THE UNIVERSITY OF THE WEST INDIES
MONA CAMPUS

FACULTY OF SCIENCE AND TECHNOLOGY

UNDERGRADUATE
STUDENT HANDBOOK

2018 - 2019

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INTRODUCTION

This Undergraduate Handbook has been compiled to improve the communication between staff and students regarding programmes, that is, the majors, minors and options offered within the Faculty. The programme requirements outlined are to be adhered to by 1) Students enrolling in the Faculty for the 2018-2019 academic year; 2) Students who transferred into the Faculty for the 2018-2019 academic year; and 3) Students who changed their major/minor for the 2018-2019 academic year.

Though the Faculty worked assiduously to present the most updated information in the Handbook, students should communicate with their Departments/Sections for changes that possibly occurred after the publication of the Handbook.

CREDIT REQUIREMENTS FOR THE AWARDING OF DEGREES IN FST

YEAR	CREDITS (minimum)	NOTES
Level 1	24	18 of which must be in-faculty
Level 2 and 3 (Total)	60	In-faculty major must be completed. However, the remaining credits are strongly encouraged to be used for minor(s) or another major.
Foundation Courses	9	3 COURSES 1. FOUN1014 OR FOUN1019-mandatory 2. FOUN1301 3. FOUN1101 Any one can be substituted with a Foreign Language course.
TOTAL	**93 credits (minimum)**	

FOUN1014 OR FOUN1019 - Critical Reading and Writing in Science and Technology and Medical Science OR Critical Reading and Writing in the Disciplines; FOUN1301 - Law, Governance, Economy & Society; FOUN1101 - Caribbean Civilization.

BIOCHEMISTRY SECTION

PROGRAMMES

Majors

1. Biochemistry
2. Biotechnology
3. Microbiology
4. Molecular Biology

UNDERGRADUATE COURSES OFFERED BY THE BIOCHEMISTRY SECTION					
CODES	**TITLES**	**CREDIT**	**SEMESTER**	**LEVEL**	**PRE-REQUISITES**
LEVEL 1					
BIOC1020	Cellular Biochemistry	3	1 or 2	1	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents
BIOC1021	Practical Biochemistry I	2	1 or 2	1	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents. Co-requisite: BIOC1020
MICR1010	Introductory Microbiology & Molecular Biology	3	1 or 2	1	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents
MICR1011	Practical Microbiology and Molecular Biology I	2	1 or 2	1	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents. Co-requisite: MICR1010
LEVEL 2					
BIOC2014	Bioenergetics and Cell Metabolism	8	1	2	BIOC1020, BIOC1021, MICR1010, MICR1011, CHEM1901 & CHEM1902.
BIOL2312	Molecular Biology I	4	2	2	BIOC1020, BIOC1021, MICR1010, MICR1011, CHEM1901 & CHEM1902. Co-requisite: BIOC2014
MICR2211	Microbiology	4	2	2	BIOC1020, BIOC1021, MICR1010, MICR1011, CHEM1901 & CHEM1902.

UNDERGRADUATE COURSES OFFERED BY THE BIOCHEMISTRY SECTION					
CODES	**TITLES**	**CREDIT**	**SEMESTER**	**LEVEL**	**PRE-REQUISITES**
					Co-requisite: BIOC2014
LEVEL 3					
BIOC3011	Advanced Biochemistry	4	2	3	BIOC2014, BIOL2312, MICR2211
BIOC3013	Biochemical Physiology	4	1	3	BIOC2014, BIOL2312, MICR2211
BIOC3014	Plant Biochemistry	4	2	3	BIOC2014, BIOL2312, MICR2211
BIOC3413	Project	4	1 or 2	3	BIOC2014, BIOL2312, MICR2211 Co-requisites: BIOC3013, BIOC3014, BIOC3311, BIOL3312, BIOL3313, BIOT3113, BIOT3114, BIOT3116, MICR3213 or MICR3214
BIOL3312	Molecular Biology II	4	1	3	BIOC2014, BIOL2312, MICR2211
BIOL3313	Human Molecular Biology	4	2	3	BIOC2014, BIOL2312, MICR2211 Pre/Co-requisite: BIOL3312
BIOT3113	Biotechnology I	4	1	3	BIOC2014, BIOL2312, MICR2211

UNDERGRADUATE COURSES OFFERED BY THE BIOCHEMISTRY SECTION					
CODES	**TITLES**	**CREDIT**	**SEMESTER**	**LEVEL**	**PRE-REQUISITES**
BIOT3114	Biotechnology II	4	2	3	BIOC2014, BIOL2312, MICR2211 Pre/Co-requisite: BIOT3113
BIOT3116	The Biotechnology of Industrial Ethanol Production	4	2	3	BIOC2014, BIOL2312, MICR2211
MICR3213	Applied and Environmental Microbiology	4	1	3	BIOC2014, BIOL2312, MICR2211
MICR3214	Molecular Microbiology	4	1	3	BIOC2014, BIOL2312, MICR2211
MICR3215	Food Microbiology and Biotechnology	4	2	3	BIOC2014, BIOL2312, MICR2211
MICR3216	Medical Microbiology	4	2	3	BIOC2014, BIOL2312, MICR2211

BIOCHEMISTRY (MAJOR)		
	A major in Biochemistry requires a total of twenty-two (22) Level 1 credits from:	
Introductory Courses (Level 1)	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
	A major in Biochemistry requires a total of thirty-two (32) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	BIOC2014	Bioenergetics and Cell Metabolism
	BIOL2312	Molecular Biology I
	MICR2211	Microbiology
	BIOC3011	Advanced Biochemistry
	BIOL3312	Molecular Biology II
	BIOC3013	Biochemical Physiology
	AND	
	BIOL3313 **or** BIOC3014	Human Molecular Biology Plant Biochemistry

BIOTECHNOLOGY (MAJOR)		
	A major in Biotechnology requires a total of twenty-two (22) Level 1 credits from:	
Introductory Courses (Level 1)	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
	A major in Biotechnology requires a total of thirty-two (32) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	BIOC2014	Bioenergetics and Cell Metabolism
	BIOL2312	Molecular Biology I
	MICR2211	Microbiology
	BIOT3113	Biotechnology I
	BIOT3114	Biotechnology II
	MICR3213	Applied and Environmental Microbiology
	AND	
	BIOT3116 or MICR3215	The Biotechnology of Industrial Ethanol Production **or** Food Microbiology and Biotechnology

MICROBIOLOGY (MAJOR)		
	A major in Microbiology requires a total of twenty-two (22) Level 1 credits from:	
Introductory Courses (Level 1)	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
	A major in Microbiology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	BIOC2014	Bioenergetics and Cell Metabolism
	BIOL2312	Molecular Biology I
	BIOL2406	Eukaryotic Microbiology **
	MICR2211	Microbiology
	MICR3213	Applied and Environmental Microbiology
	MICR3214	Molecular Microbiology
	MICR3215	Food Microbiology and Biotechnology
	MICR3216	Medical Microbiology
	ZOOL3404	Parasitology *
	Strongly recommended: BIOL3404 - Virology AND ZOOL3406 – Immunology ***A course in Statistics is required for this major*** *****Prerequisites for Levels 2 and 3 courses from Life Sciences can be satisfied by courses from Biochemistry Section***	

MOLECULAR BIOLOGY (MAJOR)		
	A major in Molecular Biology requires a total of twenty-two (22) Level 1 credits from:	
Introductory Courses (Level 1)	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
	A major in Molecular Biology requires a total of thirty-two (32) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	BIOC2014	Bioenergetics and Cell Metabolism
	BIOL2312	Molecular Biology I
	MICR2211	Microbiology
	BIOL3312	Molecular Biology II
	BIOT3113 **OR** MICR3214	Biotechnology I or Molecular Microbiology
	BIOT3114 **OR** BIOL3017	Biotechnology II or Virology
	BIOL3313	Human Molecular Biology

COURSE DESCRIPTIONS

MICR1010 **INTRODUCTORY MICROBIOLOGY AND MOLECULAR BIOLOGY**
(3 Credits) (Level 1) (Semester 1 or 2)

Pre-requisites:
CAPE Chemistry **and** CSEC Biology **OR** approved equivalents.

