (2 credits) (Pre-req CHE221)
CHE323 Inorganic Chemistry Laboratory II (1 credits) (Pre – Req CHE 223; Co-req CHE321)
CHE331 Structure and survey of functional groups II (3 credits) (Pre Req: CHE 232)
CHE341 Applications of Thermodynamic and Electrochemistry (2 credits) (Pre-req CHE242)
CHE343 Physical Chemistry Laboratory II (1 credit) (Pre-req CHE242 & CHE 244)
CHE351 Chemical Informatics (1 credit)

Recommended Electives
BIO307 Biochemistry (3 credits)
PHY353 Mathematical Methods of Physics I (2 credits)

Semester 6
CHE312 Analytical Spectroscopy (2 credits) (Pre-req CHE311)
CHE314 Analytical Chemistry Laboratory II (1 credit) (Pre-req CHE311 Co req CHE 312)
CHE322 Group Theory and Organometallic Chemistry (3 credits) (Pre-req CHE321)
CHE332 Physical Organic Chemistry (2 credits) (Pre-req CHE232 & CHE 331)
CHE334 Organic Chemistry Laboratory II (1 credit) (Pre-req CHE234 & CHE331)
CHE352 Literature Project (1 credit) (Pre-req CHE351+ all 200 level courses + at least one section at 300 level in which student intends to carry out the literature survey) (For Chemistry major only)

Semester 7
Optional Courses: Take at least 6 Credits from the following
CHE411 Advanced Analytical Techniques (3 credits) (Pre-req CHE311 & CHE312)
CHE421 Advanced Transition Metal Chemistry (3 credits) (Pre-req CHE322)
CHE431 Heterocyclic Chemistry, Synthetic Reactions and Design of Organic Synthesis (3 credits) (Pre-req CHE331 & CHE332)
CHE441 Advanced Physical Chemistry I (3 credits) (Pre-req CHE341)

Semester 8
Core Courses
CHE342 Quantum Chemistry & its Applications (3 credits) (Pre-req CHE242)
CHE334 Organic Chemistry Laboratory II (1 credit) (Pre-req CHE234 & CHE331)
CHE452 Student Research Project (3 credits) (Pre-req CHE352)

Recommended Elective
ENV476 Natural Resources Management and Economics (2 credits)

CHEMISTRY AS MINOR SUBJECT IN COMBINED DEGREE
Semester 3
Core Courses
CHE211 Introduction to Analytical Chemistry (2 credits) (Pre-req CHE 101 & CHE102)
CHE213 Analytical Chemistry Laboratory I (1 credit) (Pre-req CHE101 & CHE102, Co- req CHE211)
CHE232 Structure and Survey of Functional Groups I (2 credits) (Pre-req CHE 101 & CHE102)
CHE234 Organic Chemistry Laboratory I (1 credit) (Pre-req CHE 101 and CHE 102; co-req CHE 232)

Semester 4
Core Courses
CHE221 Atomic Structure, Bonding and Main Group Chemistry (2 credits) (Pre-req CHE 101 &CHE102)
CHE223 Inorganic Chemistry Laboratory I (1 credit) (Pre-req CHE 101 & CHE 102 Co-req CHE221)
CHE242 Introductory Physical Chemistry (2 credits) (Pre-req CHE 101 & CHE102, MAT122)
CHE244 Physical Chemistry Laboratory I (1 credit) (Pre-req CHE101&CHE102, Co-req CHE242)

Required to take at least 6 Credits including 2 Credits of Laboratory from the CHE Courses in Semester 5 and 6
Semester 5
CHE311 Separation Techniques (3 credits) (Pre-req CHE211)
CHE321 Coordination Chemistry (2 credits) (Pre-req CHE221)
CHE323 Inorganic Chemistry Laboratory II (1 credit) (Pre req CHE 223, Co-req CHE321)
CHE331 Structure and Survey of Functional Groups II (3 credits) (Pre-req CHE232)
CHE341 Applications of Thermodynamic and Electrochemistry (2 credits) (Pre-req CHE242)
CHE343 Physical Chemistry Laboratory II (1 credit) (Pre-req CHE242 & CHE 244)
CHE351 Chemical Informatics (1 credit)

Semester 6
CHE312 Analytical Spectroscopy (2 credits) (Pre-req CHE211)
CHE314 Analytical Chemistry Laboratory II (1 credit), (Pre-req CHE 311 Co req CHE 312)
CHE322 Group Theory and Organometallic Chemistry (3 credits) (Pre-req CHE321)
CHE332 Physical Organic Chemistry (2 credits) (Pre-req CHE232 & CHE 331)
CHE334 Organic Chemistry Laboratory II (1 credit) (Pre-req CHE234 & CHE 331)
CHE342 Quantum Chemistry and Applications (3 credits) (Pre-req CHE242)

Recommended Electives
BIO308 Molecular Biology (3 credits)
MGT303 Entrepreneurship and New Business Formations (3 credits)

Semester 7
Not required to take any Chemistry courses.

Semester 8
Not required to take any Chemistry courses.
Recommended Electives
ENV476 Natural Resources Management and Economics (2)

1.3 Assessment and Examination
The coursework shall be continuously assessed. Continuous assessment shall consist of written tests, assignments and laboratory exercises where applicable. The weighting of final examination where applicable, shall not be less than 50% of the overall grade for a given course.

1.4 Progression from one Semester to the next Semester
Progression from one semester to the next shall be as per General Regulations 00.9

1.5 Award of Degree
The award of the degree shall be as per General Regulations 00.852

2.0 Department of Chemistry Course Listing

100 Level Courses

CHE101 GENERAL CHEMISTRY I (4 credits)
Course covers fundamental concepts and principles of chemistry, i.e. the structure of matter, quantitative as well as qualitative aspects of chemistry.

CHE102 GENERAL CHEMISTRY II (4 credits)
This is a continuation of CHE101. The fundamental principles associated with properties of chemical systems will be presented.

CHE107 CHEMISTRY APPLIED TO HOME ECONOMICS (3 credits)
The role that chemistry plays in everyday life will be presented. Atomic structure, periodic table, oxidation and reduction, chemistry of carbon compounds, acids and bases, soaps and detergents, food and energy, fats, carbohydrates, proteins, minerals and vitamins, additives, poisons and toxins, gases, polymers and plastics, cosmetics.

CHE109 INTRODUCTORY CHEMISTRY FOR BACHELOR OF NURSING SCIENCE, BNS (3 credits)
Topics include: Structure and bonding, stoichiometry, solutions, chemistry of certain elements, electricity and chemical change, osmosis, reaction rates and catalysis, radioactivity.

200 Level courses

CHE211 INTRODUCTION TO ANALYTICAL CHEMISTRY (2 credits)
Basic principles of analytical chemistry, concepts of classical and modern methods in analytical chemistry, statistical treatment of experimental data including error analysis and significance tests; Gravimetry, titrimetry.

CHE213 ANALYTICAL CHEMISTRY LABORATORY I (1 credit)
Practical experience in analytical procedures, classical and modern methods of analytical chemistry, an overview of analytical instrumentation and the progress made towards development of analytical methodology, gravimetric analysis, titrimetric analysis, Electro analytical/ spectrophotometry.

CHE221 ATOMIC STRUCTURE, BONDING AND MAIN GROUP CHEMISTRY (2 credits)
Structure of the atom based on elementary quantum theory. Bonding in simple molecules

based on molecular orbital and valence bond theories; Trends in periodic properties and chemical reactions of s- and p-block elements.

CHE223 INORGANIC CHEMISTRY LABORATORY I (1 credit)
This course covers qualitative inorganic analysis, the synthesis of a selection of compounds, as well as solution chemistry of main group elements.

CHE232 STRUCTURE AND SURVEY OF FUNCTIONAL GROUPS I (2 credits)
Survey of various functional Groups; Aspects of stereochemistry; Review of alkanes, alkenes and alkynes: addition and substitution reactions. Organic halogen compounds: substitution and elimination reactions, aromatic compounds, and electrophilic substitution reactions. Introduction to chirality's: Acids and bases: alcohols, ethers, epoxides, carbonyls compounds.

CHE234 ORGANIC CHEMISTRY LABORATORY I (1 credit)
Course topics include: Purification and separation of organic compounds-distillation and fractional distillation, crystallization and recrystallization melting point and refractive index determination; Introduction to qualitative analysis of organic compounds; Preparations of simple organic compounds.

CHE242 INTRODUCTORY PHYSICAL CHEMISTRY (2 credits)
Basic principles of thermodynamics: first, second and third laws of thermodynamics; rates of chemical reactions.

CHE244 PHYSICAL CHEMISTRY LABORATORY I (1 credit)
This is an introduction to laboratory techniques in physical chemistry, Experiments dealing with properties of solutions, Calorimetry, thermodynamics, electrochemistry and chemical kinetics.

300 level courses

CHE311 SEPARATION TECHNIQUES (3 credits)
Introduction to chromatographic separation and detection techniques: Liquid-liquid extraction; column chromatography, TLC, GC and HPLC, Supercritical fluid; Capillary electrophoresis. Detection systems include FID/ECD & thermal conductivity for GC. UV-Vis,/ DAD/ fluorescence detector for HPLC. Electrochemical / conductivity detectors for Ion Chromatography.

CHE312 ANALYTICAL SPECTROSCOPY (2 credits)
Introduction to spectroscopic methods. Molecular absorption & emission:- UV-visible, IR, phosphorescence, fluorescence, Fourier transform spectroscopy. Atomic absorption & emission techniques; AAS / AES and ICP-MS.

CHE314 ANALYTICAL CHEMISTRY LABORATORY II (1 credit)
Introduction to practical aspects of spectroscopic methods of analysis: UV-visible, IR, Fourier transform spectroscopy, GC, HPLC, AAS/AES, etc.

CHE321 COORDINATION CHEMISTRY (2 credits)
Introduction to nomenclature, properties and reactions of coordination compounds & complexes; isomerism and magnetic properties . Valence bond and crystal field theories; absorption spectra; field strength; Jahn-Teller effects; covalency and electron delocalization in complexes. Thermodynamics of complex formation. Hard and soft acids and bases. Non-aqueous chemistry . The chemistry of d-block elements and their compounds. Trends in the properties of elements of groups 3 to 12.

CHE322 GROUP THEORY AND ORGANOMETALLIC CHEMISTRY (3 credits)
Introduction to group theory and basic knowledge of organo-metallic chemistry. Fundamental concepts of organometallic chemistry; organometallic chemistry of transition elements; catalytic applications of organometallic compounds.

CHE323 INORGANIC CHEMISTRY LABORATORY II (1 credit)
Involves use of modern instruments to characterize organic compounds. Synthesis of inorganic compounds and their characterization using various techniques such as NMR, IR and UV-VIS spectroscopy; Reactions of transition elements and their compounds

CHE331 STRUCTURE AND SURVEY OF FUNCTIONAL GROUPS II (3 credits)
Spectroscopic methods in organic chemistry: UV, IR NMR and MS. Stereochemistry: Chirality, chiral compounds without stereogenic centres, prochiral centres. Theory of aromaticity, nucleophilic aromatic substitution reactions and polycyclic aromatic hydrocarbons-. Conformations of cycloalkanes. Reactions of enolate anions: Aldol, Claisen and Knoevenegel condensations, Michael addition and Robinson annulation reactions. Enamines. The Mannich reaction.

CHE332 PHYSICAL ORGANIC CHEMISTRY (2 credits)
Study of reaction mechanisms. Review of nucleophilic substitution and elimination reactions – E1, E2, Sn1, Sn2, Sni, and E1CB. Structure – reactivity relationships: equilibrium and rate constants - the Hammett equation. Methods for determining reaction mechanisms. Pericyclic reactions: Frontier Molecular Orbital Theory, cycloadditions, electrocyclic reactions and sigmatropic rearrangements.

CHE334 ORGANIC CHEMISTRY LABORATORY III (1 credit)
Introduction to modern synthetic and characterization methods for organic compounds: Preparation of liquid and solid products then separation, purification and identification by physical and spectroscopic properties- UV, IR and NMR techniques. Chemical and spectroscopic methods in qualitative analysis of organic compounds. Molecular modeling. Simulation of spectra.

CHE341 APPLICATIONS OF THERMODYNAMIC AND ELECTROCHEMISTRY (2 credits)
Introduction to the applications of chemical thermodynamics to solutions and electrochemical processes. Partial molar quantities, thermodynamics of mixing, properties of ideal solutions, non-ideal solutions, activity and activity coefficient, phase diagrams, chemical equilibrium, conductivity, ion activities, standard potentials, electrochemical cells applications of standard potentials.

CHE342 QUANTUM CHEMISTRY AND ITS APPLICATIONS (3 credits)
Microscopic concepts of physical chemistry. Basic principles of quantum mechanics, postulates, simple quantum mechanical systems (particle in a1-D and 3-D box), rotational and vibrational energy levels in molecules, rotational, vibrational and electronic spectroscopy, photophysical and photochemical processes in molecules and atoms, photochemical kinetics.

CHE343 PHYSICAL CHEMISTRY LABORATORY II (1 credit)
Practical familiarization with microscopic and time dependent macroscopic aspects of physical chemistry. Laboratory experiments in application of quantum chemistry, spectroscopy, photochemical kinetics, conductivity and transport phenomena.

CHE351 CHEMICAL INFORMATICS (1 credit)
Use of conventional and electronic chemical information resources. An overview of information resources in chemistry. Purpose of scientific literature. Peer review process. Electronic and non-electronic databases. Searching methodologies including Internet searching (use of chemical web browsers). Searching for information using chemical names, CAS numbers, structures, sub-structures, molecular formulas, etc. Searching material safety data sheets (MSDS).

CHE352 LITERATURE BASED PROJECT (1 credit)
Course will cover professional writing in chemistry and scholarly project reports. Writing styles in chemistry: comprehensive report on an assigned topic in chemistry under the supervision of an academic staff. ; Thorough search of the chemical literature including the latest information available on the subject.

400 Level Courses

CHE411 ADVANCED ANALYTICAL TECHNIQUES (3 credits)
Advanced analytical methods: Statistical treatment of experimental data; Electroanalytical Chemistry;- potentiometry, voltammetry, coulometry, classical and modern polarography, Instrumentation and application of GC-MS, LC-MS, CE-MS, tandem MS, Thermochemical and Radiochemical methods of analysis; isotope dilution and activity analysis.

CHE412 SAMPLE HANDLING AND BIOCHEMICAL ANALYSIS (3 credits)
Sampling strategies, sample preparation and clean-up techniques; solid phase extraction, solid phase micro-extraction, dialysis, solvent extraction, supported liquid membrane. Enzymatic analysis methods; application of immobilised enzymes, competitive binding immunoassays, enzyme immunoassays, proteomics, and genomics. Properties of antibodies. Polymer structure elucidation of carbohydrate polymers; precipitation assays.

CHE413 ADVANCED ANALYTICAL CHEMISTRY LABORATORY (2 credits)
Modern instrumental methods of analysis: atomic absorption (AAS), flame emission, graphite furnace-AAS, inductively coupled plasma- AAS. Sample handling strategies. Micro high performance

anion exchange chromatography. Hyphenated techniques; LC-MS, MS-capillary electrophoresis, electrochemistry workstations

CHE416 ENVIRONMENTAL CHEMISTRY (2 credits)
Introduction to environmental pollutants and their analysis using local case studies e.g., SO2 emission from the BCL mine; Pesticide analysis, industrial waste management; Selection of safe methods of disposal. Degradation reactions and the dispersal pathways of materials into the environment .

CHE418 SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2 credits)
Special topics selected from the following: Application of Analytical Chemistry, Food, Drugs and Forensic Analysis, Chemostatistics and Clinical Analysis.

CHE421 ADVANCED TRANSITION METAL CHEMISTRY (3 credits)
Advanced topics in transition metal chemistry and introductory bio-inorganic chemistry. Electronic properties of transition metal complexes; magnetic properties of transition metal complexes; inorganic reaction mechanisms; introduction to photo-chemical reactions; f-block chemistry; introduction to bioinorganic chemistry

CHE422 ADVANCED ORGANOMETALLIC AND SOLID STATE CHEMISTRY (3 credits)
Organometallic Chemistry: Main group organometallics; structure and chemistry of (C5H5)2MLn complexes; organometallic chemistry in synthesis; stereochemically non-rigid molecules; metal clusters and metal-metal bonds; low- and high-nuclearity clusters; NMR spectra; Latimer diagrams, oxidation state stability. Solid state chemistry: lattices; crystal packing; ionicstructures; crystal defects; metallic bonding; spinels.

CHE423 ADVANCED INORGANIC LABORATORY (2 credits)
Physical methods in Inorganic Chemistry: the study of physical and chemical properties of transition metal and organometallic complexes using electronic, infrared, and nuclear magnetic resonance spectroscopy techniques as well as optical isomerism, reaction kinetics, and inert atmosphere techniques.

CHE426 SPECIAL TOPICS IN INORGANIC CHEMISTRY (2 credits)
Selection may be made from the following specialised topics: Nanochemistry, Synthesis of inorganic materials for the fabrication of semiconductors; Molecular orbital calculations; Kinetics and mechanisms of inorganic reactions in solution media; Applied homogeneous catalysis with organometallic compounds; Chemistry and applications of boranes, carboranes and metalloboranes.

CHE431 HETEROCYCLIC CHEMISTRY SYNTHETIC REACTIONS AND DESIGN OF ORGANIC SYNTHESIS (3 credits)
Aromaticity and reactions of heterocyclic compounds – furan, pyrrole, thiophene, pyridine, indole, and quinoline. Synthetic reaction, Protective groups.; Molecular rearrangements. Design of organic synthesis: introduction to disconnection approach / retrosynthetic analysis.

CHE432 SECONDARY METABOLITES AND BIOMOLECULES (3 credits)
Carbohydrates: structure, nomenclature, stereochemistry and reactions of monosaccharides and disaccharides. Structure and properties of polysaccharides. Amino acids and proteins: structure, nomenclature and stereochemistry of amino acids and peptides, analysis of peptides and proteins. Chemistry of purines and pyrimidines. Nucleosides, nucleotides and nucleic acids. Mechanisms of co-enzymes. Examples of secondary metabolites from the acetate, mevalonate and shikimic acid pathways.

CHE433 ADVANCED ORGANIC CHEMISTRY LABORATORY (2 credits)
Advanced laboratory techniques in organic synthesis- multi-step synthesis of organic compounds. Extraction and isolation of naturally occurring compounds from plant origin- application of chromatographic and spectroscopic methods. Analysis of mixtures of organic compounds.

CHE436 SPECIAL TOPICS IN ORGANIC CHEMISTRY (2 credits)
Selection may be made from the following specialised topics: Chemistry of drugs; Chemistry of lipids; Selected natural products; Agrochemicals; Free radicals and photochemistry; Polymer materials

CHE441 ADVANCED PHYSICAL CHEMISTRY I (3 credits)
Entropy and probability, partition functions, applications of statistical thermodynamics. Colloidal solutions, electrical double layer, Liquid-gas and liquid-liquid interfaces, Gibbs adsorption equation, spreading, solid-gas interface, adsorption isotherms, rates of surface processes, adsorption and catalysis.

CHE442 ADVANCED PHYSICAL CHEMISTRY II (3 credits)
Reaction kinetics, techniques of fast reactions, theories of reaction rates, reaction in solution, composite reactions, chain reactions, explosions,. Transport phenomena. Polymers, kinetics of polymerization, osmometry, viscometry, gel-permeation chromatography., TGA, DSC. Introductory polymer processing.

CHE443 PHYSICAL CHEMISTRY LABORATORY III (2 credits)
Laboratory experiments in polymers, surface and colloid chemistry.

CHE446 SPECIAL TOPICS IN PHYSICAL CHEMISTRY (2 credits)
Detailed treatment of topics chosen from: solid-state chemistry; irreversible thermodynamics; molecular dynamics; intermolecular forces; atmospheric and/or astrophysical chemistry.

CHE452 STUDENT RESEARCH PROJECT (3 credits)
The course involves scientific bench work research. Will comprise a study leading to a written report and shall be based on an original investigation of a chemical problem. To be carried out under the supervision of a member of staff.

CHE470 EXCITED STATE CHEMISTRY (2 credits)
Boltzmann population distributions, comparison of ground and excited states, methods of excitation, experimental methods of studying excited states, chemistry of the excites states of molecules, Application of chemistry of excited states (e.g. Lasers.)

THE DEPARTMENT OF COMPUTER SCIENCE

Offers the following undergraduate programmes:
Single major programmes leading to the award of:
a) B.Sc. (Computer Science),
b) B.Sc. (Computing with Finance),
c) BIS. (Computer Information Systems)
d) B.Sc. (Information Technology)
Combined Major/Minor programmes leading to the award of:
a) B.Sc.(other subject Major/ Computer Science Minor)

Entry Requirements
Subject to the General Academic Regulation 00.5, the following departmental programme entry requirements shall apply for the programmes: B.Sc. (Computer Science), BIS (Computer Information Systems), and B.Sc (Information Technology).

i) For entry into 100-level, candidates must have a minimum grade of C in Mathematics and two other science subjects with computer studies recognized as a science subject, with a minimum grade of D in English.

ii) For entry into the programme at higher level, the following shall apply.

a. Transfer student from a Computer Science or Information Systems or equivalent programme from a higher institution considered equivalent to the University of Botswana, subject to General Academic Regulation 00.313.

b. Candidates holding a post Secondary Certificate qualification which is considered by the department as being at least equivalent to the 100- level of the programme and so deemed to earn the candidate an exemption from the 100-level of the programmes.

c. Candidates holding a post-Secondary qualification who do not meet criteria b) above may be required to take some 100-level courses

(I)B.Sc. Computer Science Programme

Semester I

Courses	Type Credits Prerequisite
CSI131	Discrete Structures I core (3)
CSI141	Programming Principles 3
CSI161	Introduction to Computing Core 3
MAT111	Introductory Mathematics I Core 4
COM141	Introduction to Communication and Academic Literacy Skills (Science) GEC 3

Semester II

CSI132	Discrete Structures II Core 3 CSI131
CSI142	Object-Oriented Programming Core (4) (pre-req CSI141)
MAT122	Introductory Mathematics II Core 4 (pre-req MAT111)
STA122	Introductory Concepts of Probability core (4)

COM 142 Academic and Professional Communication (Science) GEC 3

Semester III

CSI242 Data Structures Core 3 (pre-req CSI132, CSI142)
CSI243 Functional Programming Core 3 (pre-req CSI142)
CSI213 Discrete Structures III Core 3 (pre-req CSI132)
MAT221 Calculus I Core 3
Elective 3

Semester IV

CSI262 Database Concepts Core 3 (pre-req CSI242)
CSI223 Systems Programming Core 3 (pre-req CSI242)
CSI251 Computer Architecture &Organization Core 3 (pre-req CSI161, CSI141)
MAT212 Introductory Linear Algebra C o re 3
Elective 3

Semester V

CSI322 Algorithms Core 3 (pre-req CSI242)
CSI354 Operating Systems Core 3 (pre-req CSI242, CSI251)
CSI374 Computer Networks Core 3 (pre-req CSI142, CSI251)
CSI342 Systems Analysis & Design Core 3 (pre-req CSI 262 Elective 3

Semester VI

CSI315 Web Technology and Applications Core 3 (pre-req CSI262, CSI374)
CSI332 Programming Languages Core 3 (pre-req CSI243)
CSI341 Introduction to Software Engineering C ore 3 (pre-req CSI342)
Min 6 credits from:
CSI344 Artificial Intelligence Optional 3 (pre-req CSI242)
CSI392 Human Computer Interaction Optional 3 (pre-req CSI342)
MGT303 Entrepreneurship and New Business Formation Optional 3

Winter Semester

CSI352 Industrial Attachment Core 3 (pre-req CSI354, CSI374, CSI342)

For semester VII and VIII, students choose from the following areas of specializations.
1. Software Engineering
2. Systems & Networks

Semester VII

CSI411 Theory of Computation Core 3 (pre-req CSI322)
CSI472 Social Informatics Core 3 (pre-req CSI352)
CSI481 Database Systems Core 3 (pre-req CSI262)

Software Engineering stream (Minimum 6 credits)

CSI471 Software Design Optional 3 (pre-req CSI341)
CSI441 Requirements Engineering Optional 3 (pre-req CSI341)
CSI432 Intelligent Systems Optional 3 (pre-req CSI342)

Systems & Networks stream (Minimum 6 credits)

CSI462 Distributed Computing Optional 3 (pre-req CSI354, CSI374)
CSI451 Sensors Networks Optional 3 (pre-req CSI374)
CSI493 Computer Graphics Optional 3 (pre-req CSI242)

Semester VIII

CSI405 Project Core 4 (pre-req CSI352, CSI315, CSI341)
CSI412 Programming Language Translation Core 3 (pre-req CSI411)
CSI461 Computer Networks & Security Core 3 (pre-req CSI374)

Software Engineering stream (minimum 6 credits)

CSI444 Software Project Management Optional 3 (pre-req CSI441 or CSI471)
CSI392 Human Computer Interaction Optional 3 (pre-req CSI342)
CSI345 Integrative Programming Optional 3 (pre-req CSI223, CSI354)
Elective 3

Systems & Networks stream (minimum 6 credits)

CSI464 Mobile Computing Optional 3 CSI374
CSI424 Network Algorithms Optional 3 (pre-req CSI374, CSI322)
Elective 3

2. B.Sc. (Computer Science - Minor)

The following courses constitute a minor in Computer Science with a total credit of 34.