Course Content:
This course will introduce students to examples of bacteria, archaea and yeasts and the habitats/environments in which they live; The important structural features of these microorganisms will be outlined; important applications of microbiology and microbial diseases will be discussed; The fine molecular structure of genetic material and the enzymic mechanisms used in replication, gene expression and recombinant DNA technology will be introduced; A lecture/tutorial course of 39 hours.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

MICR1011 **PRACTICAL MICROBIOLOGY AND MOLECULAR BIOLOGY I**
(2 Credits) (Level 1) (Semester 1 or 2)

Pre-requisites:
CAPE Chemistry **and** CSEC Biology **OR** approved equivalents.

Co-requisite:
MICR1010 - Introductory Microbiology and Molecular Biology.

Course Content:
Through a series of experiments students will isolate individual microorganisms and culture pure colonies; The effects of differing growth conditions on microorganisms will be demonstrated as will methods of killing unwanted microorganisms; Methods of quantifying microorganisms will be compared and discussed; A sample of DNA will be extracted and digested with restriction endonucleases, and the fragments obtained separated by gel electrophoresis;

A laboratory course of 48 hours.

Evaluation:

- Final Written Examination (2 hours) 40%
- Course Work: 60%
    - 10 Laboratory Reports (10 x 6%) 60%

BIOC1020 **CELLULAR BIOCHEMISTRY**
(3 Credits) (Level 1) (Semester 1 or 2)

Pre-requisites:
CAPE Chemistry **and** CSEC Biology **OR** approved equivalents.

Co-requisite:
None

Course Content:

1. **Cellular Organisation**: The ultrastructures and major physiological and biochemical functions of subcellular organelles.
2. **Cellular Reproduction:** The major molecular events of organisms undergoing mitosis and meiosis; cell cycles and their regulation**.**
3. **Biomolecular Structure and Functions:** Mono- di- oligo- and polysaccharides; amino acids, peptides and proteins; lipids; nucleotides and nucleic acids;
4. **Biological Membranes:** Composition of membranes; structures and functions of the major types of membrane proteins. Movement of substances across cell membrane; membrane potentials and excitable membranes.
5. **Extracellular Matrices:** Proteins and proteoglycans, cartilage, bone and biomineralisation.
6. Enzyme Activity: Mechanisms of enzyme catalysis; an introduction to enzyme kinetics.
7. **Metabolism:** Biochemical oxidation and reduction reactions; major metabolic pathways and their regulation.
8. **Cell Communication:** Basic elements of cell signalling systems.
9. A lecture/tutorial course of 39 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

BIOC1021 **PRACTICAL BIOCHEMISTRY I**
(2 Credits) (Level 1) (Semester 1 or 2)

Pre-requisites:
CAPE Chemistry **and** CSEC Biology **OR** approved equivalents.

Co-requisites:
BIOC1020 - Cellular Biochemistry.

Course Content:
This course will introduce students to the proper use and operational limitations of the instruments commonly used in biochemistry laboratories by employing them in a series of practical experiments under expert guidance; Students will also become familiar with the analysis of the data generated by the experiments and correct methods for reporting the data and interpreted results; A laboratory course of 48 hours.

Evaluation:
- Final Written Examination (2 hours) 40%
- Course Work: 60%
    - 10 Laboratory Reports (10 x 6%) 60%

BIOC2014 **BIOENERGETICS AND CELL METABOLISM**
(8 Credits) (Level 1) (Semester 1)

Pre-requisites:
BIOC1020 - Cellular Biochemistry, BIOC1021- Practical Biochemistry 1,
MICR1010 - Introductory Microbiology and Molecular Biology,
MICR1011 - Practical Microbiology and Molecular Biology,
CHEM1901 - Introductory Chemistry A **AND**
CHEM1902 - Introductory Chemistry B.

Course Content:
Basic mammalian and plant physiology; Mitochondrial and chloroplast ultrastructure; Biochemical bonding and thermal stability of molecules and membranes; Mitochondrial acetyl-CoA formation and utilization. The TCA cycle and the glyoxylate pathway. The major biosynthetic, intermediary and degradative pathways. Nitrogen fixation; Redox reactions and the mitochondrial electron transport chain; the chemiosmotics mechanism; oxygenix and anoxygenic photosynthesis. The bioenergetics of photosynthesis reactions and of the chemoautotrophs. Transport across membranes; the mechanisms and

bioenergetics. Induction and repression; auxotrophic mutants and the elucidation of metabolic pathways.

Evaluation:

- Final Exam (2 papers - MCQ & Written, 2 hours each) 60%
- Course Work: 40%
  - 2 In-course Tests 20%
  - Laboratory Practical and Reports 20%

<u>MICR2211</u> **<u>MICROBIOLOGY</u>**
(4 Credits) (Level 2) (Semester 2)

Pre-requisites:
BIOC1020 - Cellular Biochemistry, BIOC1021- Practical Biochemistry 1,
MICR1010 - Introductory Microbiology and Molecular Biology,
MICR1011 - Practical Microbiology and Molecular Biology,
CHEM1901 - Introductory Chemistry A **AND**
CHEM1902 - Introductory Chemistry B.

Co-requisite: BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:
The purpose and methods of microbial taxonomy and molecular systematics; The identification of organisms obtained in culture and the construction of phylogenetic trees; The major phylotypes of Bacteria and Archaea will each be discussed with respect to their habitats, physiology and cellular structures; Roles in natural ecosystems, applications and other outstanding features will be discussed in instances where particular organisms provide useful examples; A lecture/tutorial/practical course of 72 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 2 In-course Tests 20%
  - Laboratory Practical and Reports 20%

BIOC3011 **ADVANCED BIOCHEMISTRY**

(4 Credits) (Level 3) (Semester 2)

Pre-requisites:

BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:

The role of cell membrane in the life of the cell; Introduction to Proteomics: Ligand binding, Protein folding, Protein-protein interactions; Cell signalling: Signal transduction. Protein crystallization studies and the photosystems; Molecular biology of photosynthesis: Introduction to the large complex secondary metabolites of plants; Toxins from plants; Overview of plant hormones; Post-harvest physiology; A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOC3013 **BIOCHEMICAL PHYSIOLOGY**

(4 Credits) (Level 3) (Semester 1)

Pre-requisites:

BIOL2312 - Molecular Biology 1 **AND** BIOC2014 - Bioenergetics and Cell Metabolism

Course Content:

Cellular signalling; Endocrinology; The regulation and integration of the metabolic pathways for carbohydrate, lipid and protein metabolism; Organ specialization, macro-nutrient and micro-nutrient nutrition, digestion and absorption; Sugar and fat substitutes; Vitamin and mineral utilization by the body; Energy expenditure and requirements during feasting, fasting, exercise; Nutrient deficiencies; Malnutrition and its sequelae; Obesity; Free radical formation; Antioxidants; Clinical chemistry tests; A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOC3014 **PLANT BIOCHEMISTRY**

(4 Credits) (Level 3) (Semester 2)

Pre-requisites:

BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:

The chemical constituents of plants, their synthesis, their contribution to key metabolic processes and the regulation of their biosynthesis; The biosynthesis and method of action of phytohormones and their role in development and plant defence; The role of ethylene in fruit ripening; Carbohydrates, lipids and nitrogen fixation; Plant secondary metabolites; Anti-nutritional factors; Storage organs and tuberization; Regulation of gene expression in plants; Tools for understanding fundamental features of plant-based research, such as modification of fruit-ripening using controlled atmospheres; Secondary metabolites and their uses; A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOC3413 **PROJECT**

(4 Credits) (Level 3) (Semester 1or 2)

Pre-requisites:

BIOL2312 - Molecular Biology I, MICR2211 - Microbiology **AND** BIOC2014 - Bioenergetics and Cell Metabolism.