First Year

CSI131 Discrete Structures I
CSI141 Programming Principles
CSI161 Introduction to Computing
CSI132 Discrete Structures II
CSI142 Object-Oriented Programming

Second Year

CSI242 Data Structures
CSI262 Database Concepts
CSI251 Computer Architecture & Organization

Third Year

CSI354 Operating Systems
CSI374 Computer Networks
CSI315 Web Technology and Applications

b) B.Sc. Computing with Finance

Entry Requirement

Subject to the General Academic Regulation 00.5, the following departmental programme entry requirements shall apply for the programme:

For entry to the B.Sc. Computing with Finance, the following entry requirements shall apply.

i) For entry into 100-level, candidates must have a minimum grade of C in Mathematics and two other science subjects with Computer Studies recognized as a science subject, with a minimum grade of C in English.

ii) For entry into the programme at higher level:
a. Transfer students from a Computing with Finance or equivalent programme from a higher institution considered equivalent to the University of Botswana, subject to General Academic Regulation 00.313.

b.Candidates holding a post Secondary qualification which is considered by the department as being at least equivalent to the 100-level of the programme. For those who do not meet this criterion, they may be required to take some 100- Semester I

Semester 1

Courses Type Credits Prerequisite
CSI141 Programming Principles Core 3
CSI161 Introduction to Computing Core 3
MAT111 Introductory Mathematics I Core 4
CSI131 Discrete Structures I Core 3
COM141 Introduction to Communication and Academic Literacy Skills (Science) GEC 3

Semester II

ACC100 Introduction to Accounting Core 3
CSI142 Object-Oriented Programming Core 4 (pre-req CSI141)
MAT122 Introductory Mathematics II Core 4 (pre-req MAT111)
CSI132 Discrete Structures II Core 3 (pre-req CSI131)
COM142 Academic and Professional Communication (Science) GEC 3

Semester III

CSI242 Data Structures Core 3 (pre-req CSI132, CSI142)
FIN200 Business Finance Core 3
MAT221 Calculus I Core 3
Min 6 credits from:
ECO111 Basic Microeconomics Optional 3
MGT100 Principles of Management Optional 3
LAW251 Foundations of Business Law Optional 3

Semester IV

CSI262 Database Concepts Core 3 (pre-req CSI242)
ACC200 Financial Accounting I Core 3 (pre-req ACC100)
CSI251 Computer Architecture &Organization Core 3 (pre-req CSI141, CS161)
STA114 Business Statistics Core 3
Min 3 credits from:
ECO112 Basic Macroeconomics Optional 3
Optional 3

Semester V

CSI354 Operating Systems Core 3 (pre-req CSI242, CSI251)
FIN301 Financial Institutions and Markets I Core 3 (pre-req FIN200)
CSI374 Computer Networks Core 3 (pre-req CSI141, CSI251)
CSI342 Systems Analysis & Design Core 3 CSI 262
ACC302 Auditing I Core 3 (pre-req ACC200)

Semester VI

FIN302 Financial Planning and Forecasting Core 3 FIN200
CSI315 Web Technology and Applications Core 3 (pre-req CSI262, CSI374)
FIN300 Financial Management Core 3 FIN200
CSI341 Introduction to Software Engineering Core 3 (pre-req CSI342)

Min 3 credits from:

CSI392 Human Computer Interaction Optional 3 (pre-req CSI342)

MGT303 Entrepreneurship and New Business Formation Optional 3

Winter Semester

CSI352 Industrial Attachment Core 3 (pre-req CSI354, CSI374, CSI342)

Semester VII

CSI471 Software Design Core 3 (pre-req CSI341
CSI481 Databases Core 3 (pre-req CSI262)
CSI322 Algorithms Core 3 (pre-req CSI242)
CSI472 Social Informatics Core 3 (pre-req CSI352)

Min 3 credits from:

FIN402 International Business Finance Optional 3 (pre-req FIN301)
CSI441 Requirements Engineering Optional 3 (pre-req CSI341)
CSI432 Intelligent Systems Optional 3 (pre-req CSI342)

Semester VIII

CSI405 Project Core 4 (pre-req CSI352, CSI315, CSI341
CSI452 Information Security Administration Core 3 (pre-req CSI374)
BIS309 Accounting Information Systems Core 3 (pre-req ACC200)

Min 6 credits from:

FIN404 Investment Analysis and Portfolio Management Optional 3 (pre-req FIN300)
FIN403 Financial Institution and Markets II Optional 3 (pre-req FIN301)
CSI416 Web Computing Optional 3 (pre-req CSI315)
CSI444 Software Project Management Optional 3 (pre-req CSI471)

✤B.Sc. Computer Information Systems; new program suspended till 2012 August

III. B.Sc. Information Technology

Semester I

Courses Type Credits Prerequisite
CSI131 Discrete Structures Core 3
CSI141 Programming Principles Core 3
CSI161 Introduction to Computing Core 3
STA116 Introduction to statistics Core 4
COM141 Introduction to Communication and Academic Literacy Skills (Science) GEC 3

Semester II

CSI132 Discrete Structures II Core 3 (pre-req CSI131)
CSI142 Object-Oriented Programming Core 4 (pre-req CSI141)
MAT111 Introductory Mathematics I Core 4
ECO111 Basic Micro Economics core 3
COM142 Academic and Professional Communication (Science) GEC 3

Semester III

CSI242 Data Structures Core 3 (pre-req CSI132, CSI142)
CSI244 Information Management Core 3
CSI293 Information Technology Fundamentals Core 3
MGT100 Principles of Management Core 3
MAT122 Introductory Mathematics II Core 4

Semester IV

CSI262 Database Concepts Core 3 (pre-req CSI242)
CSI261 Computer Architecture Core 3 (pre-req CSI161)
CSI223 Systems Programming core 3 (pre-req CSI242)
MGT200 Organizational Design and Development Core 3 (pre-reqMGT100)

Min 3 credits from:

ECO112 Basic Macro Economics Optional 3
STA211 Statistical Methods Optional 3
LIS 227 Introduction to Knowledge Management Optional 3

Semester V

CSI354 Operating Systems Core 3 (pre-req CSI261, CSI242)
CSI374 Computer Networks Core 3 (pre-req CSI141, CSI261)
CSI342 Systems Analysis & Design Core 3 (pre-req CSI 262)
MGT301 Organizational Behavior core 3 (pre-req MGT200)

Elective 3

Semester VI

CSI345 Integrative Programming Core 3 (pre-req CSI354, CSI223)
CSI315 Web Technology and Applications Core 3 (pre-req CSI262, CSI374)
CSI392 Human Computer Interaction Core 3 (pre-req CSI342)
CSI341 Introduction to Software Engineering Core 3 (pre-req CSI342)

Min 3 credit from

MGT303 Entrepreneurship and Business Formation Optional 3 (pre-req MGT202)
BIS304 Management Information Systems Optional 3

Winter Semester

Courses Type Credits Prerequisite

CSI352 Industrial Attachment Core 3 (pre-req CSI354, CSI374, CSI342)

Semester VII

CSI481 Database Systems Core 3 (pre-req CSI262)
CSI472 Social Informatics Core 3 (pre-req CSI352)
CSI482 Information System Engineering Core 3 (pre-req CSI345)
CSI485 System Administration Core 3 (pre-req CSI354, CSI374)

Min 3 credit from:

LAW251 Foundations of Business Law Optional 3
FIN200 Business Finance Optional 3
LIS 403 Knowledge Management Optional 3 (pre-req LIS227)

Semester VIII

CSI405 Project Core 4 (pre-req CSI352, CSI315, CSI341)
CSI416 Web Computing Core 3 (pre-req CSI315)
CSI452 Information Security Administration Core 3 (pre-req CSI374)
CSI446 Information Systems Project Management Core 3 (pre-req CSI482)

Min 3 credits from:

BIS417 Information System Auditing Optional 3
MKT401 Marketing Management and Strategy Optional 3

DEPARTMENT OF ENVIRONMENTAL SCIENCE

4. Entrance Requirements

Normal entry requirements shall be as stipulated in General Regulation 20.00 in this Calendar and Department Regulation 1.4 (see DEPARTMENT Handbook).

5.1 Human Environment Programmes

Level 100

All courses at this level are core courses.

Semester 1

ENS101 Introduction to Environmental Science - Physical (3)
ENS141 Introductory Quantitative Techniques in Environmental Science I (3)

Semester 2

ENS102 Introduction to Environmental Science – Human (3)
ENS142 Introductory Quantitative Techniques in Environmental Science II (3)

Level 200

Semester 3

Core Courses

ENS242 Introduction to Spatial Analysis (3)

Optional Courses

ENS211 The Earth Environment System (3)
ENS251 The Human Environment System (3)

Semester 4

Core Courses

ENS243 Introduction to Remote Sensing (3)
ENS252 Botswana Environment (3)
ENS260 Environment and Population Dynamics (3)

Optional Courses

ENS241 Quantitative Techniques in Environmental Science (3)

Levels 300 to 400

Single Major Programmes

In accordance with General Academic Regulation 00.62, in each of Semesters 5 to 8 the Single Major Programme in Environmental Science shall consist of 10 to 12 core and optional courses for each of the Human Environment Areas of Specialisation, with optional courses selected from the following lists. Availability of courses and areas of specialisation are subject to the staffing situation in the particular semester and/or year. In accordance with Departmental Regulation 1.4,Entry into the programme is by application to HoD.

Human Environment Carreer areas are as follows

a) Area 1: Population, Economy and Resources;
b) Area 2: Rural and Agricultural Development;
c) Area 3: Management of the Urban and Industrial Environment;
d) Area 4: Tourism Development and Policy.

Semester 5

Core Courses
(By career Areas:)

ENS301 Environmental Issues (2, all areas)
ENS303 Directed Readings (2, all areas)
ENS304 Quantitative Techniques in Human Geography (3, all areas)(PRE: ENS141&ENS142)
ENS302 Concepts and Principles in Population Geography (2, Area 1)
ENS305 Rural Geography (2, Area 2) (Not available in 2011/12)
ENS309 Tourism I: Principles and Practices (2, Area 4)
ENS317 Industrialisation Trends and the Developing World (2, Area 3) (not available 2011/12)
ENS321 Urbanisation in the Developing World (2, Area 3) (pre: ENV210/211/212/219/ ENS241/ENS252/ENS260/POP303/ URP200/204)

Optional Courses (By Area of Specialisation)

ENS305 Rural Geography (2, Areas 1 and 4) (not available 2011/12)
ENS306 Globalisation, Socioeconomic and Environmental Change (2, all areas) (not available 2011/12)
ENS307 Human Settlements: Principles and Morphology (2, all areas) (pre:ENV210/211/212/219/ENS241/ ENS252/ENS260/POP303/URP200/204)
ENS309 Tourism I: Principles and Practices (2, Areas 1 and 2)
ENS310 Medical Geography (2, all areas)
ENS319 Economic Geography (2, all areas) (not available 2011/12)
ENS321 Urbanisation in the DevelopingWorld (2, Area 1) (pre: ENV210/211/212/219/ POP303/URP200/204)

Semester 6
Core Courses (By CAREER Areas)

ENS311 Environment, Population and Development (3, Area 1) (pre: ENV302 or POP120)
ENS312 Sustainable Development (2, all areas)(pre: ENV301)
ENS314 Project Proposal (2, all areas) (pre: ENV303)
ENS315 Environmentalism and Social Theory (2, all areas) (pre: ENV210/211/212/219/ENS241/ENS252/ ENV383/POL301/SOC322/SOC327)
ENS313 Elementary Techniques in Population Geography (3, Area 1) (pre: ENV302)
ENS316 Agricultural Development (2, Area 2)
ENS318 Tourism II: Tools and Analysis (2, Area 4) (pre: ENV309)
ENS320 Botswana's Environment (2, all areas) (not available 2011/12)

Optional Courses (By Career Areas)

ENS315 Environmentalism and Social Theory (2, all areas)(ENV210/211/212/ 219/383/ POL301/SOC322/327)
ENS339 Methods and Techniques in Environmental Appraisal (2, all areas)
ENS318 Tourism II: Tools and Analysis (2, Areas 1 and 2) (pre: ENV309)
POP305 Population Dynamics, Policies and Programmes (3, Area 1)

Semester 7
Core Courses (By CAREER AreaS)

ENV400 Project Data Collection, Analysis and Reporting I (1, all areas)(pre:ENV314)
ENV426 GIS for Socioeconomic Applications (3, all areas) (pre: ENV215/ENS242)
ENV401 Advanced Techniques in Population Geography (3, Area 1) (pre: ENV313)
ENV402 Natural Resource Conservation and Management (3, all areas) (not available 2010/11)
ENV404 Rural Development Theory and Practice (2, Area 2)
ENV405 Urban and Rural Survey Techniques (2, Area 2)
ENV407 Ecotourism (2, Area 4) (pre: ENV309&318)
ENV423 Urban Social Theory (2, Area 3) (pre: ENV315/383/POL301/SOC421/433/ URP400/407)
ENV424 Industry and the Environment (2, Area 3) (not available 2011/12)

Optional Courses (By CAREER Areas)

ENV406 Regional Development Studies (2, all areas) (not available 2011/12)
ENV425 The African Environment (3, all areas)
ENV447 Environmental Hazards (2, all areas)
ENV404 Rural Development Theory and Practice (2, Areas 1 and 4)
ENV407 Ecotourism (2, Areas 1 and 2) (pre: ENV309&318)
ENV423 Urban Social Theory (2, Area 1) (pre: ENV315/383/POL301/SOC421/433/ URP400/407)
ENV424 Industry and the Environment (2, Area 4) (not available 2011/12)

Semester 8
Core Courses (By CAREER Areas)

ENV408 Tourism and Development (2, Areas 1 and 2) (pre: ENV309&318)
ENV414 Project Data Collection, Analysis and Reporting II (2, all areas) (pre: ENV400)
ENV456 Remote Sensing for Socio-economic Applications (3, all areas) (pre: ENV216)
ENV415 Rural Development in Botswana (2, Areas 1 and 2)
ENV418 Environmental Policy (2, Area 4)
ENV481 Concepts and Principles of Industrialisation (2, Area 3)

Optional Courses (By Area of Specialisation)

ENV403 Gender and Environment (2, all areas)
ENV412 Environmental Impact Assessment (3, all areas) (not available 2011/12)
ENV427 Energy and Environment (2, all areas) (not available 2011/12)
ENV476 Natural Resource Management and Economics (2, all areas)
ENV416 Transport and Environment (2, Areas 2, 3 and 4)
ENV418 Environmental Policy (2, Areas 1, 2 and 3)
ENV419 Development Geography (3, all areas) (not available 2010/11)
ENV483 Advanced Map-work and Air Photo Interpretation (3, all areas)
ENV484 Urbanisationand Environment (2, Area 3) (pre: ENV307/321/URP213, 301)
POP423 Population and Development (3, Areas 1 and 2)

Major/Minor Programme with Environmental Science as the Major

In accordance with General Academic Regulation 00.62, in each of Semesters 5 to 8, the Major (ENV. SCIENCE) -MINOR Programme in Environmental Science shall consist of 7 to 8 core and optional courses, with optional courses selected from accompanying lists. The CAREER areas specified under Regulation 2.1 shall also apply to this Programme. Availability of courses and areas of specialisation are subject to the staffing situation in the particular semester and/or year. In accordance with DEPARTMENT Regulation 1.4, entry into the programme is by application to HoD.

Semester 5
Core Courses (By Area of Specialisation)

ENS301 Environmental Issues (2, all areas)
ENS302 Concepts and Principles in Population Geography (2, Area 1)
ENS304 Quantitative Techniques in Human Geography (3 credits, all areas) (PRE: ENS141/ENS142)
ENS305 Rural Geography (2, Area 2) (not available 2010/11)
ENS309 Tourism I: Principles and Practices (2, Area 4)
ENS317 Industrialisation Trends and Developing Countries (2, Area 3) (not available 2011/12)
ENS383 Advanced Human Geography (2, Humanities Students) (pre: ENV102/211/219)

Optional Courses (By Career Areas)

ENS306 Globalisation, Socioeconomic and Environmental Change (2, all areas) (not available 2011/12)
ENS307 Human Settlements: Principles and Morphology (2, all areas) (pre: ENV210/211/212/219/POP303/ URP200/204)
ENS310 Medical Geography (2, all areas)
ENS319 Economic Geography (2, all areas) (not available 2011/12)
ENS339 Methods and Techniques in Environmental Appraisal (2, all areas) (NOT AVAILABLE IN 2011/12)
ENS305 Rural Geography (2, Areas 1 and 4) (not available 2011/12)
ENS309 Tourism I: Principles and Practices (2, Areas 1and 2)
ENS317 Industrialisation Trends and the Developing World (2, Areas 1 and 2) (not available 2011/12)
ENS321 Urbanisation in the Developing World (2, all areas) pre ENV210/211/212/219/ POP303/URP200/204)

Semester 6
Core Courses (By CAREER Areas)

ENS311 Environment, Population and Development (3, Area 1)
ENS312 Sustainable Development (2, all areas) (pre: ENV301)
ENS313 Elementary Techniques in Population Geography (3, Area 1) (pre: ENV302)
ENS316 Agricultural Development (2, Area 2)
ENS318 Tourism II: Tools and Analysis (2, Area 4) (pre: ENV309)
ENS384 Advanced Physical Geography (2, Humanities) (pre: ENV101/214/220)

Optional Courses (By Career Areas)

POP306 Population and Development (3, all areas)

ENS315 Environmentalism and Social Theory (2, all areas) (ENV210/211/212/219/383/POL301/SOC322/327)
ENS320 Geography of Botswana (2, all areas) (not available 2010/11)
ENS339 Methods and Techniques in Environmental Appraisal (2, all areas) (not available 2011/12)
ENS318 Tourism II: Tools and Analysis (2, Areas 1 and 2) (pre: ENV309)
POP305 Population Dynamics, Policies and Programmes (3, Area 1)

Semester 7
Core Courses (By CAREER Areas)
ENV401 Advanced Techniques in Population Geography (3, Area 1) (pre: ENV313)
ENV404 Rural Development Theory and Practice (2, Area 2)
ENV405 Rural Survey Techniques (2, Area 2)
ENV407 Eco-tourism (2, Area 4) (pre: ENV309&ENV318)
ENV424 Industry and the Environment (2, Area 3) (not available 2011/12)

Optional Courses (By Career Areas)
ENV406 Regional Development Studies (2, all areas) (not available 2011/12)
ENV425 The African Environment (3, all areas)
ENV426 GIS for Socioeconomic Applications (3, all areas)(pre: ENV215)
ENV447 Environmental Hazards (2, all areas)
ENV402 Natural Resource Conservation and Management (3, all areas) (not available 2011/12)
ENV407 Ecotourism (2, Areas 1 and 2) (pre: ENV309&ENV318)
ENV404 Rural Development Theory and Practice (2, Areas 1 and 4)
ENV423 Urban Social Theory (2, Areas 1 and 3)(pre:ENV315/383/POL301/SOC421/433/URP400/407)
ENV424 Industry and the Environment (2, Area 4) (not available 2011/12)

Semester 8
Core Courses (By CAREER Areas)
ENV415 Rural Development in Botswana (2, Areas 2 and 4)
ENV418 Environmental Policy (2, Area 4)
ENV424 Industry and Environment (2, Area 3) (not available 2011/12)

Optional Courses (By Area of Specialisation)
ENV403 Gender and Environment (2, all areas)
ENV412 Environmental Impact Assessment (3, all areas) (not available 2011/12)
ENV418 Environmental Policy (2, Areas 1, 2 and 3)
ENV419 Development Geography (2, all areas) (not available 2011/12)
ENV427 Energy and Environment (2, all areas) (not available 2011/12)
ENV456 Remote Sensing for Socioeconomic Applications (3, all areas) (pre: ENV216)
ENV476 Natural Resource Management and Economics (2, all areas)
ENV416 Transport and Environment (2, Areas2, 3 and 4)
ENV483 Advanced Map-work and Air Photo Interpretation (3, all areas)
ENV484 Urbanisation and Environment (2, Area 3)
(pre: ENV307/321/URP213,301)
POP423 Population and Development (3, Areas 1 and 2)

Combined Major/Major Programme
Combined Major/Major students shall take 5 to 6 credits of core and/or optional Environmental Science courses in each of Semesters 5 to 8. No areas of specialization are prescribed under this Programme. However, candidates could use templates for Single Majors or Major/Minors (Environmental Science Major) to guide their selection of courses. Availability of courses is subject to the staffing situation in the particular semester and/or year.

Semester 5
(See above or DEPARTMENT Handbook for course pre-req.)
In Semester 5, Combined Major/Major students shall take core course ENV301 and an additional 4 credits from the following list of optional courses: ENV302, ENV304, ENV305, ENV306, ENV307, ENV309, ENV310, ENV317, ENV319, ENV321, ENV339 and ENV383. For students registered in the Faculty of Humanities, ENV383 shall be taken as a core course.

Semester 6
(See above or DEPARTMENT Handbook for course pre-req.)
In Semester 6, Combined Major/Major students shall take core course ENV312 and an additional 4 credits from the following list of optional courses POP305, ENV311, ENV313, ENV315, ENV316, ENV318, ENV320, and ENV384. For students registered in the Faculty of Humanities ENV384 shall be taken as a core course.

Semester 7
(See above or DEPARTMENT Handbook for course pre-req.)
There are no core courses for the Combined Major/Major Programme in Semester 7. Students shall take, therefore, 5 to 6 credits from the following list of optional courses: ENV401, ENV402, ENV404, ENV405, ENV406, ENV407, ENV408, ENV423, ENV424, ENV425, ENV426, ENV447.

Semester 8
(See above or DEPARTMENT Handbook for course pre-req.)
There are no core courses for the Combined Major/Major Programme in Semester 8. Students shall take, therefore, 5 to 6 credits from the following list of optional courses: ENV402, ENV403, ENV412, ENV415, ENV416, ENV418, ENV419, POP423, ENV427, ENV456, ENV476, ENV481, ENV482, ENV483, ENV484.

Combined Major/Minor Programme with Environmental Science as the Minor
In the Combined Major/Minor Programme with Environmental Science as Minor, students shall take 3 to 4 credits of Environmental Science courses in each of Semesters 5 to 8. No areas of specialisation apply to this Programme. The availability of courses is subject to the staffi ng situation in the particular semester.