Co-requisites:

MICR3213 - Applied and Environmental Microbiology, BIOC3011 - Advanced Biochemistry,
BIOL3312 - Molecular Biology II, BIOL3313 - Human Molecular Biology,
MICR3214 - Molecular Biology, BIOC3013 - Biochemical Physiology, BIOT3113 - Biotechnology I
BIOT3114 - Biotechnology II and BIOT3116 - The Biotechnology of Industrial Ethanol Production or BIOC3014 - Plant Biochemistry.

Course Content:
Practical research on an approved topic.
Evaluation:

- Project Report 60%
- Seminar Presentation 40%

Note: This course is available only to final year students majoring in Biochemistry, Biotechnology, Microbiology or Molecular Biology. Entry will be dependent on the student's academic performance to date and available space.

BIOL3312 **MOLECULAR BIOLOGY II**
(4 Credits) (Level 3) (Semester 1)

Pre-requisites:
BIOL2312 - Molecular Biology I **AND** BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:
Bacteria, eukaryotic and phage genes, genetic maps and mapping, plasmids, transposons; Genetic recombination, genetic exchange, models of recombination; The arrangement of genes, introns, exons, gene clustering, mitochondria and chloroplasts; Mutations and mutagens, base and nucleotide analogues, alkylating agents, intercalating dyes, ionizing radiation, UV, transposon mutagenesis; DNA repair mechanisms, excision repair, and SOS repair; Expression and regulation of eukaryotic and prokaryotic genes, control of transcription-operons in bacteria, control of transcription-eukaryotic RNA polymerase eukaryotic, transcription factors, DNA binding proteins, zinc-finger motif. RNA interference; A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOL3313 **HUMAN MOLECULAR BIOLOGY**

(4 Credits) (Level 3) (Semester 2)

Pre-requisites:

BIOL2312 - Molecular Biology I **AND** BIOC2014 - Bioenergetics and Cell Metabolism

Pre/Co-requisite:

BIOL3312 - Human Molecular Biology.

Course Content:

The molecular basis of the immune response; The biological basis of the HIV-AIDS epidemic; The molecular basis of cancer; Mutations and the role of genetic predisposition in the etiology of both monogenic and multifactorial diseases; Haemoglobinopathies; in-born errors of metabolism. How these genes are inherited and their frequencies among different populations; The concept of 'nature vs. nurture.' The Human Genome Project, the data generated and the practical and ethical implications of this knowledge; The projected role of gene therapy in treatment of genetic diseases; Pharmacogenomics; A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOT3113 **BIOTECHNOLOGY I**

(4 Credits) (Level 3) (Semester 1)

Pre-requisites:

BIOL2312 - Molecular Biology I **AND** BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:

The Biotechnology Revolution; Recombinant DNA technology and methods; Molecular research procedures; Manipulation of gene expression in prokaryotes; Protein production in eukaryotic cells; Site-directed mutagenesis; Protein engineering; Fermentation technology; A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOT3114 **BIOTECHNOLOGY II**

(4 Credits) (Level 3) (Semester 2)

Pre-requisites:

BIOL2312 - Molecular Biology I **AND** BIOC2014 - Bioenergetics and Cell Metabolism

Pre/Co-requisite:

BIOT3113 - Biotechnology I.

Course Content:

1. **Microbial Systems:** Microbial synthesis of pharmaceutical and other commercial products; Molecular diagnostics systems for detecting diseases and transgenic organisms; Vaccines and Therapeutic Agents; Biomass utilization & bioremediation; Plant growth-promoting bacteria; Microbial insecticides.
2. **Eukaryotic Systems:** Development and use of transgenic plants; Development and use of transgenic animals; Isolation of human genes; Human somatic cell gene therapy; *In vitro* regenerative technology & biomaterials for organ regeneration.
3. **Current Issues:** Regulation and patenting of biotechnology products; Biotechnology as a Business current market trends. A practical course of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

BIOT3116 **THE BIOTECHNOLOGY OF INDUSTRIAL ETHANOL PRODUCTION**
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
MICR2211 - Microbiology **AND** BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:
The theory and practice of industrial ethanol production: beers, wines, potable spirits and industrial grade ethanol; Preparation of fermentation feed stocks and media: batch & continuous fermentation systems; fermentor design, instrumentation & control; Biochemical aspects of nutrient utilization; Elementary Process Economics. Product recovery and treatment; waste treatment; The practical component of the course will be fulfilled by site visits to local industrial fermenteries: a brewery, a winery and a distillery; and reports will be submitted thereof, including analysis of specific data supplied on site.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Site-visit Reports 20%

MICR3213 **APPLIED AND ENVIRONMENTAL MICROBIOLOGY**
(4 Credits) (Level 3) (Semester 1)

Pre-requisite:
MICR2211 - Microbiology.

Course Content:
Microbial ecology; in situ measurement of microbial activity. Aquatic habitats: biomass distribution and oxygen relationships in lakes, rivers and marine environments. Biochemical oxygen demand and wastewater treatment: trickling filters, activated sludge and anaerobic digesters. Indicators of pollution. Soil as a microbial habitat: biodegradation of xenobiotics, microbial remediation of polluted environments. Deep subsurface microbiology. Waterborne pathogens: their occurrence in nature, factors influencing their presence in water supplies and means of control. Industrial microbiology. Usefulness of microorganisms in biotechnological applications and how the physiology of microbes are related to their role in these processes; A practical section of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 2 In-course Tests 20%
  - Laboratory Reports 20%

MICR3214 **MOLECULAR MICROBIOLOGY**
(4 Credits) (Level 3) (Semester)

Pre-requisites:
MICR2211 - Microbiology **AND** BIOL2312 - Molecular Biology I.

Course Content:
Microbial interactions: Environmental and Quorum sensing; Microbe-host interactions; Microbial pathogenesis;
Using whole genome sequencing to track bacterial and viral pathogens; Stationary phase; Stringent response.
A practical section of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 2 In-course Tests 20%
  - Laboratory Reports 20%

MICR3215 **FOOD MICROBIOLOGY AND BIOTECHNOLOGY**
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
MICR2211 - Microbiology **AND** BIOC2014/BC21D - Bioenergetics and Cell Metabolism. Other qualified students may be admitted by the Head of Department.

Course Content:
Overview of food-borne pathogens; Microbial ecology of foods; Food technology; Introduction to Food Biotechnology; Microbial Synthesis and Production; Enzyme Biotechnology. A practical section of 36 hours.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Reports 20%

Note: This course will be offered adjacent to BIOT3116 (BC35F) Biotechnology of Ethanol Fermentation, therefore students will have to choose between BIOT3116 and MICR3215.

MICR3216 **MEDICAL MICROBIOLOGY**
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
MICR2211 - Microbiology **AND** BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:
This provides the fundamental principles of medical microbiology including the sub-disciplines of bacteriology, virology, mycology, and parasitology; Basic genetic and molecular biological concepts are integrated and connected to clinical manifestations of disease; Students acquire an understanding of the physiological and virulence properties of microorganisms and epidemiological factors contributing to human infectious disease and an introduction to the activities and uses of antimicrobial agents for asepsis and treatment; The course also provides opportunities to develop informatics and diagnostic skills (via cases), including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 20%
    - Laboratory Practical and Reports 20%

DEPARTMENT OF CHEMISTRY

PROGRAMMES

Majors and B.Scs.

1. Applied Chemistry (Major)
2. Chemistry with Education (B.Sc.)
3. Chemistry and Management (B.Sc.)
4. Environmental Chemistry (Major)
5. Food Chemistry (Major)
6. General Chemistry (Major)
7. Occupational and Environmental Safety and Health (B.Sc.)
8. Special Chemistry (B.Sc.)

Minors

1. Environmental Chemistry
2. Food Chemistry
3. Food Processing
4. General Chemistry
5. Industrial Chemistry

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
PRELIMINARY				
CHEM0901	Preliminary Chemistry A	6-P	1	CSEC (CXC) Chemistry Grade 3 or better or approved equivalents
CHEM0902	Preliminary Chemistry B	6-P	2	CSEC (CXC) Chemistry Grade 3 or better or approved equivalents
LEVEL 1				
CHEM1901	Introductory Chemistry A	6	1	CHEM0901 and CHEM0902, or CAPE Chemistry I & II, or GCE A-level Chemistry
CHEM1902	Introductory Chemistry B	6	2	CHEM0901 and CHEM0902, or CAPE Chemistry I & II or GCE A-level Chemistry
LEVEL 2				
CHEM2010	Chemical Analysis A	3	1	CHEM1901 and CHEM1902; FOUN1014 or FOUN1019
CHEM2011	Chemical Analysis Laboratory I	2	1	CHEM1901 and CHEM1902; FOUN1014 or FOUN1019; (CHEM2010)
CHEM2110	Inorganic Chemistry A	3	2	CHEM1901 and CHEM1902

CODES	TITLES	CREDITS	SEMESTER OFFERED	PREREQUISITES (COREQUISITES)
CHEM2111	Inorganic Chemistry Laboratory I	2	2	CHEM1901 and CHEM1902 (CHEM2110)
CHEM2210	Organic Chemistry A	3	1	CHEM1901 and CHEM1902
CHEM2211	Organic Chemistry Laboratory I	2	1	CHEM1901 and CHEM1902 (CHEM2210)
CHEM2310	Physical Chemistry A	3	1	CHEM1901 and CHEM1902
CHEM2311	Physical Chemistry Laboratory I	2	2	CHEM1901 and CHEM1902 (CHEM2310)
CHEM2402	Chemistry in our Daily Lives	3	1	CHEM1901 and CHEM1902
CHEM2410	Water Treatment	4	1	CHEM1901 and CHEM1902 and Permission of HOD
CHEM2510	Food Processing Principles I	3	2	CHEM1901 and CHEM1902 and Permission of HOD
CHEM2511	Food Processing Laboratory	3	1	CHEM1901 and CHEM1902 and Permission of HOD (CHEM2512)
CHEM2512	Food Processing Principles II	3	1	CHEM1901 and CHEM1902 and Permission of HOD
LEVEL 3				
CHEM3010	Chemical Analysis B	3	2	CHEM2010

CHEM3011	Chemical Analysis Laboratory II	2	2	CHEM2010 Pass or Fail, but not Fail Absent; CHEM2011; (CHEM3010)
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
CHEM3110	Inorganic Chemistry B	3	1	CHEM2110
CHEM3111	Inorganic Chemistry Laboratory II	2	2	CHEM2111 and Permission of HOD; (CHEM3112 or CHEM3312)
CHEM3112	The Inorganic Chemistry of Biological Systems	3	2	CHEM2110, CHEM2111 and CHEM3110
CHEM3210	Organic Chemistry B	3	2	CHEM2210, Pass or Fail, but not Fail Absent
CHEM3211	Organic Chemistry Laboratory II	2	2	CHEM2210, CHEM2211 and CHEM3210 and Permission of HOD; (CHEM3212 or CHEM3213)
CHEM3212	Natural Products Chemistry	3	2	CHEM2210, CHEM2211 and CHEM3210 and Permission of HOD
CHEM3213	Applications of Organic Chemistry in Medicine and Agriculture	3	1	CHEM2210, CHEM2211 and CHEM3210 and Permission of HOD
CHEM3310	Physical Chemistry B	3	2	CHEM2310, Pass or Fail, but not Fail Absent
CHEM3311	Physical Chemistry Laboratory II	2	1	CHEM2311 and Permission of HOD; (CHEM3312 or CHEM3313)

CHEM3312	Chemistry of Materials	3	1	CHEM2310 and CHEM2110 and Permission of HOD
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
CHEM3313	Topics in Advanced Physical Chemistry	3	2	CHEM2310 and CHEM3310 and Permission of HOD
CHEM3401	Project Evaluation And Management For Science Based Industries	4	1	This course is only available to students majoring in Applied Chemistry and Food Chemistry but students who do not have any overlapping Management Studies courses and are majoring in areas which have an industrial direction and have the approval of the Department within which they are majoring may be allowed to take this course. CHEM2510 or CHEM2512 + CHEM2511 OR CHEM3402
CHEM3402	The Chemical Industries	4	2	Any two of: CHEM2010 + CHEM2011, CHEM2110 + CHEM2111, CHEM2210 + CHEM2211 or CHEM2310 + CHEM2311; Permission of HOD
CHEM3403	Chemical Process Principles	8	2	CHEM2310 and CHEM2311 and Permission of HOD
CHEM3510	Food Chemistry I	3	1	CHEM2010 + CHEM2011 and CHEM2210 + CHEM2211 and Permission of HOD

CHEM3511	Food Chemistry Laboratory	3	2	Permission of HOD; (CHEM3510 and CHEM3512)
CHEM3512	Food Chemistry II	3	2	CHEM2010 + CHEM2011 and CHEM2210 + CHEM2211 and Permission of HOD
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
CHEM3513	Food Safety and Quality Assurance	3	2	CHEM2510 OR CHEM2512 + CHEM2511 and Permission of HOD
CHEM3610	Marine and Freshwater Chemistry	3	1	CHEM2010, CHEM2011 and any one of the following: CHEM2110, CHEM2210, CHEM2310 or CHEM3010
CHEM3611	Environmental Chemistry Laboratory	2	1	Permission of HOD; (CHEM3610)
CHEM3612	Atmospheric Chemistry and Biogeochemical Cycles	6	2	CHEM3610 or a combination of CHEM2410, CHEM3010 and CHEM2310; Permission of HOD
CHEM3621	Marine and Freshwater Chemistry Field Course	2	3	CHEM3610 or CHEM3612; Permission of HOD
CHEM3711	Chemistry Undergraduate Research Project	6	1 & 2 or 2 & 3	Majoring in Chemistry; 20 Advanced Credits in Chemistry and Permission of HOD