Semester 5
(See above or DEPARTMENT Handbook for course pre-req.)
In Semester 5, Combined Major/Minor students shall take core course ENV301 and at least 2 additional credits from the following Environmental Science optional courses: ENV302, ENV304, ENV305, ENV306, ENV307, ENV309, ENV310, ENV317, ENV319, ENV321, ENV339 and ENV383. For students registered in the Faculty of Humanities, ENV383 shall be taken as a core course.

Semester 6
(See above or DEPARTMENT Handbook for course pre-req.)
In Semester 6, Combined Major/Minor (Environmental Science Minor) students shall take core course ENV312 and at least 2 additional credits from the following Environmental Science optional courses: POP305, ENV313, ENV311, ENV315, ENV316, ENV318, ENV320, and ENV384. For students registered in the Faculty of Humanities, ENV384 shall be taken as a core course.

Semester 7
(See above or DEPARTMENT Handbook for course pre-req.)
In Semester 7, Combined Major/Minor (Environmental Science Minor) students shall take 3 to 4 credits from the following Environmental Science options: ENV401, ENV402, ENV404, ENV405, ENV406, ENV408, ENV423, ENV424, ENV425, ENV440, and ENV447.

Semester 8
(See above or DEPARTMENT Handbook for course pre-req.)
In Semester 8, Combined Major/Minor (Environmental Science Minor) students shall take 3 to 4 credits from the following Environmental Science options: ENV402, ENV403, ENV412, ENV415, ENV416, ENV418, ENV419, POP423, ENV427, ENV456, ENV476, ENV481, ENV482, ENV483 and ENV484.

5.2 Physical Environment Programmes
The Physical Environment Programmes are designed for students registered in the Faculty of APPLIED AND NATURAL ScienceS and are subject to DEPARTMENT OF ENVIRONMENTAL SCIENCE & MANAGEMENT Regulations 1.4.1.2 to 1.4.1.5.

Level 100
In accordance with Faculty Special Regulation 23.45, Environmental Science is not offered a this level to students registered in the Faculty of APPLIED AND NATURAL Sciences.

Levels 200 to 400
Semester 3
Core Courses
ENS211 The Earth Environment System (3)
ENS242 Introduction to Spatial Analysis (3)
ENS251 The Human Environment System (3)

Semester 4
Core Courses
ENS243 Introduction to Remote Sensing (3)

Optional Courses
ENS241 Quantitative Techniques in Environmental Science (3)
ENS252 Botswana Environment (3)
ENS260 Environment and Population Dynamics (3)

Single Major Programme
In accordance with General Academic Regulation 00.62, in each of Semesters 5 to 8 the Single Major

Programme in Environmental Science shall consist of 10 to 12 core and optional courses for each of the Physical Environment Areas of Specialisation, with optional courses selected from the following lists. Availability of courses is subject to the staffing situation in the particular semester and/or year.

Semester 5
Core Courses
ENS301 Environmental Issues (2)
ENS303 Directed Readings (2)
ENS330 Remote Sensing for Environmental Science (3) (pre: ENV216/ENS243)

Optional Courses
ENS331 Hydro-meteorology (2)
ENS332 Air Photography (3) (pre: ENV215/ ENS216/ENS242/ENS243)
ENS334 Principles of Soil Science (3)
ENS338 Introduction to Geomorphology (3) (pre: ENV218)
ENS340 Biogeography (2)
ENS382 Analytical Methods for Specific Hazards (3)

Semester 6
Core Courses
ENS312 Sustainable Development (2) (pre: ENV301)
ENS314 Project Proposal (2) (pre: ENV303)
ENS336 Advanced Statistical Techniques for Environmental Science (3)

Optional Courses
ENS335 Principles of Hydrology (3)
ENS337 Dynamic Meteorology (3)
ENS339 Methods and Techniques for Environmental Appraisal (2) not available 2011/12)
ENS342 The Climate System (3)
ENS385 Soil Geography (3)

Semester 7
Core Courses
ENV400 Project Data Collection, Analysis and Reporting I (1) (pre: ENV314)
ENV440 Geographical Information Systems (3) (pre: ENV215/ENS242)

Optional Courses
ENV441 Applied Hydrology I (3) (pre: ENV335)
ENV442 Boundary Layer Climates (3)
ENV447 Environmental Hazards (2)
ENV449 Land Reclamation (3)
ENV450 Rangeland Management I (3) (pre: ENV340)
ENV462 Environmental Quality and Management: Land and Air (3) (pre: ENV382)
ENV475 Pedology (2)
ENV477 Internet Kalahari Transect Land-use Change Modelling I (3) (NOT AVAILABLE IN 2011/2012)

Semester 8
Core Course
ENV414 Project Data Collection, Analysis and Reporting II (1, all areas (pre: ENV400)

Optional Courses
ENV445 Arid Lands Geomorphology (2) (pre: ENV338)
ENV451 Rangeland Management II (2) (pre: ENV450)
ENV452 Soil survey and land evaluation (3) (pre: ENV334/385)
ENV458 Water Resources Development and Management (2)
ENV463 Environmental Quality and Management: Water and Wastewater (3) (pre: ENV462)
ENV478 Climates of Southern Africa (2) (pre: ENV342)
ENV479 Applied Hydrology II (3) (pre: ENV335)
ENV480 Internet Kalahari Transect Land-use Change Modelling II (3) (not available 2011/12)

Combined Major/Minor Programme with Environmental Science as the Major
In accordance with General Academic Regulation 00.62, the Combined Major/Minor Programme in Physical Environment shall consist of 7 to 8 credits from core and optional courses, with optional courses selected from the following lists. Courses ENV303, ENV400 and ENV414 jointly satisfy Faculty Regulation 23.47. Availability of courses is subject to the staffi ng situation in the particular semester.

Semester 3
Core Courses
ENS211 The Earth Environment System (3)
ENS242 INTRODUCTION TO SPATIAL ANALYSIS (3)
ENS251 The Human Environment System (3)

Semester 4
Core Courses
ENS243 Introduction to Remote Sensing (3)

Optional Courses
ENS241 Quantitative Techniques in Environmental Science (3)
ENS252 Botswana Environment (3)
ENS260 Environment and Population Dynamics (3)

Semester 5
Core Courses
ENS301 Environmental Issues (2)
ENS303 Directed Readings (2)

Optional Courses
ENS330 Remote Sensing for Environmental Science (3) (pre: ENV216/ENS243)
ENS331 Hydro-meteorology (2)
V332 Air Photo Interpretation (3) (pre: ENV215/ENV216/ENS242/ENS243)
ENS334 Principles of Soil Science (3)
ENS338 Introduction to Geomorphology (3) (pre: ENV218)
ENS340 Biogeography (2)
ENS382 Analytical Methods for Specific Hazards (3)

Semester 6
Core Courses
ENS312 Sustainable Development (2) (pre: ENV301)
ENS314 Project Proposal (2) (pre: ENV303)
ENS336 Advanced Statistical Techniques for Environmental Science (3)

Optional Courses
ENS335 Principles of Hydrology (3)
ENS337 Dynamic Meteorology (3)
ENS339 Methods and Techniques for Environmental Appraisal (2) (not available 2011/12)
ENS342 The Climate System (3)
ENS385 Soil Geography (3)

Semester 7
Core Course
ENV400 Project Data Collection, Analysis and Reporting I (1) (pre: ENV314)

Optional Courses
ENV440 Geographical Information Systems (3) (pre: ENV215)
ENV441 Applied Hydrology I (3) (pre: ENV335)
ENV442 Boundary Layer Climates (3)
ENV447 Environmental Hazards (2)
ENV449 Land Reclamation (3)
ENV450 Rangeland Management I (3) (pre: ENV350)
ENV462 Environmental Quality and Management: Land and Air (3) (pre: ENV382)
ENV475 Pedology (2) (pre: ENV332)

Semester 8
Core Course
ENV414 Project Data Collection, Analysis and Reporting II (2, all areas) (pre: ENV400)

Optional Courses
ENV445 Arid Lands Geomorphology (2) (pre: ENV338)
ENV451 Rangeland Management II (2) (Pre: ENV450)
ENV452 Soil Survey and Land Evaluation (3) (pre: ENV334/385)
ENV458 Water Resources Development and Management (2)
ENV462 Environmental Quality and Management: Water and Wastewater (3) (pre: ENV462)
ENV478 Climates of Southern Africa (2) (pre: ENV342)
ENV479 Applied Hydrology II (3) (pre: ENV335)

Combined Major/Major Programme In accordance with General Academic Regulation 00.62, the Major/Major Programme in Physical Environment shall consist of 5 to 6 credits from core and optional courses, with optional courses selected from the following lists. Course ENV485 satisfies Faculty Regulation 23.47. Availability of courses is subject to the staffing situation in the particular semester.

Semester 3
Core Courses
ENS211 The Earth Environment System (3)
ENS242 INTRODUCTION TO SPATIAL ANALYSIS (3)
ENS251 The Human Environment System (3)

Semester 4
Core Courses

ENS243 Introduction to Remote Sensing (3)

Optional Courses
ENS241 Quantitative Techniques in Environmental Science (3)
ENS252 Botswana Environment (3)
ENS260 Environment and Population Dynamics (3)

Semester 5

Core Course
ENV301 Environmental Issues (2)

Optional Courses
ENS330 Remote Sensing for Environmental Science (3) (pre: ENV216)
ENS331 Hydro-meteorology (2)
ENS332 Air Photography (3) (pre: ENV215/216)
ENS334 Principles of Soil Science (3)
ENS338 Introduction to Geomorphology (3) (pre: ENV218)
ENS340 Biogeography (2)
ENS382 Analytical Methods for Specific Hazards (3)

Semester 6
Core Courses
ENS312 Sustainable Development (2) (pre: ENV301)
ENS336 Advanced Statistical Techniques for Environmental Science (3)

Optional Courses
ENS335 Principles of Hydrology (3)
ENS337 Dynamic Meteorology (3)
ENS339 Methods and Techniques for Environmental Appraisal (2) (not available 2011/12)
ENS342 The Climate System (3)
ENS385 Soil Geography (3)

Semester 7
Core Courses
None

Optional Courses
ENV440 Geographical Information Systems (3) (pre: ENV215/ENS242)
ENV441 Applied Hydrology I (3) (pre: ENV335)
ENV442 Boundary Layer Climates (3)
ENV447 Environmental Hazards (2)
ENV449 Land Reclamation (3)
ENV450 Rangeland Management I (3) (pre: ENV350)
ENV462 Environmental Quality and Management: Land and Air (3) (pre: ENV382)
ENV475 Pedology (2) (pre: ENV332)

Semester 8
Core Courses
None

Optional Courses
ENV445 Arid Lands Geomorphology (2) (pre: ENV338)
ENV451 Rangeland Management II (2) (pre: ENV450)
ENV452 Soil Survey and Land Evaluation (3) (pre: ENV334/385)
ENV458 Water Resources Development and Management (2)
ENV463 Environmental Quality and Management: Water and Wastewater (3) (pre: ENV462)
ENV478 Climates of Southern Africa (2)
ENV479 Applied Hydrology II (3) (pre: ENV335)
ENV485 Research Essay (2)

Combined Minor/Major Programme with Environmental Science as Minor
In accordance with General Academic Regulation 00.62, the Major/Minor Programme in Physical Environment shall consist of 3 to 4 core and optional courses, with optional courses selected from the following lists. Availability of courses is subject to the staffing situation in the particular semester.

Semester 3
Core Courses
ENS211 The Earth Environment System (3)
ENS242 INTRODUCTION TO SPATIAL ANALYSIS (3)
ENS251 The Human Environment System (3)

Semester 4
Core Courses
ENS243 Introduction to Remote Sensing (3)

Optional Courses
ENS241 Quantitative Techniques in Environmental Science (3)
ENS252 Botswana Environment (3)
ENS260 Environment and Population Dynamics (3)

Semester 5
Core Course
ENV301 Environmental Issues (2)

Optional Courses
ENS330 Remote Sensing for Environmental Science (3) (pre: ENV216)
ENS331 Hydro-meteorology (2)
ENS332 Air Photo Interpretation (3) (pre: ENS215/216)
ENS334 Principles of Soil Science (3)
ENS338 Introduction to Geomorphology (3) (pre: ENV218)
ENS340 Biogeography (2)
ENS382 Analytical Methods for Specific Hazards (3)

Semester 6
Core Course
ENV312 Sustainable Development (2) (pre: ENV301)

Optional Courses
ENS336 Advanced Statistical Techniques for Environmental Science (3)
ENS335 Principles of Hydrology (3)
ENS337 Dynamic Meteorology (3)
ENS339 Methods and Techniques for Environmental Appraisal (2) (not available 2010/11)
ENS342 The Climate System (3)
ENS385 Soil Geography (3)

Semester 7
Core Courses
None

Optional Courses
ENV440 Geographical Information Systems (3) (pre: ENV215/ENS242)
ENV441 Applied Hydrology I (3) (pre: ENV335)
ENV442 Boundary Layer Climates (3)
ENV447 Environmental Hazards (2)
ENV449 Land Reclamation (3)
ENV450 Rangeland Management I (3)
ENV462 Environmental Quality and Management: Land and Air (3) (pre: ENV382)
ENV475 Pedology (2) (pre: ENV332)

Semester 8
Core Courses
None

Optional Courses
ENV445 Arid Lands Geomorphology (2) (pre: ENV338)
ENV451 Rangeland Management II (2) (pre: ENV450)
ENV452 Soil Survey and Land Evaluation (3) (pre: ENV334/385)
ENV458 Water Resources Development and Management (2)
ENV463 Environmental Quality and Management: Water and Wastewater (3) (pre: ENV462)
ENV478 Climates of Southern Africa (2)
ENV479 Applied Hydrology II (3) (pre: ENV335)
ENV485 Research Essay (2)

DEPARTMENT OF GEOLOGY

Programmes and Titles of Degrees

The Department of Geology offers the following Programmes leading to the award of the mentioned Degrees:

- Single Major Programme, leading to the award of a Bachelor of Science Degree in Geology as per Departmental Regulation 2.2
- Combined Major/Minor with a Geology major leading to the award a Bachelor of Science degree as per Departmental Regulation 2.2
- Combined Major/Major Degree Programme with Geology and one of Chemistry, Environmental Science and Physics leading to the award of a Bachelor of Science Degree as per Departmental Regulations 2.2
- Combined Major/Minor with Geology as a Minor leading to the award of the degree in which the student is enrolled as per Departmental Regulation 2.2
- Single Major Programme (in collaboration with the Department of Physics), leading to the award of a Bachelor of Science Degree in Applied Geophysics as per in the Faculty of Science Regulations 23.2.1 and 23.4.
- Master of Science Programme leading to the award of a Master of Science Degree in Hydrogeology as per Departmental Regulation 4.0.

Entry Requirements
(a) Admission to the Geology Single Major and Combined Degree Programmes shall be as specified in the Faculty of Science Regulations 23.2.1 and 23.4.

(b) Students who wish to register for Geology (Single Major or Combined Degree) at Level 200 must have taken and passed Mathematics, Physics, Chemistry and Geology or Mathematics, Physics and Chemistry at Level 100.

(c) In accordance with the Faculty of Science Special Regulation 23.2.4, a Geology student (Single Major and Combined Degree) can register directly at Level 200 but cannot be exempted from Level 100 Geology courses.

(d) A student admitted to Level 200 Geology who has not completed Level 100 Geology courses must take them during the first semester of Level 200.

(e) A student admitted to Level 200 Geology who

has successfully completed Level 100 Geology courses must comply with the University of Botswana Academic General Regulation 00.311 by taking relevant General Education courses or Elective courses in consultation with the Head of Department.

Award of Degree

To be awarded a Bachelor of Science Degree in Geology or a Bachelor of Science for a Combined Degree involving Geology as a subject, a student must have taken and passed the relevant courses prescribed in sections 3.1 and 3.2 and must satisfy General Academic Regulations 00.85 and 00.9 and Faculty of Science Special Regulation 23.7.

Course Structure

Geology courses shall be offered at Levels 100 to 400 for the Undergraduate Programme as outlined in Regulations 2.1 to 2.4 below and Levels 600 to 700 for Master of Science candidates.

Level 100

Semester 1

GEO101 Introduction to Geology (4)

Semester 2

GEO102 Introduction to Mineralogy (3)

Levels 200, 300 and 400

Bachelor of Science, Geology Single Major

At Level 200, the Single Major Programme consists of 19 credits of core courses and 9 credits of elective courses from Statistics and Mathematics. In addition, students must take a minimum of 4 credits of General Education Courses.

Semester 3

Core Courses

GEO201 Structural Geology (3)
GEO204 Sedimentology (3)
GEO205 Introduction to Hydrogeology (3)
MAT291 Engineering Mathematics I (3)
STA116 Introduction to Statistics (3)

Semester 4

Core Courses

GEO202 Optical Mineralogy (2)
GEO203 Photogeology and Remote Sensing Applied to Geology (2)
GEO206 Petrography (3)
GEO207 Chemical Geology (3)
MAT292 Engineering Mathematics II (3)

Level 300

At Level 300, the Single Major Programme will consist of 35 credits of core courses which include a winter course GEO301 (Field Mapping) to be done during the long vacation/winter semester after Level 200.

Long Vacation/Winter Semester

GEO301 Field Mapping (3)

Semester 5

Core Courses

GEO302 Igneous Petrology (3)
GEO303 Sedimentary Petrology (3)
GEO305 Ore Geology (3)
GEO306 Exploration Geophysics I (3)
GEO312 Research Methods & Computer Applications in Geology (2)

Semester 6

Core Courses

GEO304 Advanced Structural Geology (4)
GEO308 Metamorphic Petrology (3)
GEO309 Hydrogeology (3)
GEO310 Exploration Geophysics II (3)
GEO311 Paleontology and Stratigraphy (3)
GEO313 Theoretical Geochemistry (3)

Level 400

At Level 400, the Single Major Programme shall consist of 23 credits of core courses and at least 3 credits from optional courses.

Winter Semester

GEO401 Research Project (Data Acquisition)

Semester 7

Core Courses

GEO401 Research Project (6, yearlong)
GEO404 Geology of Africa (3)
GEO407 Economic Geology (3)
GEO408 Environmental Geology (3)

Optional (choose at least 1)

GEO409 Geology of Botswana (3)
GEO410 Advanced Methods in Exploration Geophysics (3)

Semester 8

Core Courses

GEO401 Research Project (6, yearlong)
GEO402 Geotectonics (2)
GEO403 Exploration Geochemistry (3)
GEO405 Engineering Geology (3)
+ 4 credits of GEC's/Electives

Bachelor of Science, Combined (Geology Major)

Level 200

At level 200, the Major/Minor programme shall consist of 19 credits of core courses. In addition, the students must take the relevant General Education Courses and comply with Academic General Regulations 00.62

Semester 3

Core Courses

GEO201 Structural Geology (3)
GEO204 Sedimentology (3)
GEO205 Introduction to Hydrogeology (3)

Students who are registering at level 200 and have not taken GEO101 and GEO102 in the first year have to register for these courses at level 200.

Semester 4

Core Courses

GEO202 Optical Mineralogy (2)
GEO203 Photogeology and Remote Sensing Applied to Geology (2)
GEO206 Petrography (3)
GEO207 Chemical Geology (3)

Level 300

At Level 300, the Major/Minor Programme (Geology Major) shall consist of 23 credits. In addition, the students must take relevant General Education Courses.

Long Vacation/Winter Semester

GEO301 Field Mapping (3)

Semester 5

Core Courses

GEO305 Ore Geology (3)
GEO307 Petrology I (2)
GEO312 Research Methods & Computer Applications in Geol. (2)
GEO315 Introduction to Exploration Geophysics (3)

Semester 6

Core Courses

GEO304 Advanced Structural Geology (4)
GEO309 Hydrogeology (3)
GEO313 Theoretical Geochemistry (3)
GEO314 Petrology II (2)

Level 400

At Level 400, the Major/Minor Programme shall consist of 15 credits of core courses and at least 2 to 3 credits from optional courses.

Long Vacation/Winter Semester

GEO401 Research Project (Data Acquisition)

Semester 7

Core Courses

GEO401 Research Project (yearlong)
GEO404 Geology of Africa (3)
GEO408 Environmental Geology (3)

Semester 8

Core Courses

GEO401 Research Project (6)
GEO403 Exploration Geochemistry (3)

Optional Courses

(choose at least 1)

GEO402 Geotectonics (2)
GEO405 Engineering Geology (3)

Bachelor of Science, Combined Major

Level 200

At level 200, the Major/Major Programme shall consist of 11 credits of core courses for all streams (Geology/Chemistry; Geology/ Environmental Science; and Geology/Physics).
In addition, the student must take the relevant General Education Courses and comply with Academic General Regulation 00.62

Semester 3

Core Courses

GEO201 Structural Geology (3)
GEO205 Introduction to Hydrogeology (3)

Students who are registering at level 200 and have not taken GEO101 and GEO102 in the first year have to register for these courses at level 200.

Semester 4

Core Courses

GEO203 Photogeology and Remote Sensing Applied to Geology (2)
GEO206 Petrography (3)

Level 300

At Level 300, the Major/Major Programme is offered in the 3 following streams:
a) Geology/Chemistry;
b) Geology/Environmental Science;
c) Geology/Physics.

The programme consists of 13 credits of core and optional courses. In addition, the students must take the relevant General Education courses and

comply with Academic General Regulation 00.62
Long Vacation/Winter Session Core Course for all Streams

GEO301 Field Mapping (3)

Bachelor of Science, Combined Major (Geology/Chemistry)

Semester 5
Core Courses
GEO305 Ore Geology (3)
GEO307 Petrology I (2)

Semester 6
Core Courses
GEO313 Theoretical Geochemistry (3)
GEO314 Petrology II

Level 400
At level 400, the Major/Major programme shall consist of 3 credits of core courses and 5 to 6 credits of optional courses. In addition, the students must take the relevant General Education courses and comply with the Faculty of Science General Regulation 00.62

Semester 7
Core course
GEO408 Environmental Geology (3)

Optional Courses (choose at least 1)
GEO407 Economic Geology (3)
GEO409 Geology of Botswana (3)

Semester 8
Optional Courses
(choose at least 2)
GEO402 Geotectonics (2)
GEO403 Exploration Geochemistry (3)
GEO405 Engineering Geology (3)

Important Notice for 4th Year Combined Major Students
(a) Students who wish to do a research project in Geology must register for GEO406 (in semester 2).

(b) Students who do not register for GEO406 must register for a project in the other subject.

Bachelor of Science, Combined Major (Geology/Environmental Science)

Semester 5
Core Courses
GEO305 Ore Geology (3)
GEO307 Petrology I (2)

Semester 6
Core Courses
GEO309 Hydrogeology (3)
GEO314 Petrology II (2)

Level 400
At level 400, the Major/Major programme shall consist of 3 credits of core courses and 5 to 6 credits of optional courses. In addition, the students must take the relevant General Education courses and comply with the Faculty of Science General Regulation 00.62

Semester 7
Core course
GEO408 Environmental Geology (3)
Optional Courses
(choose at least 1)
GEO407 Economic Geology (3)
GEO409 Geology of Botswana (3)

Semester 8
Optional Courses
(choose at least 2)
GEO402 Geotectonics (2)
GEO403 Exploration Geochemistry (3)
GEO405 Engineering Geology (3)

Important Notice for 4th Year Combined Major Students

(a) Students who wish to do a research project in Geology must register for GEO406 (in semester 2).

(b) Students who do not register for GEO406 must register for a project in the other subject.

Bachelor of Science, Combined Major (Geology/Physics)

Semester 5
Core Courses
GEO307 Petrology I (2)
GEO315 Introduction to Exploration Geophysics (3)

Semester 6
Core Courses
GEO309 Hydrogeology (3)
GEO314 Petrology II (2)

Level 400
At level 400, the Major/Major programme shall consist of 3 credits of core courses and 5 to 6 credits of optional courses. In addition, the students must take the relevant General Education courses and comply with the Faculty of Science General Regulation 00.62

Semester 7
Core course
GEO404 Geology of Africa (3)
GEO408 Environmental Geology (3)
Semester 8
GEO402 Geotectonics (2)
GEO405 Engineering Geology (3)

Important Notice for 4th Year Combined Major Students
(a) Students who wish to do a research project in Geology must register for GEO406 (in semester 2).

(b) Students who do not register for GEO406 must register for a project in the other subject.

Bachelor of Science, Combined Major/Minor (Geology minor)

The combined Major/Minor programme with Geology as a Minor shall consist of 24 credits of core courses taken in Semesters 3 to 8.

Core Courses
GEO101 Introduction to Geology (4)
GEO102 Introduction to Mineralogy (3)
GEO201 Structural Geology (3)
GEO204 Sedimentology (3)
GEO205 Introduction to Hydrogeology (3)
GEO206 Petrography (3)
GEO305 Ore Geology (3)
GEO408 Environmental Geology (3)

It is important to note which courses are taken in the first semester or second semester of the academic year (Refer to Single Major Programme for such information)

Service Courses
The following are offered as service courses for non-Geology Majors
GEO103 Geology for Teachers (3)
GEO104 Introductory Geology for Engineers (2)
General Education Courses
GEC250 Earth Processes, Mineral Resources and Development (2)
GEC251 Groundwater and Society (2)

Assessment and Examination
(a) 2.5.1 If not stated otherwise, the examination will represent 2/3 and the continuous assessment 1/3 of the final marks.
(b) GEO301 shall be examined by continuous assessment only.

Progression
Student progression is made in accordance with The University of Botswana General Academic Regulation 00.9

BSC201: BACHELOR OF APPLIED GEOPHYSICS

Entrance requirements
Admission to the Applied Geophysics Degree Programmes shall be as specified in the Faculty of Science Regulations 23.2.1 and 23.4.

(a) Students who wish to register for the Applied Geophysics Degree Programme at Level 200 must have taken and passed Mathematics, Physics, Chemistry and Geology or Mathematics, Physics and Chemistry at Level 100.

(b) In accordance with the Faculty of Science Special Regulation 23.2.4, an Applied Geophysics student can register directly at Level 200 but cannot be exempted from Level 100 Geology courses.

(c) A student admitted to Level 200 Applied Geophysics who has not completed Level 100 Geology courses must take them at Level 200.

(d) A student admitted to Level 200 Applied Geophysics who has successfully completed Level 100 Geology courses must comply with the University of Botswana Academic General Regulation 00.311 by taking relevant General Education courses or Elective courses in consultation with the Head of Department.

Award of Degree
To be awarded a B.Sc. (Applied Geophysics) a candidate/student must have taken and passed all the courses prescribed in Section 9 and must satisfy the University of Botswana Academic General Regulations 00.85 and 00.9 and Faculty of Science Special Regulation 23.7.

Programme Structure
The Programme is designed in such a manner as to

gradually introduce students to the principles of Applied Geophysics in the third year. It is envisaged that at this level, students are sufficiently grounded in the basic theories and principles used in Geophysics and can appreciate all the scientific/ practical developments in this field they are likely to encounter. They should have been exposed to adequate field work through the geologic field course taken during Level 100 and 200.
The fourth and final year consists of the completion of the Geology and Applied Geophysics courses and emphasis is placed on application of the various geophysical methods in exploration and fieldwork (where the students will be acquainted with the use of various geophysical equipments) which forms a major component of the course.
The courses are also designed to satisfy the required training expected for an applied geophysicist. This will enable graduates of the programme to qualify to be members of professional societies such as the Society of Exploration Geophysicists (SEG).

In the final year students will have the option of choosing either the Mining Geophysics or the Environmental Geophysics Stream, the latter including geotechnical and groundwater studies.

LEVEL 100
Semester 1

CHE101 General Chemistry I (4)
PHY112 Geometrical Optics and Mechanics (4)

MAT111 Introductory Mathematics I (4)
GEC141 Introduction to Communication and Academic Literacy Skills (Science) (3)
ICT 121 Computing Skills Fundamentals 1 (2)

Semester 2

CHE102 General Chemistry II (4)
PHY122 Electricity, Magnetism and Elements of Modern Physics (4)
MAT122 Introductory Mathematics II (4)
GEC142 Academic and Professional Communication (Science) (3)
ICT 122 Computing Skills Fundamentals 2 (2)

LEVEL 200
Semester 3
Core courses

GEO101 Introduction to Geology (4)
GPH201 Fundamentals of Geophysics (3)
GEO201 Structural Geology (3)
MAT221 Calculus I (3)

Optional Courses:
Candidates will be required to take at least 3 credits from the following:

GEO205 Introduction to Hydrogeology (3)
PHY231 Mechanics, Vibrations and Waves, Physical Optics (pre-requisite = PHY112) (3)
PHY232 Properties of Matter, Basic Thermodynamics and Introduction to Nuclear Physics (pre-requisite = PHY112 (3)
PHY239 Physics Practicals (3.1)

Note: Candidates intending to take Environmental Geophysics at level 400 are advised to take GEO205 as one of the optional courses

Semester 4

GEO102 Introduction to Mineralogy (3)
GEO206 Petrography (3)
PHY241 Advanced Electricity and Magnetism (pre-requisite =PHY122) (3)
PHY249 Physics Practicals 2.2 (4.1) (pre-requisite = PHY122, co-requisite = PHY241 or 242) (1) MAT222 Calculaus II (3)

Optional Courses:
Candidates will be required to take at least 3 credits from the following:

GEO203 Remote Sensing and GIS Applied to Geology (2)
PHY242 Basic Electronics (pre-requisite = PHY122) (3)
PHY232 Properties of Matter, Basic Thermodynamics and Introduction to Nuclear Physics (pre-requisite = PHY112 (3)
MAT242 Computing I (3)
MAT244 Numerical Methods (3)
Elective: Candidates are also advised to take the following course or any other 3-credit course of their choice as an elective.

LAW203 Environmental Laws of Botswana (3)

WINTER SEMESTER
GEO301 Field Mapping (5 weeks (3)

LEVEL 300
Semester 5

GEO316 Introduction to sedimentology and stratigraphy (3)
CCB313 Surveying (3)
PHY353 Mathematical Methods for Physical Sciences I (3)
GPH301 Gravity and magnetic methods (3)

Optional Courses: Candidates will be required to take at least 3 credits from the following:
MAT324 Differential Equations (3)
GEO304 Advanced structural Geology (4)
GEO305 Ore Geology (3)
PHY354 Advanced Electronics (pre-requisite = PHY242 (3)
PHY315 Introduction to Potential Fields Geophysics (3)

Semester 6

GPH302 Electrical and Electromagnetic Methods (3)
GPH304 Seismic Imaging: Theory and Applications (3)
GPH306 Geophysical Data Analysis and Interpretation (3)

Optional Courses:
Candidates will be required to take at least 3 credits from the following:
GEO309 Hydrogeology (3)
PHY361 Introduction to Electromagnetism (pre-requisite PHY241) (3)
PHY364 Advanced (pre-requisite PHY354) Electronics II (3)
PHY365 Physics of the Environmental (3)
PHY476 Mathematical Methods for Physical Sciences II (prerequisite PHY353) (3)

Elective:
Candidates are also advised to take the following course or any other 3-credit course of their choice as an elective.
ENV312 Sustainable Development (3)

WINTER SEMESTER
GPH307 Geophysical Field School (3 Weeks) (3)

LEVEL 400
Mining Geophysics Stream

Semester 7

GEO407 Economic Geology (3)
GPH403 Seismic Data Processing and Interpretation (3)
GPH405 Well Logging and Formation Evaluation (3)
GPH401 Research Project (3)

Optional Courses:
Candidates will be required to take at least 3 credits from the following:
GEO404 Geology of Africa (3)
GEO408 Environmental Geology (3)
GEO409 Geology of Botswana (3)
GPH407 Global Geophysics (3)
GPH404 Environmental Geophysics (3)
PHY481 Atomic and Basic Nuclear Physics(3)

Semester 8

GEO405 Engineering Geology (3)
GPH412 Research Project II (3)
GHP406 Mining Geophysics (3)

Optional Courses: Candidates will be required to take at least 3 credits from the following:

PHY485 Microcomputing for Physical Sciences (3)
GPH402 Geophysical Time Series analysis (3)
GEO402 Geotectonics (3)
GEO409 Geology of Botswana (3)

In addition candidates are required to take 3 credits of Elective/GEC
Environmental Geophysics Option

Semester 7:

GPH401 Research Project I (3)
GPH403 Seismic Data Processing and Interpretation (3)
GPH405 Well Logging and Formation Evaluation Techniques (3)
GEO408 Environmental Geology (3)

Optional Courses:
Candidates will be required to take at least 3 credits from the following:
GEO404 Geology of Africa (3)
GEO407 Economic Geology (3)
GPH407 Global Geophysics (3)
GPH407 Mining Geophysics (3)
PHY481 Atomic and Basic Nuclear Physics(3)

Semester 8

GPH404 Environmental Geophysics (3)
GEO405 Engineering Geology (3)
GPH412 Research Project II (3)

Optional Courses: Candidates will be required to take at least 3 credits from the following:
PHY485 Microcomputing for Physical sciences (3)
GPH402 Geophysical Time Series Analyses (3)
GPH407 Global Geophysics (3)
GEO404 Geology of Africa (3)

In addition candidates are required to take 3 credits of Elective/GEC

DEPARTMENT OF MATHEMATICS

Programmes and Titles of Degrees

The Department of Mathematics offers the following Programmes leading to the award of the mentioned degrees:

- Single Major Programme leading to the award of a Bachelor of Science Degree in Mathematics as outlined in Departmental Regulation 2.1
- Combined Major/Minor Programme with Mathematics as the Major, leading to the award of a Bachelor of Science Degree as outlined in Departmental Regulation 2.2
- Combined Major/Major Programme leading to the award of a Bachelor of Science Degree as outlined Departmental Regulation 2.3
- Combined Major/Minor Programme with Mathematics as the Minor leading to the award of a Bachelor of Science Degree as outlined in Departmental Regulation 2.4.

Entry Requirements

Admission to the Mathematics Programmes shall be as specified in Faculty of Science Regulation 23.21.

The entry requirement for Single Major and Major/Minor (with Mathematics Major) at level 300 shall be a GPA of 3.0 in the Mathematics courses at levels 100 and 200 subject to approval by the Head of the Department.

Single Major (Mathematics Major)

Level 100
Semester 1

MAT111 Introductory Mathematics I (4)

Semester 2

MAT122 Introductory Mathematics II (4)

Level 200
Semester 3

In Semester 3, the Single Major Programme shall consist of 6 credits of core courses and a minimum of 6 credits optional courses.

Core Courses

MAT211 Introductory Set and Number Theory (3)
MAT221 Calculus I (3)

Optional Courses

MAT244 Numerical Methods I (3)
MAT251 Vectors and Introductory Mechanics (3)
MAT271 Introduction to Mathematical Statistics (3)

Semester 4
Core Courses

In Semester 4, the Single Major Programme shall consist of 6 credits of core courses and a minimum of 6 credits of optional courses.

MAT212 Introduction to Linear Algebra (3)
MAT222 Calculus II (3)Optional Courses
MAT214 Discrete Mathematics (3)
MAT242 Computing (3)
MAT252 Newtonian Mechanics (3)

Level 300
Semester 5

In Semester 5, the Single Major Programme shall consist of 6 credits of core courses.

Additional minimum 6 credits should be taken from optional courses in accordance with General Regulation 00.62.

Core Courses

MAT311 Abstract Algebra I (3)
MAT321 Real Analysis I (3)

Optional Courses

MAT323 Vector Calculus (3)
MAT344 Numerical Methods for LinearAlgebra 3)
MAT361 Mathematical Programming and Game Theory (3)
MAT371 Mathematical Statistics I (3)

Semester 6

In Semester 6, the Single Major Programme shall consist of 9 credits of core courses. An additional minimum 3 credits should be taken from optional courses in accordance with General Regulation 00.62.

Core Courses

MAT312 Abstract Algebra II (3)
MAT322 Real Analysis II (3)
MAT324 Differential Equations (3)

Optional Courses

MAT346 Numerical Methods II (3)
MAT348 Introduction to Computational Mathematics (3)
MAT352 Dynamics I (3)
MAT372 Mathematical Statistics II (3)

Level 400
Semester 7

In Semester 7, the Single Major Programme shall consist of 7 credits of core courses. Additional minimum 6 credits should be taken from optional courses in accordance with General Regulation 00.62.

Core Courses

MAT401 Introduction to Mathematical Writing (1)
MAT411 Linear Algebra (3)
MAT421 Functions of a Complex Variable (3)

Optional Courses

MAT423 Mathematical Methods (3)
MAT425 Measure Theory (3)
MAT431 General Topology (3)
MAT451 Dynamics II (3)
MAT461 Optimisation and Control Theory (3)
MAT471 Multivariate Statistics (3)

Semester 8

In Semester 8, the Single Major Programme shall consist of 3 credits of core course and a minimum of 9 credits of optional courses in accordance with General Regulation 00.62.

Core Courses

MAT406 Project (3)

Optional Courses

MAT404 Topics in Advanced Mathematics (3)
MAT412 Number Theory (3)
MAT414 Combinatorics and Graph Theory (3)
MAT416 Abstract Algebra III (3)
MAT422 Functional Analysis (3)
MAT424 Dynamical Systems (3)
MAT426 Partial Differential Equations (3)
MAT428 Introduction to Probability Theory (3)
MAT432 Algebraic Topology (3)
MAT454 Introduction to Fluid Dynamics (3)
MAT464 Introduction to Mathematical Modelling Applied to Life Sciences (3)
MAT472 Linear Models (3)
MAT474 Stochastic Processes (3)
MAT478 Introduction to Statistical Analysis of Reliability (3)

Combined Major/Minor Programme (Mathematics Major)

Level 100
Semester 1

MAT111 Introductory Mathematics I (4)

Semester 2

MAT122 Introductory Mathematics II (4)

Level 200
Semester 3

In Semester 3, the Combined Major/Minor Programme shall consist of 6 credits of core courses and 3 credits from optional courses.

Core Courses

MAT211 Introductory Set and Number Theory (3)
MAT221 Calculus I (3)

Optional Courses

MAT244 Numerical Methods I (3)
MAT251 Vectors and Introductory Mechanics (3)
MAT271 Introduction to Mathematical Statistics (3)

Semester 4

In Semester 4 the Combined Major/Minor Programme shall consist of 6 credits of core courses and 3 credits from optional courses.

Core Courses

MAT212 Introduction to Linear Algebra (3)
MAT222 Calculus II (3)

Optional Courses

MAT214 Discrete Mathematics (3)
MAT242 Computing (3)
MAT252 Newtonian Mechanics (3)

Level 300
Semester 5

In Semester 5, the Combined Major/Minor Programme shall consist of 6 credits of core courses. Additional minimum 6 credits should be taken from optional courses.

Core Courses

MAT311 Abstract Algebra I (3)
MAT321 Real Analysis I (3)

Optional Courses

MAT251 Vectors and Introductory Mechanics (3)
MAT271 Introduction to Mathematical Statistics (3)
MAT323 Vector Calculus (3)

MAT344 Numerical Methods of Linear Algebra (3)
MAT361 Mathematical Programming and Game Theory (3)
MAT371 Mathematical Statistics I (3)

Semester 6
In Semester 6, the Combined Major/ Minor Programme shall consist of 3 credits of core courses. Additional minimum 6 credits should be taken from optional courses.

Core Courses
MAT324 Differential Equations (3)

Optional Courses
MAT312 Abstract Algebra II (3)
MAT322 Real Analysis II (3)
MAT346 Numerical Methods II (3)
MAT348 Introduction to Computational Mathematics (3)
MAT352 Dynamics I (3)
MAT372 Mathematical Statistics II (3)

Level 400
Semester 7
In Semester 7, the Combined Major/Minor Programme shall consist of 4 credits of core courses. Additional minimum 6 credits should be taken from optional courses.

Core Courses
MAT401 Introduction to Mathematical Writing (1)
MAT421 Functions of a Complex Variable (3)

Optional Courses
MAT411 Linear Algebra (3)
MAT423 Mathematical Methods (3)
MAT425 Measure Theory (3)
MAT431 General Topology (3)
MAT451 Dynamics II (3)
MAT453 Electromagnetic Theory (3)
MAT461 Optimisation and Control Theory (3)
MAT471 Multivariate Statistics (3)

Semester 8
In Semester 8, the Combined Major/Minor Programme shall consist of 3 credits of core course 9 credits of optional courses.
Core course

MAT406 Project (3)

Optional Courses
MAT402 History of Mathematics (3)
MAT412 Number Theory (3)
MAT414 Combinatorics and Graph Theory (3)
MAT416 Abstract Algebra III (3)
MAT422 Functional Analysis (3)
MAT424 Dynamical Systems (3)
MAT426 Partial Differential Equations (3)
MAT428 Introduction to Probability Theory (3)
MAT432 Algebraic Topology (3)
MAT454 Introduction to Fluid Dynamics (3)
MAT464 Introduction to Mathematical Modelling Applied to Life Sciences (3)
MAT472 Linear Models (3)
MAT474 Stochastic Processes (3)
MAT478 Introduction to Statistical Analysis of Reliability (3)

Combined Major/Major Programme
Level 100
Semester 1
MAT111 Introductory Mathematics I (4)

Semester 2
MAT122 Introductory Mathematics II (4)

Level 200
Semester 3
In Semester 3, the Combined Major/Major Programme shall consist of 6 credits of core courses. Additional credits may be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
MAT211 Introductory Set & Number Theory (3)
MAT221 Calculus I (3)

Optional Courses
MAT244 Numerical Methods I (3)
MAT251 Vectors and Introductory Mechanics (3)
MAT271 Introduction to Mathematical Statistics (3)

Semester 4
In Semester 4, the Combined Major/Major Programme shall consist of 6 credits of core courses. Additional credits may be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
MAT212 Introduction to Linear Algebra (3)
MAT222 Calculus II (3)

Optional Courses
MAT214 Discrete Mathematics (3)
MAT242 Computing (3)
MAT252 Newtonian Mechanics (3)

Level 300
Semester 5
In Semester 5, the Combined Major/Major Programme shall consist of 6 credits of core courses. Additional minimum 3 credits should be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
MAT311 Abstract Algebra I (3)
MAT321 Real Analysis I (3)

Optional Courses
MAT251 Vectors and Introductory Mechanics (3)
MAT323 Vector Calculus (3)
MAT344 Numerical Methods of Linear Algebra (3)

Semester 6
In Semester 6, the Combined Major/Major Programme shall consist of 3 credits of core courses. Additional minimum 3 credits should be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
MAT324 Differential Equations (3)

Optional Courses
MAT252 Newtonian Mechanics (3)
MAT312 Abstract Algebra II (3)
MAT322 Real Analysis II (3)
MAT346 Numerical Methods II (3)
MAT348 Introduction to Computational Mathematics (3)
MAT352 Dynamics I (3)

Level 400
Semester 7
In Semester 7, the Combined Major/Major Programme shall consist of 3 credits of core courses. Additional minimum 6 credits should be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
MAT421 Functions of a Complex Variable (3)

Optional Courses
MAT361 Maths. Programming and Game Theory (3)
MAT371 Mathematical Statistics I (3)
MAT401 Introduction to Mathematical Writing (1)
MAT411 Linear Algebra (3)
MAT423 Mathematical Methods (3)
MAT425 Measure Theory (3)
MAT431 General Topology (3)

Semester 8
In Semester 8, the Combined Major/Major Programme shall consist of 6 credits of optional courses.

Optional Courses
MAT372 Mathematical Statistics II (3)
MAT402 History of Mathematics (3)
MAT406 Project (3)
MAT414 Combinatorics and Graph Theory (3)
MAT416 Abstract Algebra III (3)
MAT422 Functional Analysis (3)
MAT428 Introduction to Probability Theory (3)
MAT464 Introduction to Mathematical Modelling Applied to Life Sciences (3)

Combined Major/Minor Programme
(Mathematics Minor)

Level 100
Semester 1
MAT111 Introductory Mathematics I (4)

Semester 2
MAT122 Introductory Mathematics II (4)

Level 200
Semester 3
In Semester 3, the Combined Major/Minor Programme with Mathematics as Minor shall consist of 6 credits of core courses.

Core Courses
MAT211 Introductory Set and Number Theory (3)
MAT221 Calculus I (3)

Semester 4
In Semester 4, the Combined Major/Minor Programme with Mathematics as Minor shall consist of 6 credits of core courses.

Core Courses
MAT212 Introduction to Linear Algebra (3)
MAT222 Calculus II (3)

Level 300
Semester 5
In Semester 5, the Combined Major/Minor Programme with Mathematics as Minor shall

consist of 6 credits of optional courses.

Optional Courses
MAT251 Vectors and Introductory Mechanics (3)
MAT271 Introduction to Mathematical Statistics (3)
MAT311 Abstract Algebra I (3)
MAT323 Vector Calculus (3)
MAT344 Numerical Methods of Linear Algebra (3)

Semester 6
In Semester 6, the Combined Major/Minor Programme with Mathematics as Minor shall consist of 6 credits of optional courses.

Optional Courses
MAT252 Newtonian Mechanics (3)
MAT312 Abstract Algebra II (3)
MAT346 Numerical Methods II (3)
MAT348 Introduction to Computational Mathematics (3)

Level 400
Semester 7
In Semester 7, the Combined Major/Minor Programme with Mathematics as Minor shall consist of 3 credits of optional courses.

Optional Courses
MAT321 Real Analysis I (3)
MAT361 Mathematical Programming and Game Theory (3)
MAT371 Mathematical Statistics I (3)
MAT411 Linear algebra (3)

Semester 8
In Semester 8, the Combined Major/Minor Programme with Mathematics as Minor shall consist of 6 credits of optional courses.

Optional Courses
MAT322 Real Analysis II (3)
MAT324 Differential Equations (3)
MAT372 Mathematical Statistics II (3)
MAT402 History of Mathematics (3)
MAT414 Combinatorics and Graph Theory (3)

Courses for Non-Mathematics Majors (Service courses)
MAT103 Mathematics for Allied Sciences I (3)
MAT104 Mathematics for Allied Sciences II(3)
MAT201 Ancillary Mathematics (3)

Engineering Mathematics
MAT191 Design Mathematics I (3)
MAT192 Design Mathematics II (3)
MAT291 Engineering Mathematics I (3)
MAT292 Engineering Mathematics II (3)
MAT391 Engineering Mathematics III (3)
MAT392 Engineering Mathematics IV (3)
MAT394 Engineering Mathematics IVB (3)
MAT491 Engineering Mathematics V (3)
MAT492 Engineering Mathematics VI (3)

General Education Course
MAT105 Numeracy Skills (2)

Bachelor of Education Degree (Secondary)
In Semesters 5 to 8, students pursuing the Bachelor of Education (Secondary) Programme shall take credits from the following core courses:

Semester 5
MAT381 Calculus for Teachers I (3)
MAT383 Linear Algebra for Teachers (3)
MAT387 Mechanics for Teachers I (3)
MAT389 Linear Programming and GameTheory for Teachers (3)

Semester 6
MAT382 Calculus for Teachers II (3)
MAT384 Computing for Teachers (3)
MAT388 Mechanics for Teachers II (3)

Semester 7
MAT481 Geometry for Teachers I (3)
MAT483 Real Analysis for Teachers (3)
MAT485 Number Theory and Abstract Algebra for Teachers (3)

Semester 8
MAT324 Differential Equations (3)
MAT482 Geometry for Teachers II (3)
MAT484 Introduction to Probability and Statistics for Teachers (3)

General Education Courses
MAT105 Numeracy Skills (3)
MAT101 Mathematics for Social Scientists (3)
MAT102 Mathematics in Business (3)

Assessment and Examination
Performance in each course shall be evaluated by the combination of continuous assessment and final examination marks:
(a) Continuous Assessment (CA): In all years CA shall be based on tests and/or assignments with at least two tests per semester.