OESH1000	Introduction to Occupational and Environmental Safety and Health	6	2	none
OESH2000	Environmental Contaminants	1 & 2	8	Course requirements met by doing CHEM3610, CHEM3611 and CHEM3401
OESH3010	Occupational and Environmental Health Disorders	2	4	OESH 1000
OESH3020	Occupational and Environmental Safety and Health Measurement Methods	2	4	OESH 3220
OESH3030	Workplace Survey and Evaluation	1	4	OESH3200
OESH3040	Disaster and Emergency Management	2	4	GEOG1231 and GEOG1232
OESH3100	Environment Hazard Evaluation and Risk Management and Control	1	4	OESH 1000
OESH3200	Occupational Safety Evaluation and Measurement	1	8	OESH3210
OESH3210	Ergonomics	2	4	OESH 1000
OESH3220	Occupational Hygiene	1	4	OESH 1000
OESH3430	Practicum	summer	4	-

APPLIED CHEMISTRY (MAJOR)

Introductory Courses (Level 1)	**A major in Applied Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	AND	
	MATH - 6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2)	
Advanced Courses (Levels 2 and 3)	**A major in Applied Chemistry requires a total of forty-three (43) credits from Levels 2 and 3 (including 10 credits from prerequisite courses) and must include:**	
	Level 2: twenty-three (23) compulsory credits	
	CHEM2010	Chemical Analysis A (prerequisite)
	CHEM2011	Chemical Analysis Laboratory I (prerequisite)
	CHEM2310	Physical Chemistry A (prerequisite)
	CHEM2311	Physical Chemistry Laboratory I (prerequisite)
	CHEM2410	Water Treatment
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3402	The Chemical Industries
	CHEM2010, CHEM2011, CHEM2310 and CHEM2311 may be counted as elective credits.	
Electives *Students must ensure that they satisfy the prerequisite courses required for entry to the electives of interest. In most instances, 12 Level 1 credits in the subject of interest are required. One or more advanced courses may also be needed.*	**Level 3: seventeen (17) compulsory credits**	
	CHEM3401	Project Evaluation & Management for Science
	CHEM3403	Chemical Process Principles
	CHEM3610	Marine & Freshwater Chemistry
	CHEM3611	Environmental Chemistry Laboratory
	And three (3) additional Level 2 or 3 credits from:	
	CHEM2110	Inorganic Chemistry A
	CHEM2210	Organic Chemistry A
	CHEM2510	Food Processing Principles I
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	CHEM3110	Inorganic Chemistry B
	CHEM3112	The Inorganic Chemistry of Biological Systems

	CHEM3210	Organic Chemistry B
	CHEM3212	Natural Products Chemistry
	CHEM3213	Applications of Organic Chemistry in Medicine & Agriculture
	CHEM3310	Physical Chemistry B
	CHEM3312	Chemistry of Materials
	CHEM3313	Topics In Advanced Physical Chemistry
	CHEM3510	Food Chemistry I
	CHEM3512	Food Chemistry II
	CHEM3513	Food Safety & Quality Assurance
	CHEM3621	Marine & Freshwater Chemistry Field Course
	CHEM3711	Chemistry Undergraduate Research Project

Major requires thirty (30) credits of specified Applied Chemistry courses along with one Level 2 or 3 elective (≥ 3 credits). Ten (10) credits of prerequisite General Chemistry courses (CHEM2010, CHEM2011, CHEM2310 and CHEM2311) are also required.

<table>
<tr><th colspan="5">CHEMISTRY WITH EDUCATION (B.Sc.)
(FOR TRAINED AND PRE-TRAINED TEACHERS)</th></tr>
<tr><th colspan="2">Semester
&
Year</th><th>Course Option</th><th>Trained Teachers Double Option Science Diploma</th><th>Pre-trained Teachers - CAPE/A ‘ Levels to Qualify (90 credits)</th></tr>
<tr><td rowspan="4">1</td><td rowspan="3">1</td><td>Science Education Specialization</td><td>EDSC2405
EDSC3403</td><td>-</td></tr>
<tr><td>Core Education</td><td>3 credits from:
EDEA2305
EDGC2010
EDSC3408
EDCU2013</td><td>EDTL1020
EDPS1003
EDCU2013</td></tr>
<tr><td>Faculty of Science and Technology</td><td>Level 1 MATH
CHEM1901</td><td>Level 1 MATH
CHEM1901</td></tr>
<tr><td></td><td>Science Education Specialization</td><td>EDSC3411
OR
EDSC3404</td><td>EDSC2407</td></tr>
</table>

	2			
		Core Education	EDTK2025	EDTL1021
		Faculty of Science and Technology	Level 1 MATH CHEM1902	Level 1 MATH CHEM1902
		University Foundation Course	FOUN1014	FOUN1014
2	1	**Science Education Specialization**	EDSC3417	EDSC2405 EDSC3403
		Core Education	EDTL3020 EDTL3021	EDTK2025
		Chemistry	CHEM2010 CHEM2011 CHEM2210 CHEM2211 CHEM2310	CHEM2010 CHEM2011 CHEM2210 CHEM2211 CHEM2310
		University Foundation Course	FOUN1101, FOUN1301 or any other Foundation	FOUN1101, FOUN1301 or any other Foundation FOUN1101, FOUN1301 or any other Foundation
	2	**Science Education specialization**	EDSC3410	EDSC3410
		Core Education	EDRS3019	EDTL2021
		Chemistry	CHEM2311 CHEM2110 CHEM2111 CHEM2510	CHEM2311
		University Foundation	FOUN1101 or FOUN1301 or any other that is available	FOUN1101, FOUN1301 or any other that is available
	1	**Science Education Specialization**	-	EDSC3417
		Core Education	-	EDTL3017 EDPS3003
		Chemistry	-	-

3	**2**	**Core Education**		EDRS3019
		Chemistry	CHEM3010 CHEM3011 **ANY TWO of:** CHEM3210 CHEM3310 **or** CHEM3512	CHEM2110 CHEM2111
		University Foundation	-	-

Note: Please consult the Faculty of Humanities and Education regarding the selection of Education (ED...) courses.

CHEMISTRY ELECTIVES	
CHEM2402	Chemistry in our Daily Lives
CHEM2410	Water Treatment
CHEM2510	Food Processing Principles I
CHEM2511	Food Processing Laboratory
CHEM2512	Food Processing Principles II
CHEM3112	The Inorganic Chemistry of Biological Systems
CHEM3212	Natural Products Chemistry
CHEM3213	Applications of Organic Chemistry in Medicine & Agriculture
CHEM3312	Chemistry of Materials
CHEM3313	Topics In Advanced Physical Chemistry
CHEM3402	The Chemical Industries
CHEM3510	Food Chemistry I
CHEM3512	Food Chemistry II
CHEM3610	Marine & Freshwater Chemistry
CHEM3612	Atmospheric Chemistry & Biogeochemical Cycles
CHEM3111	Inorganic Chemistry Laboratory II
CHEM3211	Organic Chemistry Laboratory II
CHEM3311	Physical Chemistry Laboratory II
CHEM3511	Food Chemistry Laboratory
CHEM3611	Environmental Chemistry Laboratory
CHEM3621	Marine and Freshwater Chemistry Field Course
CHEM3711	Chemistry Undergraduate Research Project

Pre-Trained Teacher: An important feature of this programme is the field work component carried out in local secondary schools that enables pre-trained teachers to get initial teaching experience by first working in pairs in their second year and then individually in their final year for 4 and 6 weeks respectively. For the field work components they are required to plan and deliver aspects of secondary schools' science curricula under the supervision of their UWI supervisors and the cooperating teachers in the schools assigned. Efforts are made to expose them to teaching at both lower and upper secondary levels in more than one type of secondary institution in the two years.