(b) The Project courses MAT401, MAT406; and the course MAT404 shall be assessed by CA only.

(c) Examinations: Each course shall be examined at the end of the semester.

(d) Final marks: The ratio between CA and Examination normally shall be 1:2. For the courses MAT242, MAT348 and MAT384 the ratio between CA and Examination shall be 1:1.

Progression from Semester to Semester
In order to proceed from one semester to the next, a student must obtain a cumulative
GPA, which is in accordance with General Regulation 00.9.

DEPARTMENT OF PHYSICS

DEPARTMENTAL REGULATIONS

General Provisions
Subject to the provisions of Academic General Regulations and Faculty of Science Special Regulations, the following Departmental Regulations shall apply.

Programmes and Titles of Degrees
The Department of Physics offers three (3) BSc degree programmes leading to the award of the mentioned degrees:

- BSc230 (Basic Physics Programme)
- BSc202 (BSc in Physics with Meteorology)
- BSc203 (BSc in Radiation and Health Physics)

The Department of Physics in collaboration with The Department of Geology offers a Single Major Programme, leading to the award of a Bachelor of Science Degree in Applied Geophysics as per in the Faculty of Science Regulations 23.2.1 and 23.4. For Details refer to the Geology Department.

Entry Requirements
Admission to the Physics Programmes shall be as specified in Faculty of Science Regulation 23.21.
To register into the 300 level of Physics Single Major Programme, a student must have passed all the levels 100 and 200 Physics courses.

Award of Degree
To be awarded a degree, a student must satisfy appropriate provisions of Academic General Regulation 23.71.

PROGRAMME STRUCTURE
The physics courses shall be offered at levels 100 to 400 for the undergraduate programme as outlined in Regulations Departmental regulations 2.1 to 2.3, levels 600 to 700 for MSc candidates, levels 800 and 900 for MPhil and PhD candidates.

In addition to physics courses, an undergraduate candidate majoring in physics courses shall take General Education Courses (GECs) and Electives in accordance with General Regulation 00.2124.

The Department of Physics offers service courses in physics to non-physics majors as outlined in departmental regulation 2.4

BSC 230: BASIC PHYSICS PROGRAMME
- Single major programme (Departmental Regulation 2.3.1), leading to the award of BSc (Physics).
- Combined major/minor (Physics Major)(Departmental Regulation 2.3.2), leading to the award of BSc
- Combined major/major programme (Departmental Regulation 2.3.3), leading to the award of BSc
- Combined major/minor (Physics Minor)(Departmental Regulation 2.3.4), leading to the award of BSc if the student is registered in the Faculty of Science

LEVEL 100
Semester 1
PHY112: Geometrical Optics and Mechanics (4)

Semester 2
PHY122: Electricity, Magnetism and Elements of Modern Physics (4)

LEVEL 200
Semester 3
PHY 231: Mechanics, Vibrations and Waves, Physical Optics (pre-requisite PHY112) (3)
PHY 232: Properties of Matter, Basic Thermodynamics and Introduction to Nuclear Physics (pre-requisite PHY112) (3)
PHY 239: Physics Practicals 3.1 (pre-requisites PHY112, co-requisites PHY231 or 232) (1)

Semester 4
PHY 241: Advanced Electricity and Magnetism

(pre-requisites = PHY122) (3 Credits)
PHY 242: Basic Electronics (pre-requisite = PHY122) (3 Credits)
PHY 249: Physics Practicals 4.1 (pre-requisites = PHY122, co-requisites = PHY241 or 242) (1 Credit)

2.1.3 Levels 300 and 400

2.1.3.1 Single Major Programme

Semester 5
In semester 5, the single major programme shall consist of 11 credits of core courses and additional credits may be taken from optional courses in accordance with General Regulation 00.62.

Core Courses

PHY351: Advanced Mechanics (pre-requisite = PHY231) (3)
PHY352: Introduction to Quantum Mechanics (pre-requisite = PHY231) (3)
PHY354: Advanced Electronics I (pre-requisite PHY242)(3)
PHY359: Physics Practicals 5.1 (pre-requisite PHY239 and 249) (2)

Optional Course
PHY353: Mathematical Methods for Physical Sciences I(3)
PHY355: Basic Potential Fields in Geophysics (3)
PHY356: Special Relativity (pre-requisite PHY231, 241) (3)

Semester 6
In semester 6, the single major programme shall consist of 11 credits of core courses and additional credits may be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
PHY 361: Introduction to Electromagnetism (pre-requisite = PHY241)(3)
PHY 362: Analytical Thermodynamics (pre-requisite = PHY232)(3)
PHY 363: Vibrations, Waves and Advanced Physical Optics (pre-requisite PHY231) (3)
PHY 369: Physics Practicals 6.1 (pre-requisite PHY239 and 249) (2)

Optional Courses
PHY364: Advanced Electronics II (pre-requisite PHY354) (3)
PHY365: Physics of the Environment (pre-requisite PHY231)(3)
PHY 367: Elements of Air Pollution I (3)

Semester 7
In semester 7, the single major programme shall consist of 11 credits of core courses and additional credits may be taken from optional courses in accordance with General Regulation 00.62

Core Courses
PHY 472: Statistical Mechanics I (3)
PHY473: Solid State Physics (3)
PHY478: Project in Physics I (3)
PHY479: Physics Practicals 7.1 (pre-requisite PHY359 and 369) (2)

Optional Courses
PHY 474: Physics of Renewable Energy(3)
PHY 475: Microprocessor and Digital Systems (pre-requisite PHY354) (3)
PHY 476: Mathematical Methods for Physical Sciences II (pre-requisite PHY353) (3)
PHY477: Elements of Air Pollution II(3)

Semester 8
In semester 8, the single major programme shall consist of 11 credits of core courses and additional credits may be taken from optional courses in accordance with General Regulation 00.62.

Core Courses
PHY 481: Atomic and Basic Nuclear Physics (3)
PHY482: Statistical Mechanics II (pre-requisitePHY472)(3)
PHY483: Advanced Solid State Physics (pre-requisite PHY473; co-requisite PHY 482) (3)
PHY489: Physics Practicals 8.1 (pre-requisite PHY359 and 369) (2 Credits)

Optional Courses
PHY485: Microcomputing for Physical Sciences (3 Credits)
PHY486: Basic Seismology (3 Credits)
PHY487: Introduction to Astrophysics (3 Credits)
PHY488: Project in Physics II (3 Credits)

2.1.3.2 Combined Major/Minor Programme (Physics Major)

Semester 5
In semester 5, the combined major/minor programme shall consist of 8 credits of core courses and at least 3 credits from optional courses

Core Courses
PHY351: Advanced Mechanics (pre-requisite = PHY231)(3 Credits)
PHY352: Introduction to Quantum Mechanics (pre-requisite = PHY231)(3 Credits)
PHY359: Physics Practicals 5.1 (pre-requisite = PHY239 and 249) (2 Credits)

Optional Courses
PHY353: Mathematical Methods for Physical Sciences I (3 Credits)
PHY354: Advanced Electronics I (pre-requisite = PHY242) (3 Credits)
PHY355: Basic Potential Fields in Geophysics (3 Credits)

Semester 6
In semester 6, the combined major/minor programme shall consist of 8 credits of core courses and at least 3 credits from optional courses

Core Courses
PHY361: Introduction to Electromagnetism (pre-requisite = PHY241)(3 Credits)
PHY 362: Analytical Thermodynamics (pre-requisite = PHY232)(3 Credits)
PHY 369: Physics Practicals 6.1 (pre-requisite = PHY239 and 249) (2 Credits)

Optional Courses
PHY363: Vibrations, Waves and Advanced Physical Optics (pre-requisite = PHY231)(3)
PHY364: Advanced Electronics II (pre-requisite = PHY354) (3)
PHY365: Physics of the Environment (pre-requisite = PHY231)(3)
PHY367: Elements of Air Pollution I (3)

Semester 7
In semester 7, the combined major/minor programme shall consist of 8 credits of core courses and at least 3 credits from optional courses.

Core Courses
PHY472: Statistical Mechanics I (3 credits)
PHY473: Solid State Physics (3 Credits)
PHY479: Physics Practicals 7.1 pre-requisite PHY359 and 369) (2 Credits)

Optional Courses
PHY474: Physics of Renewable Energy (3 Credits)
PHY475: Microprocessor and Digital Systems (pre-requisite = PHY354) (3 Credits)
PHY 477: Elements of Air Pollution II (3 Credits)
PHY 478: Project in Physics I (3 Credits)

Semester 8
In semester 8, the combined major/minor programme shall consist of 8 credits of core courses and at least 3 credits from optional courses.

Core Courses
PHY481: Atomic and Basic Nuclear Physics (3 Credits)
PHY485: Microcomputing for Physical Sciences (3 Credits)
PHY 489: Physics Practicals 8.1 (pre-requisite = PHY359 and 369) (2 Credits)

Optional Courses
PHY487: Introduction to Astrophysics (3 Credits)
PHY488: Project in Physics II (3 Credits)

2.1.3.3 Combined Major/Major Programme

Semester 5
In semester 5, the combined major/major programme shall consist of 8 credits of core courses. Additional credits may be taken from optional courses PHY 355 and PHY 356 in accordance with General Regulation 00.62.

Core Courses
PHY351: Advanced Mechanics (pre-requisitePHY231)(3 Credits)
PHY352: Introduction to Quantum Mechanics (pre-requisite = PHY231) (3 Credits)
PHY359: Physics Practicals 5.1 (pre-requisite = PHY239 and 249) (2 Credits)

Semester 6
In semester 6, the combined major/major programme shall consist of 8 credits of core courses. Additional credits may be taken from optional courses PHY363 and PHY364 and PHY 365 in accordance with

General Regulation 00.62.

Core Courses

PHY361: Introduction to Electromagnetism (pre-requisite = PHY241) (3 Credits)
PHY 362: Analytical Thermodynamics (pre-requisite = PHY232) (3 Credits)
PHY 369: Physics Practicals 6.1 (pre-requisite = PHY239 and 249) (2 Credits)

Semester 7

In semester 7, the combined major/major programme shall consist of 8 credits of core courses. Additional credits may be taken from optional courses PHY474, PHY475 and PHY477 in accordance with General Regulation 00.62.

Core Courses

PHY472: Statistical Mechanics I (3 credits)
PHY 473: Solid State Physics (3 Credits)
PHY 479: Physics Practicals 7.1 (pre-requisite = PHY359 and 369) (2 Credits)

Semester 8

In semester 8, the combined major/major programme shall consist of 8 credits of core courses. Additional credits may be taken from optional courses PHY 486 or PHY 488 in accordance with General Regulation 00.62.

Core Courses

PHY481: Atomic and Basic Nuclear Physics (3 Credits)
PHY485: Microcomputing for Physical Sciences (3 Credits)
PHY489: Physics Practicals 8.1 (pre-requisite = PHY359 and 369) (2 Credits)

Combined Major/Minor Programme (Physics Minor)

Semesters 5-8

In semesters 5 - 8, the combined major/minor (Physics Minor) programme shall consist of 6 to 8 credits of any of the physics courses from the core courses or optional courses of the Combined Major/Minor Physics Programme as defined in Regulation 2.3.2, in the given semester. To complete the Physics Minor programme, a candidate must take 4 credits of practical courses, PHY 359 or PHY 369 at 300 level, and PHY 479 or PHY 489 at 400 level.

BSC 202: PHYSICS WITH METEOROLOGY

(Departmental Regulations 23.2.1 and 23.4) leading to the award of BSc (Physics with Meteorology)

REGULATIONS

Entrance requirements

Admission to the degree programme shall be as specified in the Faculty of Science Regulations 23.2.1 and 23.4

Award of Degree

To be awarded a degree, a candidate/student must have taken and passed all relevant courses as prescribed in Section 13 and must satisfy the University of Botswana Academic General Regulations 00.8 and 00.9 and Faculty of Science Special Regulation 20.

Programme Structure

Level l00

Semester I

PHY112; Geometrical Optics and Mechanics (4 Credits)
CHE101: General Chemistry I (4 Credits)
MAT111: Introductory Mathematics I(4 Credits)
COM141 Introduction to Communication and Academic Literacy Skills (Science) (3 credits)
ICT121 Computing Skills Fundamentals 1 (2 credits)

Semester II

PHY122: Electricity and Magnetism, Introduction to Modern Physics (4 Credits)
CHE102: General Chemistry II (Pre-requisite: CHE 101) (4 Credits)
MAT122: Introductory Mathematics II (Pre-requisite: MAT 111) (4 Credits)
PHY122 Electricity, Magnetism and Elements of and Elements of Modern Physics (3 credits)
COM142 Academic and Professional Communication (Science) (3 credits)
ICT122 Computing Skills Fundamentals 2 (2 credits)

LEVEL 200

Semester III

Core Courses

PHY232: Properties of Matter, Basic Thermodynamics and Introduction to Nuclear Physics (Pre-requisite: PHY 112) (3 Credits)
PMT231: The Earth's Atmosphere (3 Credits)
MAT271: Introduction to Mathematical Statistics (Pre-requisite: MAT 122) (3 Credits)

MAT 221: Calculus I (Pre-requisite: MAT 122) (3 Credits)
CHE 211: Introduction to Analytical Chemistry (Pre-requisite: CHE 102) (2 Credits)
Optional Course (3 Credits)

Semester IV

PHY242: Basic Electronics (Pre-requisite: PHY 122) (3 Credits)
PMT241 Thermodynamics (3 Credits)
MAT222: Calculus II (Pre-requisite: MAT 221)(3 Credits)
MAT244: Numerical Methods (Pre-requisite: MAT122) (3 Credits)
PMT242: Computer Programming – FORTRAN, MatLab (3 Credits)

WINTER SEMESTER

PMT299: Internship: Synoptic Meteorology (3 Credits)

Level 200

Optional Courses

Semester III

PHY231: Mechanics, Vibrations and Waves (Pre-requisite: PHY 112) (3 Credits)
MAT 242: Computing I (Pre-requisite: GEC 121 and 122) (3 Credits)

Level 300

Semester V

Core Courses

PMT351: Atmospheric Radiation (3 Credits)
PMT352: Atmospheric and Ocean Dynamics I (Pre-requisite: MAT331 OR 222) (3 Credits)
PHY353: Mathematical Methods for Physical Sciences I (3 Credits)
MAT 371: Mathematical Statistics 1 (Pre-requisite: MAT 271)(3 Credits)
Optional Course (3 Credits)

Semester VI

Core Courses

PMT361: Introduction to Agrometeorology (3 Credits)
PMT 362: Numerical Weather Prediction (Pre-requisite: PMT 232 and 352) (3 Credits)
PMT369: Electronic Instrumentation (Pre-requisite: PHY 242) (3 Credits)

Optional Course

(6 Credits)

WINTER SESSION

PMT399: Internship: Forecasting and Agrometeorology (3 Credits)

LEVEL 300

Optional Courses

Semester V

PHY 354: Advanced Electronics I (Pre-requisite: PHY 242) (3 Credits)
ENV 337: Dynamic meteorology

(3 Credits)

Semester VI

PHY364: Advanced Electronics II (Pre-requisite: PHY254) (3 Credits)
PHY367: Elements of Air Pollution I (3 Credits)
PHY365: Physics of the Environment (Pre-requisite: PHY231) (3 Credits)

LEVEL 400

Semester VII

Core Courses

PMT471: Global Circulation Models I (Pre-requisite PMT 352)(3 Credits)
PMT472 Atmospheric and Ocean Dynamics II (Pre-requisite: PMT 352)(3 Credits)
PMT473: Boundary Layer Meteorology (Pre-requisite: pmt 351)(3 Credits)
PMT 474: Basic Atmospheric Chemistry (3 Credits) Elective Course(3 Credits)

Semester VIII

PMT481: Global Circulation Models II (Pre-requisite: PMT 352)(3 Credits)
PMT 482: Global Climate Change (Pre-requisite: PMT 231)(3 Credits)
PMT 483: Cloud Physics (Pre-requisite: PMT 351) (3 Credits)
PMT 489: Research Project (6 Credits)

BSC 203 BSC IN RADIATION AND HEALTH PHYSICS

(Departmental Regulations 23.2.1 and 23.4) leading to the award of BSc (Radiation and Health Physics)

REGULATIONS

Entrance Requirements

Admission to the degree programme shall be as specified in the Faculty of Science Regulations 23.2.1 and 23.4

Award of Degree

To be awarded a degree, a candidate/student must have taken and passed all relevant courses as prescribed in Section 13 and must satisfy the University of Botswana Academic General Regulations 00.8 and 00.9 and Faculty of Science Special Regulation 20.

Programme Structure

LEVEL 100

Semester I

PHY112; Geometrical Optics and Mechanics (4 Credits)
CHE101: General Chemistry I (4 Credits)
MAT111: Introductory Mathematics I (4 Credits)
COM141 Introduction to Communication and Academic Literacy Skills (Science) (3 Credits)
ICT121 Computing Skills Fundamentals 1 (2 Credits)

Semester II

PHY122: Electricity and Magnetism, Introduction to Modern Physics (4 Credits)
CHE102: General Chemistry II (Pre-requisite: CHE101) (4 Credits)
MAT122: Introductory Mathematics II (Pre-requisite: MAT 111) (4 Credits)
PHY122 Electricity, Magnetism and Elements of and Elements of Modern Physics (3 Credits)
COM142 Academic and Professional Communication (Science) (3 Credits)

LEVEL 200

Semester III

PHY232: Properties of Matter, Basic Thermodynamics and Introduction to Nuclear Physics (Pre-requisite: PHY112) (3 Credits)
PHY 239: Physics Practicals 3.1 (Pre-requisite: PHY 112)(1 Credit)
CHE 211: Introduction to Analytical Chemistry (Pre-requisite: CHE 102) (2 Credits)
CHE 213: Analytical Chemistry Laboratory (Co-requisite: CHE 211) (1 Credit)
ENH 211: Introduction to Environmental Health (3 Credits)
MAT 221: Calculus I (Pre-requisite: MAT122) (3 Credits)
MAT 271: Introduction to Mathematical Statistics (Pre-requisite: MAT 122)(3 Credits)

Semester IV

Core Courses

PHY 242: Basic Electronics (Pre-requisite: PHY 122) (3 Credits)
PHY 249: Physics Practicals 4.1 (Pre-requisite: PHY122) (1 Credit)
PRH 241: Radiation Physics I (3 Credits)
PRH 242: Radiation Therapy I (3 Credits) Optional Course (3 Credits) Elective Course(3 Credits)

WINTER SEMESTER

PRH299: Internship: Supervised Clinical and/or Industrial Exposure (3 Credits)

LEVEL 200

Optional Courses

Semester IV

(May take any one course)
PHY241: Electricity and Magnetism (Pre-requisite: PHY 122) (3 Credits)
CSI 241: Structured Programming (3 Credits)
ENH 222: Epidemiology (3 Credits)

LEVEL 300

Semester V

Core Courses

PRH351: Radiation Physics II (Pre-requisite: PRH 241) (3 Credits)
PRH 352: Radiation Therapy II (Pre-requisite: PRH 242) (3 Credits)
PRH 353: Introduction to Radiography (3 Credits)
PRH354: Introduction to Radiology (3 Credits) Optional Course(3 Credits)

Semester VI

Core Courses

PRH 361: Radiobiology and Protection (3 Credits)
PRH 362: Physics of Medical Imaging (Pre-requisite: PRH 354) (3 Credits)
PRH 363: Radiation Detection and Instrumentation (Pre-requisite: PHY 242)(3 Credits)
PRH 365: Environmental Physics (3 Credits) Elective Course(3 Credits)

WINTER SEMESTER

PHY399: Internship: Supervised Clinical and/or Industrial Exposure (3 Credits)

LEVEL 300

Optional Courses

Semester V

(May take any one course)
MAT371: Mathematical Statistics I (Pre-requisite: MAT 271) (3 Credits)
ENH 313: Basic Toxicology
PHY 367: Elements of Air Pollution I

LEVEL 400

Semester VII

Core Courses

PRH471: Nuclear Rules and Regulations (3 Credits)
PRH472: Fundamentals of Nuclear Energy (Pre-requisite: PHY 232) (3 Credits)
GPH402 Geophysical Time Series Analysis (3 Credits) Optional Course (3 Credits) Elective Course (3 Credits)

Semester VIII

PRH481: Applied Nuclear Physics (Pre-requisite: PHY 232)(3 Credits)
PRH482: Radiation Protection and Dosimetry (Pre-requisite: PRH 361) (3 Credits)
PRH483: Applied Radiation Safety Techniques (3 Credits)
PRH489: Research Project (6 Credits)

LEVEL 400

Optional Courses

Semester VII

(May take any one course)
PHY477: Elements of Air Pollution II (3 Credits)
PHY476: Microprocessor and Digital Systems (Pre-requisite: PHY 353)(3 Credits)

GRADUATE PROGRAMMES:

- MSc Programme in Physics (Departmental Regulation 5.0), leading to the award of MSc (Physics)
- MPhil and PhD Programmes in Physics (Departmental Regulation 6.0), leading to the award of MPhil (Physics) and PhD (Physics) respectively.

SERVICE COURSES

The following physics courses are offered as service courses for non-physics majors.

PHY161: Physics for Nurses (3 Credits)
PHY162: Physics Applied to Home Economics (3 Credits) BEd (Secondary)

Semesters 5-8

In semesters 5 - 8, students pursuing the BEd (Secondary) programme shall choose credits from the core courses or optional courses of the Combined Major/Minor Physics Programme as defined in Regulation 2.3.2, or from the Combined Major/Major programme as defined in Regulation 2.3.3, in the given semester. The courses chosen must include practical courses PHY 359, PHY 369, PHY 479 and PHY 489.

GENERAL EDUCATION COURSES

The Department of Physics currently offers the following General Education courses under the Area 5 (Science and Technology) pending the outcome of the University review of General education Courses:
GEC 252: Origin of the Universe (2 Credits)
GEC 253: Energy and Society (2 Credits)

Assessment

Performance in each course shall be evaluated by the combination of continuous assessment and final examination marks in the ratio of 1:1, except for physics practicals and physics projects which will be assessed by CA only.

Progression

In order to proceed from one semester to the next, a student must obtain a Cumulative GPA which is in accordance with General Regulation 00.9.

DEPARTMENT OF PHYSICS

PHY 112: GEOMETRICAL OPTICS AND MECHANICS (4)

Geometrical Optics: Rectilinear propagation of light, Laws of reflection; Reflection from plane and spherical surfaces; Laws of refraction: Refraction at plane and spherical surfaces; Combined Lenses; Defects of Lenses; Optical Instruments; Mechanics: Units and dimensions; Vector algebra; Linear Kinematics; Kinematics in two dimensions: Circular motion, Projectiles; Newton's laws of motion; Static and Kinetic Friction; Work, Energy and

Power; Torque. A set of experiments to illustrate theoretical concepts.

PHY 122: ELECTRICITY, MAGNETISM AND ELEMENTS OF MODERN PHYSICS (4)

Electricity and Magnetism: Electrostatics: Electrostatic energy and dielectrics; Capacitance: Combination of capacitors in series and in parallel, Potential energy in a capacitor, Effects of dielectrics on capacitance and energy; Current Electricity; Resistance, Combination of resistors in series and in parallel; Magnetism; Cathode Ray Oscilloscope; Introduction to Modern Physics: Electromagnetic wave spectrum; Atomic Structure: Thompson's model, Rutherford model, Bohr's hydrogen model; Wave-particle duality: De Broglie's relation, Dual nature of light, dual nature of matter: Compton effect, X-ray diffraction, Electron diffraction, Neutron diffraction. A set of experiments to illustrate theoretical concepts.

PHY161: PHYSICS FOR NURSES (3)

The course will consist of lectures and associated laboratories for the following six modules: 1. Mechanics and properties of matter, 2. Thermal Physics, 3. Optics, 4. Sound and ultrasonics, 5. Electricity and magnetism, 6. Modern Physics.

PHY 162: PHYSICS APPLIED TO HOME ECONOMICS (3)

The course will consist of lectures and associated laboratories for the following six modules: Mechanics and Properties of Matter (4 weeks); Thermal Physics (2 weeks); Optics (2 weeks); Sound and Ultrasonics (1.5 weeks); Electricity and Magnetism (3 weeks); Modern Physics (1.5 weeks)

PHY 231: MECHANICS, VIBRATIONS AND WAVES, PHYSICAL OPTICS (3)

Mechanics: Vector analysis including cross products: examples of their applications to physics: motion in two dimensions: gravitational fields and potentials: center of gravity calculations for a system of particles including 3D bodies. Vibrations and Waves: Hooke's law; Simple harmonic motion; Damped Oscillations; Forced Oscillations and Resonance; Wave motion: Reflection of waves, Waves on strings and in pipes. Rotation of rigid bodies including application of parallel and perpendicular axis theorem; Physical Optics: interference of light waves including applications to lasers and Newton's: Franhofer diffraction for single and double slits: plane and circular. Polarisation: superposition of waves including Lissajous' figures.

PHY 232: PROPERTIES OF MATTER, BASIC THERMODYNAMICS AND INTRODUCTION TO NUCLEAR PHYSICS (3)

Properties of Matter: Elasticity: Stress and strain including Young, rigidity and bulk moduli: surface tension including contact angles: viscosity including Poiseuille's Law: Thermodynamics: kinetic theory: gas laws: Heat and work and first law of thermodynamics: second law of thermodynamics including application to heat engines. The nucleus: Structure of the nucleus, nucleons, nuclear forces and binding energy, atomic mass unit. Radioactivity: Definition, decay particles, decay constant, basic equations, half-life, carbon dating. Radiometric dating, nuclear reactions including stellar evolution.

PHY 239: PHYSICS PRACTICALS 3.1 (1)

A set of experiments to be performed in Semester 3 illustrating work done in the 200 level physics lecture courses.

PHY241:ADVANCED ELECTRICITY AND MAGNETISM (3)

Electrostatics field applied to line, surface and volume charges: applications of Gauss' law of electric fields: electric potential and potential energy of line surface and volume charges: applications to capacitance with and without dielectrics: magnetic field including Biot-savart law and amperes law: electromagnetic induction including faraday and Lenz laws.

PHY242: BASIC ELECTRONICS (3)

Alternating current circuits: ac source, peak, r.m.s. values, ac source with R, L, C, RC circuits, differentiating and integrating circuits, filters, series and parallel LCR circuits, and using them as band pass and band stop filters. Ideal transformers. Electronics: Equivalent circuits including application of Norton and Thevenin theorems: Basic theory of the Physics of semi-conductors: diodes and diode applications including clipping and clamping circuits: transistors e.g. BJT, FET, JFET and MOSFET: other devices such as thyristor and opto-electronic devices.

PHY 249: PHYSICS PRACTICALS 4.1 (1)

A set of experiments to be performed in Semester 4 illustrating work done in the 200 level physics lecture courses

PHY 351: ADVANCED MECHANICS (3)

Newtonian formulation of mechanics including integration of Newton's equations of motion. Projectile in resistive media, central force motion, collision and scattering; Inertia matrix, Euler's equation of motion, spinning top; Lagrangian and Lagrange's equation of motion. Introduction to the theory of Special Relativity.

PHY 352: INTRODUCTION TO QUANTUM MECHANICS (3)

Historical Development of Quantum Mechanics; Heisenberg's uncertainty principle. The Schroedinger equation: Piecewise potentials in one and three-dimensions; Quantum Harmonic Oscillator: The Hydrogen Atom; Angular momentum Operators. Approximation Schemes: Time-Independent Perturbation Theory.

PHY353: MATHEMATICAL METHODS FOR PHYSICAL SCIENCES I (3)

Matrix Algebra including diagonalization of matrices. Complex Numbers. Vector analysis: vector differential calculus, vector identities, vector integral theorems; Ordinary differential equations with constant coefficients, complex analysis: analytic functions, contour integration.

PHY 354: ADVANCED ELECTRONICS I (3)

Frequency characteristics of RLC networks, Bode-plots; Principles of voltage amplifiers: amplifier characteristics for the bipolar junction transistor (BJT) amplifier, the field-effect-transistor (FET) amplifier, and the operational amplifier (Op Amp.); Feedback and its applications: negative feedback, positive feedback and oscillators. Logic elements; Multivibrators; Introduction to digital electronics.

PHY 355: BASIC POTENTIAL FIELDS IN GEOPHYSICS (3)

The Earth in the Solar System; Radiometrics; Gravity; Earth's thermal and electrical regime; geo-electricity and geomagnetism; plate tectonics; application of potential fields to exploration geophysics; field and laboratory exercises; Use of potential fields with other methods such as Seismics, Ground Penetrating Radar, e.t.c.

PHY 356: SPECIAL RELATIVITY (3)

Galilean transformation, Michelson-Morley experiment, Lorentz transformation; four vector formulation of mechanics; energy momentum tensor, four vector formulation of Maxwell theory; Introduction to general relativity: Principle of equivalence, Einstein's field equations, Schwarzchild solution.

PHY 359: PHYSICS PRACTICALS 5.1(2)

A set of advanced experiments to be performed in Semester 5 illustrating work done in the 300 level lecture courses of the Combine Major/minor (Physics Major) or Combined Major/major Programmes.

PHY 361: INTRODUCTION TO ELECTROMAGNETISM (3)

Electromagnetic waves: Synthesis of the laws leading to the Maxwell's equations. Brief description of the wave equation, electromagnetic waves. Special techniques in electrostatics; Electrostatic fields in matter. Magnetostatic fields in matter; Electromagnetic radiation.

PHY 362: ANALYTICAL THERMODYNAMICS (3)

Equation of state, laws of thermodynamics, thermodynamic potentials, transport phenomena, principles of heat transfer. Entropy change during various processes.

PHY 363: VIBRATIONS, WAVES AND ADVANCED PHYSICAL OPTICS (3)

Damped oscillations; Forced oscillations and resonance; Coupled oscillations and normal modes; Wave equation; Interference; Diffraction. Elliptical polarization of light.

PHY 364: ADVANCED ELECTRONICS II (3)

Laplace transform methods; Fourier series analysis; Special purpose circuits; Principles of Radio communication; Digital systems; Semiconductor device physics. A set of experiments to illustrate theoretical concepts.

PHY 365: PHYSICS OF THE ENVIRONMENT (3)

The Earth's atmosphere. The radiation environment. Microclimatology of radiation. Transfer principles. Introduction to Soil Physics. Crop micrometeorology. Ionising radiation and the environment.

PHY 367: ELEMENTS OF AIR POLLUTION I (3)

The Earth's atmosphere. Thermodynamics of atmosphere, Inversion layer, Convective instability, Solar radiation, Radiative energy transfer, Transport of momentum, energy and mass, Airborne particulate and gaseous pollutants, Health hazards. Some pollution-caused global phemomena. Field-based exercises.

PHY 369: PHYSICS PRACTICALS 6.1 (2)

A set of advanced experiments to be performed in Semester 6 illustrating work done in the 300 level lecture courses of the Combine Major/minor (Physics Major) or Combined Major/major Programmes.

PHY 472: STATISTICAL MECHANICS I (3)
Statistical mechanics: Need for statistical laws in many particle systems; condition equations; partition function; Lagrange's method of undetermined multipliers; Maxwell-Boltzmann distribution and applications; Fermi-Dirac statistics and applications; Bose-Einstein statistics and applications.

PHY 473: SOLID STATE PHYSICS (3)
Crystal structure, Experimental methods for determining crystal structure: x-ray crystallography and others; Interatomic forces and binding mechanisms. Elementary Excitations in solids: Phonons (lattice vibrations). Free electron theory (classical and quantum), Band theory; Classification of solids: metals, semiconductors, insulators; Some semiconductor devices; Magnetism: Diamagnets, Paramagnets and Spin ordered systems (ferromagnets, antiferromagnets and ferrimagnets)

PHY 474: PHYSICS OF RENEWABLE ENERGY (3)
Renewable energy resources: solar energy, wind power, hydro-power, geothermal energy, bio-fuels, ocean power systems

PHY475: MICROPROCESSOR AND DIGITAL SYSTEMS (3)
Interfacing with Analog World: D/A converter and A/D converter; transducers; Digital wave-shaping and timing circuits; Digital Signal Processing (DSP); Microprocessor: Architecture and system operation, addressing modes, instruction set and programming; Microprocessor interfacing and applications.

PHY 476: ADVANCED MATHEMATICAL METHODS FOR PHYSICS II (3)
Laplace transform Fourier series. Fourier transform; Ordinary differential equations with variable coefficients; Partial differential equations: the wave heat and Laplace equations; Integral equations. Numerical analysis: Linear algebraic equations, Eigenvalue problems, Numerical roots of equations.

PHY477: ELEMENTS OF AIR POLLUTION II (3)
Air pollutants, Gaseous and particulate, Dispersion of pollutants, Monitoring techniques, Preventive techniques, Air quality standards, Air pollution control management, strategies and legislation. Air pollution and impacts on energy, water resources, health and agriculture. Field based exercises.
PHY 478: PROJECT IN PHYSICS I (3)
A supervised independent study on any topic in Physics.

PHY 479: PHYSICS PRACTICALS 7.1 (2)
A set of advanced experiments to be performed in Semester 7 illustrating work done in the 400 level lecture courses of the Combine Major/minor (Physics Major) or Combined Major/major Programmes.

PHY 481: ATOMIC AND BASIC NUCLEAR PHYSICS (3)
Atomic Structure; Structure and spectra of many-electron atoms; Structure of the Nucleus; Nuclear Reactions: Classification of Nuclear Reactions, Elementary particles: Basic interaction and conservation laws, properties of elementary particles.

PHY 482: STATISTICAL MECHANICS II (3)
Statistical mechanics: Review of Distribution functions; Boltzmann transport equation without and with collisions; Phase transitions: critical points, order parameters, critical points exponents.

PHY 483: ADVANCED SOLID STATE PHYSICS (3)
Elementary excitations in solids: phonons, electrons, magnons. Semiconductors: Excitation mechanisms; Ferroelectrics: properties of ferroelectrics; Superconductivity: properties of superconductors, theories of superconductivity: London's theory, Ginzburg-Landau theory, BCS theory; Low-dimensional systems: surfaces and interfaces, liquid crystals, polymers, fullerenes.

PHY 485: MICROCOMPUTING FOR PHYSICAL SCIENCES (3)
Computer programming languages; Numerical methods: Roots of equations; Numerical integration; Solution of ordinary differential equations; Data reduction.

PHY486: BASIC SEISMOLOGY (3)
Elasticity and seismic waves; seismic ray theory and boundary interactions; seismometry and seismogram interpretation; seismotectonics and earthquake prediction; the earth's internal structure from seismic waves; seismic waves application to exploration; field and laboratory exercises.

PHY 487: INTRODUCTION TO ASTROPHYSICS (3)
Astronomy and Astrophysics; The Astronomical Context; Radiation; Classical Dynamics; Stars and Stellar Structure

PHY488 PROJECT IN PHYSICS II (3)
A supervised independent study on any topic in Physics

PHY489: PHYSICS PRACTICALS 8.1 (2)
A set of advanced experiments to be performed in Semester 8 illustrating work done in the 400 level courses of the combined Major/Minor (Physics Major) or Combined Major/Major programmes.

PMT 231: THE EARTH'S ATMOSPHERE (3)
Origin of the Atmosphere, The Earth's Four Spheres. Weather and Climate. Composition of the Atmosphere. Vertical Structure of the Atmosphere. Temperature Measurements, Temperature Scales. Hydrologic Cycle: Changes of State, Humidity, Humidity Measurement, Condensation Adiabatic Temperature Changes, Atmospheric Lifting Processes (Convective Lifting, Orographic Lifting). Condensation and Cloud Formation. Types of clouds. Scales of Atmospheric Motion. Global Distribution of Precipitation Optical phenomena of the atmosphere: Mirages, Rainbows, Halos, Sun Dogs, Solar Pillars, The Corona.

PMT 232: COMPUTER PROGRAMMING – C/C++ (3)
Introduction to computers. Types of high level programming languages. Structure of C/C++ program. Reserved words. Identifiers. Numbers and strings. Constants and variables. Expressions and statements. Integer - type data. Real - type data. Char - type data. Boolean - type data. Standard constants. Standard functions. Enumerated - type data. Subrange - type data. Utilizing user-defined data. Read and Read-in statements. Write and Write-in statements. The EO/n and Eof functions. Formatted output. Declaring string types and variable. String manipulations. The FOR structure. The WHILE - DO structure. The REPEAT - UNTIL structure. Nested control structures. The IF structure. The GOTO statement. Procedures - nested procedures. Parameters - value and reference. Functions. Recursion. The C/C++ editor. Planning a C/C++ program. Writing a C/C++ program. Entering the program into the computer. Compiling and running.

PMT 241: THERMODYNAMICS (3)
The law of conservation of energy including the zeroth law of thermodynamics. Gas laws: ideal gas law, kinetic theory of gases, Dalton's law, Van der Waal's gas. Specific heat and enthalpy: heating at constant pressure and constant volume, enthalpy, adiabatic processes, dry adiabatic lapse rate, thermodynamic diagrams. Entropy: free expansion, heating and cooling, reversible and irreversible processes, potential temperature, Carnot cycle. Water and its transformations: moisture variables, condensation and evaporation, phase changes, Clausius-Clapeyron equation, phase diagrams. Moist air and clouds: cloud formation, moist adiabatic lapse rate, conditional instability, CAPE (convective available potential energy) and entrainment.

PMT 299: METEOROLOGY INTERNSHIP I (3)
Supervised internship in Synoptic Meteorology

PMT 351; ATMOSPHERIC RADIATION (3)
Earth-Sun Relationships (Motions of the Earth, The Seasons), Heat and Temperature, Mechanism Transfer (Conduction, Convection, Radiation), Incoming Solar Radiation (Scattering, Reflections, Absorption Atmosphere), Terrestrial Radiation, Heat Budget, Latitudinal Heat Balance. Equation of radiative transfer. Modeling atmospheric transmission and emission. Scattering of radiation by molecules and particles. Remote Sensing. Role of radiation in climate system. Thermodynamic concepts of radiation and energy levels in molecules. Absorption and emission by gases.

PMT 352; ATMOSPHERIC AND OCEAN DYNAMICS I (3)
Atmosphere radiative transfer through high and low level clouds and the physical implications of aerosols on climate; atmospheric circulation, surface ocean/terrestrial/biosphere exchange processes, greenhouse gas fluxes; implications of sea ice extent and sea level change, deep convection and mixed layer dynamics on ocean heat budgets and the breakdown of the thermohaline circulation.

PMT369: ELECTRONIC INSTRUMENTATION (3)
A set of experiments in electronics to underscore the principles behind weather-monitoring equipment.

PMT 399: METEOROLOGY INTERNSHIP II (3)
Supervised internship in Forecasting and Agrometeorology

PMT 471: GLOBAL CIRCULATION MODELS I (3)
General global circulation. The Hadley circulation: its strength and extent. The angular momentum budget. Kinetic energy of the atmosphere in motion. Tropical tropospheric dynamics. Tropospheric circulation over Southern Africa. The stratosphere: quasi-biennial oscillation and sudden warmings. Design of global circulation models.

PMT 472: ATMOSPHERIC AND OCEAN DYNAMICS II (3)
Kinematics---vorticity and divergence; Lagranian and Eulerian frames of reference and the Lagrangian derivative; Continuity and state equations; Forces in a Newtonian fluid; The Navier Stokes equations and some basic solutions; Scale analysis and the Reynolds number; Bernouilli's theorem; Incompressible and irrotational flows; The vorticity equation; Some effects of buoyancy and stratification; Fluids on a rotating plane---the Coriolis force.

PMT 473: BOUNDARY LAYER METEOROLOGY (3)
Boundary layer definition: forcing mechanisms, meteorological scales, comparison with the free atmosphere, significance of the boundary layer. General characteristics and evolution of the boundary layer: winds in the boundary layer, turbulence and Taylors hypothesis, thermodynamic variables, boundary layer depth and structure, introduction to evolution over land, daytime convectively mixed boundary layer, nocturnal boundary layer. Boundary layer phenomena: coastal fronts, sea/land breeze circulations, lake breezes, gust fronts, boundary layer convection - horizontal rolls, open/closed cell convection, urban heat island, local circulations due to land heterogeneity.

PMT 474: BASIC ATMOSPHERIC CHEMISTRY(3)
Atmospheric composition. Emission inventories. Anthropogenic and biogenic contributions to the atmosphere. Trace gas distributions in the atmosphere. Reaction Kinetics and Photochemistry: The importance of transient species in atmospheric chemistry, absorption processes, quantum yields, photodissociation. Photochemical air pollution and ozone production. Ozone depletion: the distribution and role of ozone in the natural stratosphere. Recovery of the ozone layer. Pollution of the stratosphere. The Montreal Protocol. Acid rain: formation of SO2 and NOx in combustion. Particles in the atmosphere: physical properties, type of particles, reactions involved in particle formation and growth. Atmospheric pollution and climate change.

PMT 481: GLOBAL CIRCULATION MODELS II (3)
Discussion on the prognostic equations of a GCM that are stepped forward in time (typically winds, temperature, moisture, and surface pressure) together with a number of diagnostic equations that are evaluated from the simultaneous values of the variables. Computer simulations of these equations to include: equations of fluid motion, typically for surface pressure, horizontal components of velocity in layers, temperature and water vapor in layers; a radiation code split into solar/short wave and terrestrial/infra-red/long wave and parameterizations for convection, land surface processes, albedo, hydrology and cloud cover.

PMT 482: GLOBAL CLIMATE CHANGE (3)
Observed climate variability and change: Recent centuries; climate reconstruction; the last 100 years. Climate science: Energy balance; heat fluxes; the carbon cycle, physical climate interactions, chemistry-, biogeochemistry- and biosphere-climate interactions; natural modes and coupled systems. Human perturbation of climate: Climate forcing agents; aerosol forcing of climate; climate models and simulation of current climate; climate change detection and attribution. Future climate: future emissions; future climate predictions; effects of climate change. Different portrayals of climate change issues, including scientific consensus and uncertainty, and their social and political implications- Environmental mechanisms through which climate change leads to socio-economic impacts. Methods for assessing socio-economic impacts of climate change: regional predictions, adaptability and vulnerability (including case studies from Sub-Saharan Africa). Climate change mitigation: the international political response, including the flexibility mechanisms of the Kyoto Protocol.

PMT 483; CLOUD PHYSICS (3)
Overview of cloud systems; theories of phase changes in clouds and micro-physical mechanisms of precipitation formation; cloud electrification. Topics include nucleation, hydrodynamics of cloud and precipitation particles, ice physics, mechanisms of precipitation formation, electrical and radiative properties. Formation of cloud droplets, droplet growth by condensation, formation of ice crystals, precipitation processes, weather radars, cloud models.

PMT 489: RESEARCH PROJECT (6)
A supervised independent study

PRH 241: RADIATION PHYSICS I (3)
The concept of radiation, its sources, and its interaction with matter. Charged particles and photon interaction with matter. Radiation detectors. Radiation dosimetry. The X-ray machine, circuits, components, and practical application. Symptoms of radiation sickness. Radiation protection.

PRH 242: RADIATION THERAPY I (3)
X-ray production, x-ray properties, gamma rays, electrons, and their respective interactions with matter. Other topics include the measurement of radiation, radioactivity, and particulate radiation. Brachytherapy, including radioactive sources, exposure rate, implant dosimetry, and remote after-loading units

PRH 299: RADIATION AND HEALTH PHYSICS INTERNSHIP I (3)
Supervised internship in Clinical and/or Industrial Exposure

PRH 351: RADIATION PHYSICS II (3)
Principles of radiation physics as they apply to the treatment and care of the cancer patients. Topics studied include measurements, general principles, structure of the atom, structure of the matter, electrostatics, magnetism, electrodynamics, electromagnetism, rectification and production and properties of radiation and radiographic techniques.

PRH 352: RADIATION THERAPY II (3)
Basic Radiation Therapy focusing on quality assurance, basic dosimetry concepts, radiographic anatomy, clinical objectives, and medical and technical terminology. Fundamentals of radiography, film construction, processing, and x-ray generation. Other topics include professional ethics, patient care procedures, pharmacology, nutrition, and oncology. Basic dosimetry skills including dose calculations for external beam, radiation therapy equipment, practical treatment planning, and brachytherapy applications.

PRH 353: INTRODUCTION TO RADIOGRAPHY (3)
Introduction to hospital organization and professional ethics in radiography. Also introduces elementary radiation protection, general radiographic anatomy and positioning, medical terminologies, and the basic principles of exposure.

PRH 354: INTRODUCTION TO RADIOLOGY (3)
Introduction to radiology and necessary skills of a health care professional. Nuclear medicine, and radiation therapy by incorporating lectures with field site visits. The roles of an allied health professional in the hospital and community setting. Explores career potentials and alternatives

PRH 361: RADIOBIOLOGY AND PROTECTION (3)
Introduction to biological responses to radiation and factors influencing radiation effects, tissue sensitivity, tissue tolerance, and clinical applications. Also includes a study of radiation protection principles, units of measurement and survey methods, advanced brachytherapy, personnel monitoring techniques and regulatory agencies and regulations.

PRH 362: MEDICAL IMAGING PHYSICS (3)
Basics of imaging science, X-ray imaging modalities including basic principles, detectors, scattered radiation, planar imaging, CT, fluoroscopic imaging, nuclear medicine imaging. State-of-the-art specialized organ imaging, equipment, and procedures. Image intensification, serial radiography, cineradiography, TV and video systems, tomography, computerized technologies, and magnetic resonance imaging.

PRH 363: RADIATION DETECTION AND INSTRUMENTATION (3)
Principles and mechanisms underlying nuclear radiation detection and measurements; operation of nuclear electronic laboratory instrumentation; application of gas-filled, scintillation and semiconductor laboratory detectors for measurement of alpha, beta, gamma, and neutron radiation; experimental investigation of interactions of radiation with matter.

PRH 365: ENVIRONMENTAL PHYSICS (3)
Introduction to the atmosphere; the radiation environment; transfer principles; introduction to soil physics; radiation from groundwater; ionizing radiation and the environment

PRH 399: INTERNSHIP II (3)
Supervised internship in Clinical and/or Industrial Exposure

PRH 471: NUCLEAR RULES AND REGULATIONS (3)
Introduction to key nuclear regulatory agencies; major nuclear legislations; current radiation protection standards and organizational responsibility for their implementation. Introduction to rules and regulations applicable to (1) radiation and environmental protection, (2) the operation and licensing of nuclear facilities, and (3) the medical use of radioactive material.

PRH 472: FUNDAMENTALS OF NUCLEAR ENERGY (3)
Power from fission; fission process, neutron chain reactions, reactor types, reactor operation and criticality, fuel types, energy balance, nuclear

heat energy, breeder reactors, commercial reactors, reactor safety, advanced reactors; fusion, fusion reactors, history of nuclear explosions; environmental effects of nuclear power generation and weapons.

PRH 481: APPLIED NUCLEAR PHYSICS (3)
Radioactivity, statistical nature, Alpha decay, barrier penetration, Gammow's theory, alpha particle spectra, Beta decay, neutrino hypothesis, Fermis' theory, detection of neutrino, Gamma decay, multipole classification, gamma interaction, Two body systems and nuclear force. Nuclear power; Reactor Physics.