Trained Teachers: Trained teachers take the same courses pursued by the pre-trained teachers in their second and third years but the focus is on professional development. As such, a strong emphasis is placed on reflective practice and on identifying areas of their teaching that need to be strengthened. The trained teachers get an opportunity to revisit teaching through their field work experience. Here they are required to use action research as a means of planning, implementing and evaluating specific interventions used to teach topics from the CSEC curriculum over a 6 weeks period in secondary schools.

CHEMISTRY AND MANAGEMENT (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Chemistry and Management requires a total thirty-six (36) compulsory Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	STAT1001	Statistics for Scientists
	ACCT1003*	Introduction to Cost Management and Accounting
	ACCT1005*	Introduction to Financial Accounting
	ECON1000*	Principles of Economics
	ECON1012*	Introduction to Industrial and Organization Psychology
	PSYC1002*	Principles of Economics II
	SOCI1002*	Sociology for the Caribbean
	AND	
	MATH - 3 credits from any Level I Mathematics courses (taken in Semester 1 or Semester 2)	

	A B.Sc. in Chemistry and Management requires a total of sixty-two (62) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	**Level 2: forty-one (41) compulsory credits**	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2110	Inorganic Chemistry A
	CHEM2111	Inorganic Chemistry Laboratory I
	CHEM2210	Organic Chemistry A
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2310	Physical Chemistry A
	CHEM2311	Physical Chemistry Laboratory I
	MGMT2003*	Principles of Marketing
	MGMT2004*	Computer Application
	MGMT2008*	Organizational Behaviour
	MGMT2012*	Introduction to Quantitative Methods
	MGMT2021*	Business Law I
	MGMT2023*	Financial Management 1
	MGMT2026*	Introduction to Production & Operations Management
	Level 3: eighteen (18) compulsory credits	
	Nine (9) credits from:	
	CHEM3010	Chemical Analysis B
	CHEM3110	Inorganic Chemistry B
	CHEM3210	Organic Chemistry B
	CHEM3310	Physical Chemistry B
	Plus six (6) additional credits from:	
	MGMT3031*	Business Strategy and Policy
	MGMT3058*	New Venture Management
	And three (3) additional Level 2 or 3 credits from:	
	CODE	**COURSE TITLE**
	CHEM2410	Water Treatment
	CHEM2510	Food Processing Principles I
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	CHEM3112	The Inorganic Chemistry of Biological Systems
	CHEM3212	Natural Products Chemistry

Electives ***Students must ensure that they satisfy the prerequisite courses required for entry to the electives of interest. In most instances, 12 Level 1 credits in the subject of interest are required. One or more advanced courses may also be needed.***	CHEM3213	Applications of Organic Chemistry in Medicine & Agriculture
	CHEM3312	Chemistry of Materials
	CHEM3313	Topics In Advanced Physical Chemistry
	CHEM3402	The Chemical Industries
	CHEM3510	Food Chemistry I
	CHEM3512	Food Chemistry II
	CHEM3610	Marine & Freshwater Chemistry
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycles
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3111	Inorganic Chemistry Laboratory II
	CHEM3211	Organic Chemistry Laboratory II
	CHEM3311	Physical Chemistry Laboratory II
	CHEM3511	Food Chemistry Laboratory
	CHEM3611	Environmental Chemistry Laboratory
	CHEM3621	Marine and Freshwater Chemistry Field Course
	CHEM3711	Chemistry Undergraduate Research Project
	And 3 additional credits from Level 2 or 3 Management Studies Courses.	
***Courses are offered by the Faculty of Social Sciences**		

ENVIRONMENTAL CHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in Environmental Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	AND	
	MATH - 6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2)	
	A major in Environmental Chemistry requires a total of forty-eight (48) credits from Levels 2 and 3 and must include:	
	Level 2: thirty-one (31) compulsory credits	

Advanced Courses (Levels 2 and 3)	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2110	Inorganic Chemistry A
	CHEM2210	Organic Chemistry A
	CHEM2310	Physical Chemistry A
	CHEM2410	Water Treatment
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3402	The Chemical Industries
	Plus four (4) credits from:	
	CHEM2111	Inorganic Chemistry Laboratory
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2311	Physical Chemistry Laboratory I
	Level 3: eleven (11) compulsory credits	
	CHEM3610	Marine and Freshwater
	CHEM3611	Chemistry Laboratory
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycle
	And six (6) additional credits from Level 2 or 3 taken from environmental courses including but not limited to:	
	CHEM3621	Marine and Freshwater Chemistry Field Course
	CHEM3711	Chemistry Undergraduate Research Project (Project must be environment-based)
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL3405	Pest Ecology and Management
	BIOL3406	Freshwater Biology
	BIOL3407	Oceanography
	BIOL3408	Coastal Systems
	BIOL3409	Caribbean Coral Reefs
	BIOL3410	Water Pollution Biology
	BOTN3403	Fundamentals of Horticulture
	BOTN3404	Economic Botany
	BOTN3405	Plant Ecophysiology

	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	GEOG2131	Urban Geography
	GEOG2232	Climate Change
	GEOG3132	Tourism Planning & Development
	GGEO2233	Water Resources
	GGEO3232	Climate Change in the Tropics
	GGEO3233	Hydrology and Hydrological Geology
	PHYS3661	Physics of the Atmosphere and Climate
	PHYS3671	Solar Power
	PHYS3681	Wind and Hydro Power

Major requires 24 credits of specified Environmental courses along with 6 credits from Level 2 or 3 approved environment related electives. There are 14 credits of defined prerequisite courses (CHEM2010, CHEM2011, CHEM2110, CHEM2210, and CHEM2310); an additional 4 credits from Level 2 laboratory electives are also required.

FOOD CHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in Food Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	AND	
	MATH - 6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2)	
Advanced Courses (Levels 2 and 3)	**A major in Food Chemistry requires a total of forty-four (44) credits from Levels 2 and 3 (including 10 credits from prerequisite courses) and must include:**	
	Level 2: twenty-four (24) compulsory credits	
	CHEM2010	Chemical Analysis A (prerequisite)
	CHEM2011	Chemical Analysis Laboratory I (prerequisite)
	CHEM2210	Organic Chemistry A (prerequisite)
	CHEM2211	Organic Chemistry Laboratory I (prerequisite)

	CHEM2510	Food Processing Principles I
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	Level 3: twenty (20) Compulsory Credits	
	CHEM2410	Water Treatment
	CHEM3401	Project Evaluation & Management for Science Based Industries
	CHEM3510	Food Chemistry I
	CHEM3511	Food Chemistry Laboratory
	CHEM3512	Food Chemistry II
	CHEM3513	Food Safety and Quality Assurance

Major requires thirty-four (34) credits of specialized Food Chemistry courses supported by 10 prerequisite credits of General Chemistry (CHEM2010, CHEM2011, CHEM2210, and CHEM2211).