PRH 482: RADIATION PROTECTION AND DOSIMETRY (3)
Theoretical principles of shielding for neutron and gamma radiation and applications to problems of practical interest. Principles of radiation protection dealing with major forms of ionizing and non-ionizing radiation, the physics and chemistry of radiation biology, biological effects of ionizing and non-ionizing radiations (lasers, etc.) at cellular and tissue levels, radiation protection quantities and units, medical HP issues in clinical environments, radiation safety regulations, and basic problem solving in radiation safety.

PRH 483: APPLIED RADIATION SAFETY TECHNIQUES (3)
Application of radiation protection as practiced in the fields of nuclear science and engineering; application of health physics principles to reduce the health hazards at each of the following stages of nuclear laboratory equipment design: design, prevention, assessment, and post-incident. A history of the key nuclear regulatory agencies; early and current radiation protection standards and regulatory authorities; major nuclear legislation; pertinent nuclear rules and regulations and their application.

PRH 484: ENVIRONMENTAL RADIOACTIVITY (3)
Radionuclides in the environment: their measurement and identification, uptake and transfer through food chains. Effects of radiation on natural populations of plants and animals.

PRH 485: ANATOMY AND PHYSIOLOGY FOR MEDICAL PHYSICS (3)
A course focused on medical terminology, biochemistry pertaining to MP, basic Anatomy and physiology, elementary tumor and cancer biology, and overview of disease in general. Upon completion, the student should: (a) understand anatomic structures, their relationships, their cross-sectional and planar projections, and how they are modified by attenuation and artifacts in the final images; (b) understand the physiology underlying radionuclide images, (c) understand how (a) – (b) are modified by disease, (d) identify anatomical entities in medical images (different modalities), and (e) identify basic disease features in medical images (e.g., Pneumothorax in chest radiographs, microcalcoifications in mammograms).

PRH 489: RESEARCH PROJECT (6)
A supervised independent study

GEC 252: ORIGINS OF THE UNIVERSE (2)
Introduction to Astronomy: The solar system, Stars, Galaxies, The universe, Distance measurement in astronomy; The Expansion of the Universe: Analysing light from stars, Doppler effect, Spectral red shift, The Hubble constant; The Big Bang: The age of the universe, Age from its expansion, Age from the oldest stars, Age from the oldest atoms, Half life of U235, U238, Th232, Rh187; The remnant of the Big Bang at 3K; The formation of the universe: First few minutes, Formation of stars and galaxies, Formation of interstellar material and planets.

GEC 253: ENERGY AND SOCIETY (2)
Introduction: Energy and civilization, Energy and development; Various sources of energy, their applications, advantages and limitations: Woodfuel, Coal, Oil and Petroleum products, Electricity, Nuclear Energy, Renewable Energies and Technologies: Solar Energy, Wind Energy, Geothermal Energy; Energy resources and technologies of the future: Energy from the Nuclear fusion, Hydrogen as a fuel of the future, Fuel cells., Magneto hydro generator (MHD) technology, thermoelectric and Thermomagnetic energy conversion. Total energy systems, Energy conservation and pursuit for high efficiency devices.

DEPARTMENT OF CHEMISTRY

100 Level Courses
CHE101 General Chemistry I (4 credits)
Course covers fundamental concepts and principles of chemistry, i.e. the structure of matter, quantitative as well as qualitative aspects of chemistry.

CHE102 General Chemistry II (4 credits)
This is a continuation of CHE101. The fundamental principles associated with properties of chemical systems will be presented.

CHE107 Chemistry Applied to Home Economics (3 credits)
The role that chemistry plays in everyday life will be presented. Atomic structure, periodic table, oxidation and reduction, chemistry of carbon compounds, acids and bases, soaps and detergents, food and energy, fats, carbohydrates, proteins, minerals and vitamins, additives, poisons and toxins, gases, polymers and plastics, cosmetics.

CHE109 Introductory Chemistry for Bachelor of Nursing Science, Bns (3 credits)
Topics include: Structure and bonding, stoichiometry, solutions, chemistry of certain elements, electricity and chemical change, osmosis, reaction rates and catalysis, radioactivity.

200 Level Courses
CHE211 Introduction To Analytical Chemistry (2 credits)
Basic principles of analytical chemistry, concepts of classical and modern methods in analytical chemistry, statistical treatment of experimental data including error analysis and significance tests; Gravimetry, titrimetry; Introduction to analytical spectroscopy and electro analytical chemistry.

CHE213 Analytical Chemistry Laboratory I (1 Credit)
Practical experience in analytical procedures, classical and modern methods of analytical chemistry, an overview of analytical instrumentation and the progress made towards development of analytical methodology, gravimetric analysis, titrimetric analysis, Electro analytical/ spectrophotometry.

CHE221 Atomic Structure, Bonding and Main Group Chemistry (2 Credits)
Structure of the atom based on elementary quantum theory. Bonding in simple molecules based on molecular orbital and valence bond theories; Trends in periodic properties and chemical reactions of s- and p-block elements.

CHE223 Inorganic Chemistry Laboratory I (1 credit)
This course covers qualitative inorganic analysis, the synthesis of a selection of compounds, as well as solution chemistry of main group elements.

CHE232 Structure And Survey Of Functional Groups I (2 credits)
Survey of various functional Groups; Aspects of stereochemistry; Review of alkanes, alkenes and alkynes: addition and substitution reactions. Organic halogen compounds: substitution and elimination reactions, aromatic compounds, and electrophilic substitution reactions. Introduction to chirality's: Acids and bases: alcohols, ethers, epoxides, carbonyls compounds.

CHE234 Organic Chemistry Laboratory I (1 credit)
Course topics include: Purification and separation of organic compounds-distillation and fractional distillation, crystallization and recrystallization melting point and refractive index determination; Introduction to qualitative analysis of organic compounds; Preparations of simple organic compounds.

CHE242 Introductory Physical Chemistry (2 credits)
Basic principles of thermodynamics: first, second and third laws of thermodynamics; rates of chemical reactions.

CHE244 Physical Chemistry Laboratory I (1 credit)
This is an introduction to laboratory techniques in physical chemistry, Experiments dealing with properties of solutions, Calorimetry, thermodynamics, electrochemistry and chemical kinetics.

300 Level Courses
CHE311 Separation Techniques (3 credits)
Introduction to chromatographic separation and detection techniques: Liquid-liquid extraction; column chromatography, TLC, GC and HPLC, Supercritical fluid; Capillary electrophoresis. Detection systems include FID/ECD & thermal conductivity for GC. UV-Vis,/ DAD/ fluorescence detector for HPLC. Electrochemical / conductivity detectors for Ion Chromatography.

CHE312 Analytical Spectroscopy (2 credits)
Introduction to spectroscopic methods. Molecular absorption & emission:- UV-visible, IR, phosphorescence, fluorescence, Fourier transform spectroscopy. Atomic absorption & emission techniques; AAS / AES and ICP-MS; NMR and X-ray spectroscopy.

CHE314 Analytical Chemistry Laboratory II (1 credit)
Introduction to practical aspects of spectroscopic methods of analysis: UV-visible, IR, Fourier

transform spectroscopy, GC, HPLC, AAS/AES, etc.

CHE321 Coordination Chemistry (2 credits)
Introduction to nomenclature, properties and reactions of coordination compounds & complexes; isomerism and magnetic properties . Valence bond and crystal field theories; absorption spectra; field strength; Jahn-Teller effects; covalency and electron delocalization in complexes. Thermodynamics of complex formation. Hard and soft acids and bases. Non-aqueous chemistry . The chemistry of d-block elements and their compounds. Trends in the properties of elements of groups 3 to 12.

CHE322 Group Theory and Organometallic Chemistry (3 credits)
Introduction to group theory and basic knowledge of organo-metallic chemistry. Fundamental concepts of organometallic chemistry; organometallic chemistry of transition elements; catalytic applications of organometallic compounds.

CHE323 Inorganic Chemistry Laboratory II (1 credit)
Involves use of modern instruments to characterize organic compounds. Synthesis of inorganic compounds and their characterization using various techniques such as NMR, IR and UV-VIS spectroscopy; Reactions of transition elements and their compounds

CHE331 Structure And Survey Of Functional Groups II (3 credits)
Spectroscopic methods in organic chemistry: UV, IR NMR and MS. Stereochemistry: Chirality, chiral compounds without stereogenic centres, prochiral centres. Theory of aromaticity, nucleophilic aromatic substitution reactions and polycyclic aromatic hydrocarbons-. Conformations of cycloalkanes. Reactions of enolate anions: Aldol, Claisen and Knoevenegel condensations, Michael addition and Robinson annulation reactions. Enamines. The Mannich reaction.

CHE332 Physical Organic Chemistry (2 credits)
Study of reaction mechanisms. Review of nucleophilic substitution and elimination reactions – E1, E2, SN1, SN2, SNi, and E1CB. Structure – reactivity relationships: equilibrium and rate constants - the Hammett equation. Methods for determining reaction mechanisms. Pericyclic reactions: Frontier Molecular Orbital Theory, cycloadditions, electrocyclic reactions and sigmatropic rearrangements.

CHE334 Organic Chemistry Laboratory III (1 credit)
Introduction to modern synthetic and characterization methods for organic compounds: Preparation of liquid and solid products then separation, purification and identification by physical and spectroscopic properties- UV, IR and NMR techniques. Chemical and spectroscopic methods in qualitative analysis of organic compounds. Molecular modeling. Simulation of spectra.

CHE341 Applications Of Thermodynamic and Electrochemistry (2 credits)
Introduction to the applications of chemical thermodynamics to solutions and electrochemical processes. Partial molar quantities, thermodynamics of mixing, properties of ideal solutions, non-ideal solutions, activity and activity coefficient, phase diagrams, chemical equilibrium, conductivity, ion activities, standard potentials, electrochemical cells applications of standard potentials.

CHE342 Quantum Chemistry And Its Applications (3 credits)
Microscopic concepts of physical chemistry. Basic principles of quantum mechanics, postulates, simple quantum mechanical systems (particle in a1-D and 3-D box), rotational and vibrational energy levels in molecules, rotational, vibrational and electronic spectroscopy, photophysical and photochemical processes in molecules and atoms, photochemical kinetics.

CHE343 Physical Chemistry Laboratory II (1 credit)
Practical familiarization with microscopic and time dependent macroscopic aspects of physical chemistry. Laboratory experiments in application of quantum chemistry, spectroscopy, photochemical kinetics, conductivity and transport phenomena.
CHE351 Chemical Informatics (1 credit)
Use of conventional and electronic chemical information resources. An overview of information resources in chemistry. Purpose of scientific literature. Peer review process. Electronic and non-electronic databases. Searching methodologies including Internet searching (use of chemical web browsers). Searching for information using chemical names, CAS numbers, structures, sub-structures, molecular formulas, etc. Searching material safety data sheets (MSDS).

CHE352 Literature Based Project (1 credit)
Course will cover professional writing in chemistry and scholarly project reports. Writing styles in chemistry: comprehensive report on an assigned topic in chemistry under the supervision of an academic staff. Thorough search of the chemical literature including the latest information available on the subject.

400 Level Courses

CHE411 Advanced Analytical Techniques (3 credits)
Advanced analytical methods: Statistical treatment of experimental data; Electroanalytical Chemistry;- potentiometry, voltammetry, coulometry, classical and modern polarography, Instrumentation and application of GC-MS, LC-MS, CE-MS, tandem MS, Thermochemical and Radiochemical methods of analysis; isotope dilution and activity analysis.

CHE412 Sample Handling and Biochemical Analysis (3 credits)
Sampling strategies, sample preparation and clean-up techniques; solid phase extraction, solid phase micro-extraction, dialysis, solvent extraction, supported liquid membrane. Enzymatic analysis methods; application of immobilised enzymes, competitive binding immunoassays, enzyme immunoassays, proteomics, and genomics. Properties of antibodies. Polymer structure elucidation of carbohydrate polymers; precipitation assays.

CHE413 Advanced Analytical Chemistry Laboratory (2 credits)
Modern instrumental methods of analysis: atomic absorption (AAS), flame emission, graphite furnace-AAS, inductively coupled plasma- AAS. Sample handling strategies. Micro high performance anion exchange chromatography. Hyphenated techniques; LC-MS, MS-capillary electrophoresis, electrochemistry workstations

CHE416 Environmental Chemistry (2 credits)
Introduction to environmental pollutants and their analysis using local case studies e.g., SO2 emission from the BCL mine; Pesticide analysis, industrial waste management; Selection of safe methods of disposal. Degradation reactions and the dispersal pathways of materials into the environment.

CHE418 Special Topics in Analytical Chemistry (2 credits)
Special topics selected from the following: Application of Analytical Chemistry, Food, Drugs and Forensic Analysis, Chemostatistics and Clinical Analysis.

CHE421 Advanced Transition Metal Chemistry (3 credits)
Advanced topics in transition metal chemistry and introductory bio-inorganic chemistry. Electronic properties of transition metal complexes; magnetic properties of transition metal complexes; inorganic reaction mechanisms; introduction to photo-chemical reactions; f-block chemistry; introduction to bioinorganic chemistry

CHE422 Advanced Organometallic and Solid State Chemistry (3 credits)
Organometallic Chemistry: Main group organometallics; structure and chemistry of (C5H5)2MLn complexes; organometallic chemistry in synthesis; stereochemically non-rigid molecules; metal clusters and metal-metal bonds; low- and high-nuclearity clusters; NMR spectra; Latimer diagrams, oxidation state stability. Solid state chemistry: lattices; crystal packing; ionicstructures; crystal defects; metallic bonding; spinels.

CHE423 Advanced Inorganic Laboratory (2 credits)
Physical methods in Inorganic Chemistry: the study of physical and chemical properties of transition metal and organometallic complexes using electronic, infrared, and nuclear magnetic resonance spectroscopy techniques as well as optical isomerism, reaction kinetics, and inert atmosphere techniques.

CHE426 Special Topics in Inorganic Chemistry (2 credits)
Selection may be made from the following specialised topics: Nanochemistry, Synthesis of inorganic materials for the fabrication of semiconductors; Molecular orbital calculations; Kinetics and mechanisms of inorganic reactions in solution media; Applied homogeneous catalysis with organometallic compounds; Chemistry and applications of boranes, carboranes and metalloboranes.

CHE431 Heterocyclic Chemistry Synthetic Reactions and Design of Organic Synthesis (3 credits)
Aromaticity and reactions of heterocyclic compounds – furan, pyrrole, thiophene, pyridine, indole, and quinoline. Synthetic reaction, Protective groups.; Molecular rearrangements. Design of organic synthesis: introduction to disconnection approach / retrosynthetic analysis.

CHE432 Secondary Metabolites and Biomolecules (3 credits)
Carbohydrates: structure, nomenclature, stereochemistry and reactions of monosaccharides and disaccharides. Structure and properties of polysaccharides. Amino acids and proteins: structure, nomenclature and stereochemistry of amino acids and peptides, analysis of peptides and proteins. Chemistry of purines and pyrimidines. Nucleosides, nucleotides and nucleic acids. Mechanisms of co-enzymes. Examples of secondary metabolites from the acetate, mevalonate and shikimic acid pathways.

CHE433 Advanced Organic Chemistry Laboratory (2 credits)
Advanced laboratory techniques in organic synthesis- multi-step synthesis of organic compounds. Extraction and isolation of naturally occurring compounds from plant origin- application of chromatographic and spectroscopic methods. Analysis of mixtures of organic compounds.

CHE436 Special Topics in Organic Chemistry (2 credits)
Selection may be made from the following specialised topics: Chemistry of drugs; Chemistry of lipids; Selected natural products; Agrochemicals; Free radicals and photochemistry; Polymer materials

CHE441 Advanced Physical Chemistry I (3 credits)
Entropy and probability, partition functions, applications of statistical thermodynamics. Colloidal solutions, electrical double layer, Liquid-gas and liquid-liquid interfaces, Gibbs adsorption equation, spreading, solid-gas interface, adsorption isotherms, rates of surface processes, adsorption and catalysis.

CHE442 Advanced Physical Chemistry II (3 credits)
Reaction kinetics, techniques of fast reactions, theories of reaction rates, reaction in solution, composite reactions, chain reactions, explosions,. Transport phenomena. Polymers, kinetics of polymerization, osmometry, viscometry, gel-permeation chromatography., TGA, DSC. Introductory polymer processing.

CHE443 Physical Chemistry Laboratory III (2 credits)
Laboratory experiments in polymers, surface and colloid chemistry.

CHE446 Special Topics in Physical Chemistry (2 credits)
Detailed treatment of topics chosen from: solid-state chemistry; irreversible thermodynamics; molecular dynamics; intermolecular forces; atmospheric and/or astrophysical chemistry.

CHE452 Senior Research Project (3 credits)
The course involves scientific bench work research. Will comprise a study leading to a written report and shall be based on an original investigation of a chemical problem. To be carried out under the supervision of a member of staff.

CHE470 Excited State Chemistry (2 credits)

DEPARTMENT OF COMPUTER SCIENCE

BSc/BIS Degree Course Details

CSI231 Discrete Mathematics I (3)pre-req.: MAT122/STA102
Sets, relations and functions Propositional and predicate calculus; Mathematical proofs; Induction; Basic number theory — well-ordering, divisibility and congruence; Discrete probability; Algebraic structures — groups and rings

CSI232 Discrete Mathematics II (2) pre-req. : CSI231
Counting - basics, pigeon-hole principle, permutations and combinations, generating permutation and combinations, principle of inclusion and exclusion. Discrete probability and probability theory: Sequences and summations. Recurrence relations: Graphs - representation, isomorphism, connectivity, Euler and Hamilton paths. Trees - application, traversal, sorting, spanning and minimum spanning trees.

CSI241 Structured Programming (4) pre-req.: GEC122
Problem solving with computer: The programming process. High level language programming: data types, input/output, control structures, functions, objects and classes, file I/O; simple data structures like arrays and records. Programme design concepts. Programme testing, debugging and documentation Practical problem-solving exercises.

CSI242 Data Abstraction and Structures (4) pre-req. : CSI241
Abstraction, decomposition, Abstract Data Types, information hiding; records, sets, arrays, tables, stacks, queues, binary trees, trees, graphs, etc. Object-orientated paradigm; practical application in problem-solving.

CSI252 Operating System Concepts (3)
History, evolution, philosophies, structures of OS systems. Introduction to the concepts processes; resource management; virtual machines; scheduling; memory management; file systems; device management, allocation techniques, memory protection; virtual memory; paging and segmentation. OS in security and protection: OS interface and distributed/network. Detailed comparative study of features and architecture of current OS

CSI261 Machine Organization (3)
Introduction to computer hardware: Computer systems organization: CPU organization; memory organization; I/O devices characteristics. Digital logic circuit; Combinational logic: sequential logic. Data representation; data coding: error detection and correction. Microprogramming based on a simplified machine example; sample macro-architecture. Some examples from Intel-80x86 architectures

CSI272 Computer Communications Networks Fundamentals (2)
Network basic Concepts Data transmissions, Multiplexing, Concentrators; Front-end Controllers line connectors, components of data communications system, network topologies, ISO-OSI reference model, LAN, WAN, Internet; Network Components and Technologies. Installation of networks particularly LAN and WAN Network tools, cables, hubs, and routers, NICs. Practical involving cables preparations etc, network installation. NOS and installation.

CSI292 Information Systems
Fundamentals (3)
Fundamental Systems Concepts; Systems components and relationships; IS in perspective; Information and knowledge economy; Information as an organizational resource; Processing models; IS Architectural Framework: IS infrastructure: Organisations as systems; IS in organizational context; IS Development frameworks: Life cycles and Methodologies; Global IS; Fundamentals of IS for Enterprise: Elements of Socio-economics of of IS. Case studies

CSI311File Systems and Data Management (4)pre-req.: CSI242
Techniques for storing, accessing, and managing long-term data in computer systems Hardware and software aspects of data processing: processors, storage devices, communications, file I/O control. Techniques for organizing and managing files: DBMS. Data organisation methods in relation to physical database design. Major practical data management systems implementation

CSI312 Programming Language Translation (3) pre-req. : CSI241, CSI351/CSI361
The principles and design aspects of programming language translation. Compiler organisation Lexical analysis, Syntax analysis, type checking, code generation, optimisation Alternative parsing strategies, comparison with respect to time and space trade offs. Grammars and ambiguity Data representation Error recovery strategies Symbol table design Binding Compiler writing tools: Incremental compiling, interpreters' Abstract machine concept

CSI314 Decision Support Systems II (3)
Structure of the decision problem DSS Framework and applications: DSS Model Representation. DSS; Data Warehousing, Data marting and Data Mining for DSS; DSS Re-engineering; Modelling and decision support; Decision model construction; Forecasting; Optimisation and Simulation; Group support systems. Model Based Management Systems. DS and IS DSS Development Tools Group DSS; DSS development project

CSI315 Web Technology and Applications (3) pre-req. : CSI241
The Internet, intranet and Web technologies; Systems development; Rapid Applications Development concept; Web application development, architectures, environments, and technologies. Web applications Web Development using Web-authoring tools Database –Web connectivity Scripting languages for Web development; Web application Client/Server technologies Project.

CSI322 Algorithm Analysis and Design (3) pre-req.: CSI242
Measuring algorithm performance: worst case analysis; average case analysis; lower bounds. Techniques of efficient algorithm design: greedy method, dynamic programming graph traversal. Illustration with topics from integer and polynomial

arithmetic; matrix multiplication; random number generation; sorting; searching; graph and tree algorithms. Introduction to complexity theory Parallel and Randomized algorithms

CSI331 Numerical Methods I (3)
Approximation and errors Finite differences Interpolation Solution of linear an non – linear equations. Numerical integration Curve fittings

CSI332 Programming Languages (3) pre-req.: CSI241
Principles of programming language design. A brief history of major developments Procedural and non-procedural paradigms (languages-functional, logic, object-oriented, parallel) Virtual machines and language translation Binding time Sequence control. Representation of data types; data control, sharing, and type checking. Encapsulation Polymorphism Run-time storage management: allocation, recovery, and reuse of storage.

CSI341 Introduction to Software Engineering (3)
The software development process Design objectives. Function oriented and object oriented design methodologies. Documentation Implementation strategies Debugging, anti bugging Introduction to specifications verification, and validation Elementary proof of correctness Code and design reading, structured walkthroughs. Testing strategies Software reliability issues Configuration management. CASE tools Team project assignments

CSI342 Systems Analysis and Design (3)
General Systems Theory: development life cycle; analysis; description and modelling techniques: Systems development project planning: concepts and tools; System Requirements; design: implementation, changeover and maintenance overview; Documentation; Systems development management; Modern systems development tools, implementation, techniques, and methodologies; Systems Analysis and Design project.

CSI351 Assembly Language Programming (3)
Assembly language programming Language hierarchy, the assembly-linking process and the role of the OS in assembly level programming. Machine level data structures Assembly language programming techniques: advanced data structures like arrays; advanced I/O. Interrupt handling and introduction to concurrent programming. Use and definition of macros; conditional assembly object modules and linking Assembly/high-level language interface. Run-time considerations.

CSI352 Industrial Attachment (2)pre-req.: Completion of All Level 200 courses

CSI361 Computer Architecture (3) pre-req. : CSI261
The computer system: interconnection structure; internal & external memory; input/output; relationship between the architecture and the OS. Advance topic in computer organization: pipelining; horizontal vertical microprogramming architecture; microprogramming applications. Alternative architectures: parallel processing; vector processing; RISC vs. CISC.

CSI362 Database Concepts (3)
Principles and concepts of the DBS DBMS architecture Databases and data modelling Services of DBMS Overview of database languages Transactions The relational model. Mapping from a conceptual model to a relational model Database design methodologies The network and hierarchical models. Database Design languages Overview of commercially available systems. Practical work with DBMS

CSI371 Information Systems Resources Management (3)
Information Systems resources (ISR) ISR Management objectives, responsibilities, principles and environment. IS Management, Control and Maintenance (MCM) concepts IS Management tasks and state models; Tasks at ISR Tasks Management level; IS Control and Maintenance Processes modeling; Organisation of ISR management ISR Management types. ISR Management issues; practice; IT infrastructure Library; resources planning; and impact on organisational planning cycle Case studies

CSI372 Expert Systems (3)pre-req.: CSI241
Expert System technology forward and backward reasoning State space, decompositions and game trees Heuristic search. Plausible reasoning Bayesian probability theory Certainty factors and other approach to uncertainty Knowledge representation (KR) Knowledge acquisition. Hybrid expert systems design. ES development tools ES and database systems. Intelligent data handling.

CSI373 Economics of Information Technology(3)
Economic aspects of IT; systems managers, system users, the IT industry, and national policy-makers; the systems management perspective; performance and capacity, system financing, and price-for-service strategies. Cost/ benefit trade-off and measurement. Impacts of IT industries and markets National issues Global competition Informatics policies, and the role of IT in development

CSI382: Formal languages and Automata (3)pre-req.: CSI231 and CSI232
Theory of formal languages The Chomsky hierchy of formal grammars and the corresponding automata Finite state automata and regular expressions Deterministic and nondeterministic finite state automata, Criterion for regularity Context-free grammars and push down automata Pumping Lemma for regular and context-free languages Push-down automata in parsing programming languages Decision problems

CSI392 Human Computer Interaction (3)
Basic principles and methodology for user interface design, Background of human information processing and human factors. Practical case studies Techniques for user-centred analysis and design Prototyping tools Introduction to Usability Engineering and evaluation methods. Methods for enhancing system usability including systems ergonomics

CSI393 Multimedia Computing (3)
Multimedia computing concepts and principles; Multimedia computing application, Multimedia computing application packages; Multimedia components - Sound, Graphics, Animation, Video; Understanding multimedia components and developing contents; Web Integration of multimedia components; Visual communication; Database integration of multimedia components.

CSI403 Project I (2)
Project proposal, Literature review, Systems Analysis and Design It shall be a pre-req. course which must be passed before taking CSI405.

CSI405 Project II (4) pre-req: CSI403
Continuation of CSI405 covering implementation and full documentation in form of a project report

CSI411 Complexity and Computability theory (3)pre-req.: CSI322
Computational complexity of algorithms Phrases like NP-Complete and NP-Hard have already become common to the lexicon of algorithm designers. Computability, addresses time-honoured issues such as the famous halting problem, and, of course, some of the more interesting variations on the Turing machine theme.

CSI412 Topics in Computer Science (3)
A selected advanced topic in computer science may be offered depending on the qualification and interest of available teaching staff. This course would be offered in first semester
Number of hours/week: 4 lecture hours, or equivalent.

CSI414 Information Interfaces and Presentation (3)
General: Multimedia IS; Animations Artificial, augmented and virtual realities. Audio I/O; Hypertext Navigation and maps; Video; Users Interfaces; Auditory feedback: Benchmarking; Evaluation/methodology; Graphical user interface (GUI) I/O strategies; Interaction styles Natural language prototyping; Screen design Standardization; Style guides Theory and methods; User-centred design User interface management systems Voice I/O Windowing systems Group and Organization interface: Hypertext/Hypermedia: Sound and Music Computing.

CSI416 Topics in Information Systems (3)
Selected current topics in Information Systems may be offered depending on the qualification and interest of available teaching staff. This course would be offered in first semester.

CSI421 Operating Systems (3) pre-req.: CSI252
Issues in analyzing, designing and implementing operating systems (OSs); Models of OS structure Processes:models,scheduling.Memorymanagement: allocation techniques, memory protection; virtual memory; paging and segmentation. File System: structure; directories; implementation; security and protection and deadlocks. Distributed OSs: design issues; communications; synchronization; processes and processors. In-depth case studies of implementation of selected Operating Systems.

CSI422 Operations Research (3)
Operations Research (OR): concepts, tools, techniques, applications in solving practical problems. Topics include: linear programming, parametric programming, dual, post optimal analysis, integer programming, the transportation problem, networks, simulation, queuing theory, inventory control and forecasting models. OR packages and their uses

CSI423: Systems Programming (3) pre-req.: CSI241
Introduction to Systems Programming Process

Control and Scheduling Processes Threads and Threads Programming File I/O and Signal Processing. Memory Management Programming Distributed Systems and Client Server Programming Unix socket programming. Java Systems Programming: SWING, multithreading and networking.

CSI431 Formal Methods (3)
Introduction to Formal Methods: Introduction; Rationale for use of formal methods; Review of specification methods; Properties of specifications; Specification classes; Overview of formal method approaches. Mathematical Basis for Formal Methods: Propositional logic; Predicate calculus; Theories and proof systems; Reasoning and proof techniques. Formal Specification using Z : Z notation and structure; Building Z specifications; Functional and data refinement; Proving properties of Z specifications; Use of automated theorem proving tools.

CSI432 Intelligent Interfaces and Systems (3)pre-req.: CSI372
Introduction to Natural Language Processing Natural Language Interfaces The linguistic Application if NLP NLP as a tool for Linguistic Research. Software for Natural Language Systems Comparison between Natural Language Interactive Interfaces and direct manipulation, graphical interfaces

CSI433 Algorithmic Graph Theory (3) pre-req.: CSI322
Graph Algorithms: depth first search, breadth first search, connected components, topological sorting, shortest path algorithm, network flow, string searching, parallel computation, graph partitioning, and graph isomorphism.

CSI434 Knowledge Management Systems (3)pre-req.: CSI362
Knowledge systems theoretical foundations infrastructure enabling technologies, emerging applications and management Knowledge-based Economy; Knowledge Management systems; Types of knowledge Technologies KM technical infrastructure; Data Warehousing/Data Mining and Knowledge delivery Systems; Knowledge modeling; Application of AI technologies in KMS development; Case studies;

CSI441 Software Engineering (3) pre-req. CSI341
Conventional development Requirements analysis architectural high-level design, implementation testing maintenance Formal development Project planning and control Metrics and measurement Software reliability modelling AI/KBS approaches environments AI/KBS development techniques Principles of object-oriented systems Prototyping Software reuse

CSI442 Artificial Intelligence (3)pre-req. : CSI372
Proof techniques: State space search: exhaustive, heuristic, performance evaluation. Searching decompositions, AND/OR graphs, means-end analysis. Playing games by searching trees minimax procedure, pruning: Alternative search strategies. Searching and rule base systems. Language for AI problem solving: Natural Language Processing. Computer vision systems and image processing: Neural networks.

CSI451 Knowledge Engineering (3) pre-req.: CSI372
The facility of KE and problem solving – an overview Fuzzy sets and fuzzy operations Fuzziness and probability. Fuzzy systems Neural Networks Theoretical and Computational models Real and artificial neurons Fuzzy neurons and fuzzy neural networks NN for Knowledge Engineering and problem Solving NN as a problem solving paradigm Hybrid Symbolic and Fuzzy Systems

CSI452 Computer Simulation (3) pre-req.: CSI331 and MAT271
Models, model development, verification, and validation; Simulation Study; Discrete and Continuous Probability distributions Linear congruential method for generating uniform random numbers; Tests for uniformity and independence; Inverse transform technique, Acceptance-rejection technique ; Student, Chi-square and Kolmogorov-Smirnov tests, Covariance and Correlation, ANOVA; Testing for significance of regression.

CSI461 Computer Communications Networks Management (4) pre-req.: CSI272
Data communications: theory, and systems structures. Networks types, structures, ISO-OSI reference model Protocols types and structure. Protocol layers: functions. LAN and WAN and ISDN; Network management and Administration

CSI462 Distributed Systems (3) pre-req.: CSI411 and CSI361
Design issues of Distributed Systems (DS), Architecture, design, and implementation of DS. Comparison of DS to PC's and centralized systems. Performance security and reliability issues Process communication: IPC, remote procedure calls (RPC), java communications, transactions; processing and concurrency control. Naming, security, Distributed file system, replication, shared memory, distributed algorithms and message passing.

CSI471 Object Oriented Systems Development (3) pre-req.: CSI241
Object-orientation paradigm; analysis design, OO databases; Software reusability Abstraction Polymorphism Object messages and encapsulation Classes, inheritance, and class categories Foundations and collection classes Iconic user interfaces. Design and implementation Survey of Object Oriented features of programming languages, modelling database and knowledge – based systems.

CSI472 Social Issues of Information Technology (3)
Historical development and transfer of Science and Technology of computing; Social context of computing; Perspectives to computer systems development; Risks and liabilities of computer-based systems; intellectual property; Privacy and civil liberties; Computer crime; Ethics and professionalism issues; IT in socio-economic development: Computing technology transfer to Developing countries. Case studies

CSI481 – Database Systems (3) pre-req.: CSI362
Database systems development framework, Planning; Logical and Physical DB design Query processing. Backup and recovery Concurrency Management; Performance tuning DB security, integrity and control. DBS architectural frameworks: Client/Server, Distributed and parallel DBS. Object-oriented DB KB and DBS Intelligent DB Data and DBA; Data Warehouse DB Design; Web-DBS; DB Programming languages Current topics.

CSI482 Information Systems Engineering (3)
Information Systems(ISs) Engineering principles; Design for ISs; IS architectural (ISA): frameworks, models, and concepts; IS Strategies, Planning; methodologies; .IS Requirements Engineering; IS Engineering; Enterprise IS Integration: Framework, dimensions, and impacts; Legacy IS re-engineering; Data Warehouse systems engineering; Web-based systems engineering; IS Engineering impacts assessment; . Practical I

CSI484 National Information Systems Infrastructure (3)
IS Technology (IST) and techno-economic development; National IST (NIST); Components and Perspectives; IT structure and System. Human capital economic growth, and policy; National development vision versus IST infrastructure vision Models to Strategic thrusts: E-Governance; IST culture issues; Telecommunications regulation. Legislative framework for IST; translating vision to reality, thrusts to action; Case studies

CSI491 Pattern Recognition (3)
pre-req. : CSI372
Introduction to Pattern Recognition Statistical Decision theory, Image processing and Analysis. Pattern recognition models Pattern Recognition Design Methodology. NN for Pattern recognition Pattern Recognition implementation – interactive systems, special architectures Pattern recognition applications – computer vision, signal processing, text processing etc

CSI493 Computer Graphics I (3)
pre-req: CSI241
Computer Graphics (CG)?, Image Analysis(IA) vs. CG. Hardware devices Software packages 2D-Graphics; homogenous coordinates, Transformations, Clippings 3D-Grahics 2D screens, projection Realism (basic illumination models, primary and secondary effects.

CSI494 Computer Graphics II (3)
pre-req. : CSI493
Colour Models and Colour Applications; Modelling in 3D; Surface Rendering; Lighting effects; Computer Animation; Interaction; Computer Graphics in Scientific Visualization; Graphics on the World Wide Web; Graphics and multimedia systems.

GEC Area 2

ICT 121 Computing Skills Fundamentals 1 (2)
Hardware and software systems concepts and principles OS and file management basics Applications areas of computers; Data Communications and network systems; Internet and Electronic mails basics; Computers and society issues; Information skills and organisation Information need, and sources Security and legal issues. Problem-solving with computers Practical laboratory exercises.

ICT 122 Computing Skills Fundamentals 2 (2) pre-req.: ICT 121
Advanced operating systems file management; Spreadsheet and database management; Use of basic spreadsheet application package facilities; Basic database application package facilities; Principles of problem-solving with computers. Design and specification with pseudo-code and

other tools; evaluating information sources; Practical

GEC 221 Information Management Skills (2) pre-req.: IEC 122
Word processing and database management; application package facilities; DB application package facilities; problem-solving methods Data communication and network systems Evaluating information sources; Electronic information resources. Information management using intermediate to advanced Database management; Electronic information communications Topic analysis; integrated information management.

GEC222 Problem-Solving with Spreadsheet (2) pre-req.: IEC122
Problem solving Concepts and principles Spreadsheet problem-solving methodology: Problem-specification and solution design. Advanced Spreadsheet features. Survey of Spreadsheet application domains Spreadsheet programming Practical problem-solving using spreadsheet facilities Further information skills: Electronic information sourcing and evaluation; Information synthesis; Practical lab exercises.

GEC 223 Web Application Skills (2) pre-req.-IEC122
The Internet and Web technologies; Systems development Web Application development cycle; Web-Based Systems, structure and applications; Survey of Web application development tools and use; HTML components and syntax; Web planning, design using programmatic (e.g. scripting) and non-programmatic approaches; Use of tables and pictures; Validation and verification, error checking; Qualities of a good web site; Static versus Dynamic web concepts; Practical

GEC321 Multimedia Information Presentation Skills (2) pre-req.: IEC122
Multimedia information resources; Use of facilities in appropriate Presentation application packages Integrated use of presentation application packages with related application packages (e.g. Word processing, Spreadsheet, and Database packages). Advanced information skills: Topic analysis - Information needs analysis and problem definition; Use of advanced electronic information resources.

DEPARTMENT OF MATHEMATICS

MAT111 Introductory Mathematics I (4)
Basic algebra; Introduction to functions; Trigonometry; Series; Induction; Complex numbers; Permutations and combinations.

MAT122 Introductory MathematicS II (4)
Calculus; Co-ordinate geometry; Vectors.

MAT191 Design Mathematics I (3)
Basic Algebra; Trigonometry, Statistics.

MAT192 Design Mathematics II (3)
Co-ordinate Geometry; Matrices and Determinants; Calculus.

MAT201 Ancillary Mathematics (3)
Linear algebra; Calculus; Probability and statistics.

MAT211 Introductory Set and Number Theory (3)
Logic; Sets; Relations; Integers; Modular Arithmetic.

MAT212 Introductory Linear Algebra (3)
Linear equations; Matrices; Vector spaces; Transformations; Eigenvectors.

MAT 221 Calculus I (3)
Techniques of integration; Applications of integration; Improper integrals; Generalized mean value theorem; Taylor's theorem; Differential equations; Sequences and series.

MAT 222 Calculus II (3)
Power series; Conic sections; Differential calculus; Multiple integrals.

MAT 242 Computing I (3)
Elements of programming; Procedures and subroutines; Structured design; Introduction to modularization.

MAT244 Numerical Methods (3)
Computer arithmetic; Numerical approximation and integration.

MAT251 Vectors and Introductory Mechanics (3)
Vectors; Vector calculus; Particle motion in a straight line; Newton's laws of motion; Kinematics; Dynamics in space; Statistics.

MAT252 Newtonian Mechanics (3)
Work, power and energy; Momentum; Simple harmonic motion; Statics of rigid bodies; Centre of gravity; Dynamics of a rigid body.

MAT271 Introduction to Mathematical Statistics (3)
Sample space and probability function; Distributions of random variables; Expectations; Normal distribution; Applications of t, chi-square and F distributions; Sampling distributions; Statement of central limit theorem; Confidence intervals and testing of hypothesis.

MAT291 Engineering Mathematics I (3)
Determinants and matrices; Application of derivatives; Number sequences and series; Partial derivatives; Application of integration.

MAT292 Engineering Mathematics II (3)
Ordinary differential equations; Statistics; Probability; Binomial, Poisson and normal distributions.

MAT311 Abstract Algebra I (3)
Groups; Factor groups; Homomorphisms; Rings.

MAT312 Abstract Algebra II (3)
Group actions; p-groups; Rings; Fields.

MAT 321 Real Analysis I (3)
The real number system; Sequences of real numbers; Series; Functions; Continuity; Differentiability; Integration.

MAT 322 Real Analysis II (3)
Introduction to Rn as a metric space; Differentiation in Rn ; Power series; Integration in Rn.

MAT 323 Vector Calculus (3)
Vectors and applications to lines and planes; Curves and surfaces; Differentiation and integration of vector functions; The divergence theorem and Stoke's theorem.

MAT324 Differential Equations (3)
Second order linear differential equations; Power series solutions to ordinary differential equations; Systems of differential equations; Boundary value problems for ordinary differential equations and partial differential equations.

MAT342 Computing II (3)
Recursion, pointers and linked lists; Object oriented programming; Dynamic memory allocation; Mathematical usage of objects and modules.

MAT344 Numerical Methods of Linear Algebra (3)
Direct and iterative methods for solving systems of linear equations; Numerical methods for computation of eigenvalues and eigenvectors of matrices.

MAT352 Dynamics I (3)
Central forces, systems of particles, variable mass; Non-inertial frames; Rigid body motion; Lagrangian and Hamiltonian dynamics.

MAT361 Mathematical Programming and Game Theory (3)
Graphical solution for linear programming; Simplex method and new developments; K-T condition and basic methods for non-linear programming; Linear programming method for two person zero-sum games.

MAT371 Mathematical Statistics I (3)
Review of probability; Distributions of random variables; Conditional distributions; Normal, gamma, t, chi-square and F distributions; Different modes of convergence; Limiting distributions; Introduction to estimation theory and hypothesis testing.

MAT372 Mathematical Statistics II (3)
Estimation theory; Classical methods of estimation versus Bayes estimation; Theory of uniformly powerful tests and likelihood ratio tests; Introduction to linear models; Linear regression and ANOVA models.

MAT381 Calculus for Teachers I (3)
Differentiation; Integration.

MAT382 Calculus for Teachers II (3)
Complex numbers; Differential equations; Partial differentiation

MAT383 Linear Algebra for Teachers (3)
Linear equations; Matrices; Transformations; Vectors; Geometric equations.

MAT384 Computing for Teachers (3)
Introduction to computing; Basics of programming; laboratory exercises.

MAT387 Mechanics for Teachers I(3)
Vectors; Co-ordinate systems; Kinematics; Velocity; Acceleration; Projectiles; Relative motion and circular motion.

MAT388 Mechanics for Teachers II (3)
Newton's law of motion; Momentum and impulse; Conservation of momentum; Work, power and

energy; Simple harmonic motion.

MAT389 Linear Programming and Game Theory For Teachers (3)
Mathematical formulation of linear programming (LP) problem; Graphical method; The simplex procedure and other techniques; Game theory; Two-person games; Zero-sum games; Mixed strategies; Graphical solution; The best mixed strategy as an LP problem.

MAT391 Engineering Mathematics III (3)
Laplace transforms; Vector analysis; Interpolation; Numerical solution of differential equations; Fourier series representation of periodic functions.

MAT392 Engineering Mathematics IVA (3)
Laplace transforms; Partial differential equations; Complex analysis.

MAT394 Engineering Mathematics IVB (3)
Partial differential equations; Laplace transforms.

MAT400 Project (3)

MAT402 History Of Mathematics (3)
The origins of mathematics; Greek mathematics; Mathematics in other cultures; The European renaissance; Modern mathematics.

MAT404 Topics in Advanced Mathematics (3)
Topics to be determined.

MAT411 Linear Algebra (3)
Vector spaces; Linear transformations; Eigenvalues and eigenvectors; Inner product spaces; Multilinear algebra.

MAT412 Number Theory (3)
Brief revision of elementary number theory; Quadratic reciprocity; Number theoretic functions; Sums of squares; Algebraic integers.

MAT414 Combinatorics and Graph Theory (3)
Graphs; Planar graphs; Paths; Directed graphs; Networks; Matchings.

MAT416 Abstract Algebra III
Group theory; Field theory.

MAT421 Functions of a Complex Variable (3)
The elementary functions; Analytic functions; Series; Calculus of residues; Introduction to conformal mappings and analytic continuation.

MAT422 Functional Analysis (3)
Normed linear spaces; Inner product spaces; Fundamental theorems for normed linear spaces; Applications.

MAT423 Mathematical Methods (3)
Laplace transforms and applications; Fourier series; Fourier transforms and applications; Classifi cation of partial differential equations; Boundary value problems.

MAT424 Dynamical Systems (3)
Periodic attractors; Stability and bifurcations; Chaos and chaotic attractors.

MAT425 Measure Theory (3)
Measure spaces; Measurable functions; Integration; Spaces of functions; Product measures.

MAT426 Partial Differential Equations (3)
Initial boundary problems for parabolic, elliptic and hyperbolic equations.

MAT431 General Topology
Topological spaces; Bases and sub-bases; Continuous mappings; Hausdorff spaces; Compact spaces; Connected spaces.

MAT432 Algebraic Topology (3)
Homotopy theory; Homology theory; Categories and functors.

MAT441 Numerical Analysis (3)
Multi-step linear methods and Runge Kutta methods for ordinary differential equations; Finite difference methods for partial differential equations.

MAT442 Computational Mathematics (3)
Symbolic calculations with a computer; Automatic symbolic differentiation and integration; Symbolic solution of differential equations; Approximation of functions with a computer.

MAT451 Dynamics II (3)
Further work on systems of particles; Lagrangian and Hamiltonian dynamics; Variational principles; anonical transforms; Hamilton-Jacobi theory.

MAT452 Quantum Mechanics (3)
Quantization rules; Application to the hydrogen atom; Schrodinger wave equation; Poisson brackets and commutation relations;The uncertainty principle.

MAT453 Electromagnetic Theory (3)
Electric fi eld; Electric currents in linear conductors; Biot-Savart law; Magnetic fi eld; Potentials and related boundary value problems; Maxwell's equations.

MAT454 Introduction to Fluid Dynamics (3)
Tensor methods; Two dimensional steady fl ow; Stream lines and streak lines; Properties of fl uids; Mass conservation; Continuity equations; Convective derivative; Vorticity.

MAT 461 Optimization And Control Theory (3)
Calculus of variation; Pontryagin maximum principle; Optimal control of linear systems; Linear systems with quadratic cost.

MAT 462 Mathematical Modelling (3)
Population models; Competing species; Epidemic models; Van der Pol and Lotka- Volterra equations.

MAT 471 Multivariate Statistics (3)
Multivariate, marginal and conditional distributions; Multivariate normal distribution Np (m,S). Wishart distribution and Hotelling T2 distribution; Maximum likelihood estimation of m and S of Np (m,S) distribution; Likelihood ratio test for testing Ho: m = mo; Multivariate regression; Canonical correlations; Principal components.

MAT 472 Linear Models (3)
General linear model and linear hypotheses; Models of full rank and models not of full rank; Estimable functions; Testable hypotheses; The exponential family and generalized linear models; Introduction to fi xed models; Illustration of fi tting models to real life data with a computer package.

MAT 474 Stochastic Processes (3)
Stochastic processes in both discrete and continuous time; Markov chains; Poisson processes; Renewal theory; Branch processes; Applications.

MAT 476 Statistical Computing (3)
Use of symbolic computation in statistics with a computer algebra system; Developing computational methods for selected problems of multivariate statistics; Using a statistics package for estimation and testing of hypotheses in different statistical models with real life data and/or data supplied by simulation.

MAT481 Geometry for Teachers I (3)
Logic; Axiomatic systems; Incidence geometry; Euclidean geometry.

MAT482 Geometry for Teachers II (3)
Analytic Geometry in the Euclidean plane and space; Transformational Geometry in the Euclidean plane.

MAT483 Real Analysis for Teachers (3)
Sequences; Functions; Continuity; Derivatives; Riemann integral.

MAT484 Introduction to Probability and Statistics For Teachers (3)
Sample space and probability function; Distributions of random variables and their moments; Binomial, Poisson, normal and other probability functions; Estimation and hypothesis testing.

MAT485 Number Theory and Abstract Algebra for Teachers (3)
Elementary number theory; The Diophantine equation; Congruences; Fermat's and Wilson's theorems; Group theory; Polynomials.

MAT491 Engineering Mathematics V
Partial differential equations; Bessel functions; Legendre polynomials; Reliability theory

MAT492 Engineering Mathematics VI
Tests of hypothesis; Linear programming; Stochastic processes.