MAJOR IN GENERAL CHEMISTRY		
Introductory Courses (Level 1)	**A major in General Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	AND	
	MATH - 6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2)	
	A major in General Chemistry requires a minimum of thirty-nine (39) credits from Levels 2 and 3 and must include:	
	Level 2: twenty (20) credits	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2110	Inorganic Chemistry A
	CHEM2111	Inorganic Chemistry Laboratory I
	CHEM2210	Organic Chemistry A
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2310	Physical Chemistry A
	CHEM2311	Physical Chemistry Laboratory I
	Level 3: minimum of nineteen (19) Credits	

Advanced Courses (Levels 2 and 3)	**At least six (6) Level 3 credits from:**	
	CHEM3010	Chemical Analysis B
	CHEM3110	Inorganic Chemistry B
	CHEM3210	Organic Chemistry B
	CHEM3310	Physical Chemistry B
	At least four (4) Level 3 credits from:	
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3111	Inorganic Chemistry Laboratory II
	CHEM3211	Organic Chemistry Laboratory II
	CHEM3311	Physical Chemistry Laboratory II
	At least three (3) Level 3 credits from:	
	CHEM3112	The Inorganic Chemistry of Biological Systems
	CHEM3212	Natural Products Chemistry
	CHEM3213	Applications of Organic Chemistry in Medicine and Agriculture
	CHEM3312	Chemistry of Materials
	CHEM3313	Topics in Advanced Physical Chemistry
Electives ***Students must ensure that they satisfy the prerequisite courses required for entry to the electives of interest. In most instances, 12 Level 1 credits in the subject of interest are required. One or more advanced***	**And six (6) additional Level 2 or 3 credits from:**	
	CHEM2410	Water Treatment
	CHEM2510	Food Processing Principles I
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	CHEM3112	The Inorganic Chemistry of Biological Systems
	CHEM3212	Natural Products Chemistry
	CHEM3213	Applications of Organic Chemistry in Medicine & Agriculture
	CHEM3312	Chemistry of Materials
	CHEM3313	Topics In Advanced Physical Chemistry
	CHEM3402	The Chemical Industries
	CHEM3510	Food Chemistry I
	CHEM3512	Food Chemistry II
	CHEM3610	Marine & Freshwater Chemistry
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycles
	CHEM3111	Inorganic Chemistry Laboratory II

courses may also be needed.	CHEM3211	Organic Chemistry Laboratory II
	CHEM3311	Physical Chemistry Laboratory II
	CHEM3511	Food Chemistry Laboratory
	CHEM3611	Environmental Chemistry Laboratory
	CHEM3621	Marine and Freshwater Chemistry Field Course
	CHEM3711	Chemistry Undergraduate Research Project

Major requires 20 Level 2 credits consisting of core courses in Analytical, Inorganic, Organic and Physical Chemistry (A, I, O and P) and include 8 credits in laboratory courses which span the four sub-disciplines. At Level 3, students take 10 credits of core chemistry (inclusive of 4 credits in laboratory courses) and 9 credits in electives.

OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH (B.Sc.)

Introductory Courses (Level 1)	**A B.Sc. in Occupational and Environmental Safety and Health requires a total of thirty-nine (39) Level 1 credits from:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	GEOG1231	Earth Environments I: Geomorphology and Soil
	GEOG1232	Earth Environments II: Climate and the Biosphere
	OESH1000	Introduction to OESH
	Foundation Course (FOUN1014 or FOUN1019)	
Advanced Courses	**A B.Sc. in Occupational and Environmental Safety and Health requires a total of seventy-three (73) credits from Levels 2 and 3 and must include:**	
	Year 2: thirty (30) compulsory credits	
	BIOL2406	Eukaryotic Microorganisms
	BIOL2403	Principles of Ecology
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM3010	Chemical Analysis B

(Levels 2 and 3)	CHEM3011	Chemical Analysis Laboratory II
	LANG3101*	Business Communication: Principles and Practices
	OESH3200	Occupational Safety Evaluation and Measurement
	OESH3220	Occupational Hygiene
	PHAL3306**	Toxicology
	Foundation Course	
	Year 2: Summer: six (6) credits	
	PSYC1002	Introduction to Industrial and Organizational
	MDSC3200**	Understanding Research
	Year 3: thirty-six (36) credits	
	OESH2000	Environmental Contaminants
	OESH3010	Occupational and Environmental Health Disorders
	OESH3020	OESH Measurement Methods
	OESH3030	Workplace Survey and Evaluation
	OESH3040	Disaster and Emergency Management
	OESH3100	Environment Hazard Evaluation and Risk Management and Control
	OESH3210	Ergonomics
	MGMT3063***	Labour and Employment Law
	Foundation Course	
	Level 3: Summer: four (4) credits	
	OESH3430	Practicum

Course offered by the Faculty of Humanities and Education.
***** Course offered by the Faculty of Medical Sciences.***
****** Course offered by the Faculty of Social Sciences.***

SPECIAL CHEMISTRY (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Special Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
	AND	
	MATH - 6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2) PHYS - CAPE Physics or equivalent is required.	
Advanced Courses (Levels 2 and 3)	**A B.Sc. in Special Chemistry requires a total of fifty-four (54) credits from Levels 2 and 3 and must include:**	
	Level 2: twenty (20) compulsory credits	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2110	Inorganic Chemistry A
	CHEM2111	Inorganic Chemistry Laboratory I
	CHEM2210	Organic Chemistry A
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2310	Physical Chemistry A
	CHEM2311	Physical Chemistry Laboratory I
	Level 3: twenty (20) compulsory credits	
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3110	Inorganic Chemistry B
	CHEM3210	Organic Chemistry B
	CHEM3310	Physical Chemistry B
	CHEM3711	Chemistry Undergraduate Research Project
	At least four (4) Level 3 credits from:	
	CHEM3111	Inorganic Chemistry Laboratory II
	CHEM3211	Organic Chemistry Laboratory II
	CHEM3311	Physical Chemistry Laboratory II
	And ten (10) additional Level 2 or 3 credits from :	
	CHEM2410	Water Treatment
	CHEM2510	Food Processing Principles I
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	CHEM3112	The Inorganic Chemistry of Biological Systems

Electives ***Students must ensure that they satisfy the prerequisite courses required for entry to the electives of interest. In most instances, 12 Level 1 credits in the subject of interest are required. One or more advanced courses may also be needed.***	CHEM3212	Natural Products Chemistry
	CHEM3213	Applications of Organic Chemistry in Medicine & Agriculture
	CHEM3312	Chemistry of Materials
	CHEM3313	Topics In Advanced Physical Chemistry
	CHEM3402	The Chemical Industries
	CHEM3510	Food Chemistry I
	CHEM3512	Food Chemistry II
	CHEM3610	Marine & Freshwater Chemistry
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycles
	CHEM3111	Inorganic Chemistry Laboratory II
	CHEM3211	Organic Chemistry Laboratory II
	CHEM3311	Physical Chemistry Laboratory II
	CHEM3511	Food Chemistry Laboratory
	CHEM3611	Environmental Chemistry Laboratory
	CHEM3621	Marine and Freshwater Chemistry Field Course
	CHEM3711	Chemistry Undergraduate Research Project
	And six (6) credits from Level 2 courses in another subject area in science or Mathematics.	

The 40 compulsory Levels 2 and 3 credits consist of core courses in analytical, inorganic, organic and physical chemistry (A, I, O and P) and include 8 credits in laboratory courses which span the four sub-disciplines, as well as a 6-credit project course.

ENVIRONMENTAL CHEMISTRY (MINOR)		
Introductory Courses (Level 1)	**A minor in Environmental Chemistry requires a total of twelve (12) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
Advanced Courses (Levels 2 and 3)	**A minor in Environmental Chemistry requires a total of fifteen (15) credits from Levels 2 and 3 and must include:**	
	CHEM2410	Water Treatment
	CHEM3610	Marine and Freshwater Chemistry
	CHEM3611	Environmental Chemistry Laboratory
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycles

FOOD CHEMISTRY (MINOR)		
Introductory Courses (Level 1)	**A minor in Food Chemistry requires a total of twelve (12) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
Advanced Courses (Levels 2 and 3)	**A minor in Food Chemistry requires a total of at least sixteen (16) credits from Levels 2 and 3 and must include:**	
	CHEM3510	Food Chemistry I
	CHEM3511	Food Chemistry Laboratory
	CHEM3512	Food Chemistry II
	AND at least (7) credits from:	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2210	Organic Chemistry A
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2310	Physical Chemistry A
	CHEM2311	Physical Chemistry Laboratory I
	CHEM2410	Water Treatment
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II

	CHEM3210	Organic Chemistry B
	CHEM3513	Food Safety & Quality Assurance

Minor consists of 16 credits of Advanced courses. The required Level 3 courses explore the chemistry of food components while the additional 7 credits may be selected from Level 2 or Level 3 courses that cover central areas of organic and physical chemistry, chemical analysis, water treatment, instrumental methods or food safety.

FOOD PROCESSING (MINOR)		
Introductory Courses (Level 1)	**A minor in Food Processing requires a total of twelve (12) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
Advanced Courses (Levels 2 and 3)	**A minor in Food Processing requires a total of at least sixteen (16) credits from Levels 2 and 3 and must include:**	
	CHEM2510	Food Processing Principles I
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	AND at least seven (7) credits from:	
	CHEM2310	Physical Chemistry A
	CHEM2311	Physical Chemistry Laboratory I
	CHEM2410	Water Treatment
	CHEM3401	Project Evaluation & Management for Science Based Industries
	CHEM3402	Chemical Analysis Laboratory II
	CHEM3403	Chemical Process Principles
	CHEM3513	Food Safety & Quality Assurance

Minor consists of 16 Advanced (Level 2 and Level 3) credits. The compulsory Level 2 courses (9 credits) explore the theory of various food processing technologies, laboratory analyses of raw and processed foods as well as pilot scale processing of local foods. The additional 7 credits may be selected from Level 2 or Level 3 courses that cover central areas of physical chemistry, water treatment, industrial chemistry, unit operations, food safety and the integration of business and management in the food industry.

GENERAL CHEMISTRY (MINOR)		
Introductory Courses (Level 1)	**A minor in General Chemistry requires a total of twelve (12) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
Advanced Courses (Levels 2)	**A minor in General Chemistry requires a total of at least fifteen (15) credits from Level 2 and must include:**	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	AND at least six (6) credits from:	
	CHEM2110	Inorganic Chemistry A
	CHEM2210	Organic Chemistry A
	CHEM2310	Physical Chemistry A
	AND at least four (4) credits from:	
	CHEM2111	Inorganic Chemistry Laboratory I
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2311	Physical Chemistry Laboratory I
Minor gives students a foundation in analytical chemistry and two of the other traditional sub-disciplines (inorganic, organic and physical chemistry). The minor is comprised of 9 credits of theory and 6 credits of laboratory from Level 2 core courses.		

	INDUSTRIAL CHEMISTRY (MINOR)	
Introductory Courses (Level 1)	**A minor in Industrial Chemistry requires a total of twelve (12) Level 1 credits from:**	
	CHEM1901	Introductory Chemistry A
	CHEM1902	Introductory Chemistry B
Advanced Courses (Level 3)	**A minor in Industrial Chemistry requires a total of sixteen (16) credits from Level 3 and must include:**	
	CHEM3401	Project Evaluation & Management for Science Based Industries
	CHEM3402	The Chemical Industries
	CHEM3403	Chemical process Principles

CHEM2010, CHEM2011, CHEM2310 and CHEM2311 are prerequisites for CHEM3403 and CHEM3402.

Minor consists of 16 compulsory advanced credits. A four-credit course covers the organization and operation of critical chemical industries and provides for internship within an approved chemical industry while courses in project management and chemical unit operation round out the required courses.

COURSE DESCRIPTIONS

CHEM0901 **PRELIMINARY CHEMISTRY A**
(6 P-Credits) (Level 0) (Semester 1)

Pre-requisite:
CSEC (CXC) Chemistry Grade 3 or better **OR** approved equivalents.

Course Content:
Introduction to Chemistry: Atomic theory of matter. Electronic configuration of the elements. The Periodic Table and related studies. The mole concept and stoichiometry. Chemical Bonding and molecular geometry; The characteristics and properties of matter: Properties of solutions. Chemical Energetics, the First Law of Thermodynamics; Enthalpy and its calculation; The chemistry of aliphatic hydrocarbons; A practical course of 72 hours.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Assignments 15%
    - Practical Work 15%

Practical work is assessed throughout the duration of the course. Students whose practical work is considered to be unsatisfactory are required to sit a practical examination of not more than six hours. Candidates must provide the ORIGINAL worksheets of their laboratory work at the practical examination. These must be certified by the laboratory course Supervisor and may be taken into consideration by the Examiners.

CHEM0902 **PRELIMINARY CHEMISTRY B**
(6 P-Credits) (Level 0) (Semester 2)

Pre-requisite:
CSEC (CXC) Chemistry Grade 3 or better **OR** approved equivalents.

Course Content:
Properties and Reactivity of Main Group Elements and their compounds. Transition Elements and their compounds. Coordination compounds; Kinetics, Rates of chemical reactions. Principles of Electrochemistry. Chemical Equilibrium and its application; A functional group approach to the chemistry of organic compounds: alkyl halides, alcohols, carbonyl compounds, carboxylic acids and their derivatives and amines; A practical course of 72 hours.

Evaluation:

• Final Written Examination (2 hours)	70%
• Course Work:	30%
• Assignments	15%
• Practical Work	15%

Practical work is assessed throughout the duration of the course. Students whose practical work is considered to be unsatisfactory are required to sit a practical examination of not more than six hours. Candidates must provide the ORIGINAL worksheets of their laboratory work at the practical examination. These must be certified by the laboratory course Supervisor and may be taken into consideration by the Examiners.

CHEM1901 **INTRODUCTORY CHEMISTRY A**
(6 Credits) (Level 1) (Semester 1)

Pre-requisites:
CHEM0901- Primary Chemistry A **AND** CHEM0902 - Preliminary Chemistry B **or** CAPE Chemistry (Units 1 and 2) **or** GCE A-level Chemistry or approved equivalents.

Course Content:
Introductory Analytical Chemistry: Theory of neutralization titrations, titration curves, spectrophotometry; Atomic Theory: Interactions between atoms, ions and molecules. Crystal structures and symmetry elements. Born-Haber cycle. Molecular Orbital Theory for homo- and hetero-nuclear diatomic molecules; Energetics and Molecular Structure: heat capacity variation with temperature,

wave behaviour in molecules, Boltzmann distribution, origin of molecular spectra; A mechanistic approach to the chemistry of alkanes, alkenes and alkynes. An introduction to the stereochemistry of organic molecules; A practical course of 72 hours.

Evaluation:

- Final Written Examination (2 hours) 75%
- Course Work: 25%
  - In-course Tests 10%
  - Practical Work 15%

Practical work is assessed throughout the duration of the course. Students whose practical work is considered to be unsatisfactory are required to sit a practical examination of not more than six hours. Candidates must provide the ORIGINAL worksheets of their laboratory work at the practical examination. These must be certified by the laboratory course Supervisor and may be taken into consideration by the Examiners.

CHEM1902 **INTRODUCTORY CHEMISTRY B**
(6 Credits) (Level 1) (Semester 2)

Pre-requisites:
CHEM0901- Primary Chemistry A **AND** CHEM0902 - Preliminary Chemistry B **or** CAPE Chemistry (Units 1 and 2) **or** GCE A-level Chemistry or approved equivalents.

Course Content:
A detailed study of Main Group elements based on their position in the Periodic Table; The properties of oxygen and its compounds; Coordination compounds of First Row Transition Elements and their stereochemical features; Introduction to Crystal Field Theory. Stability of metal complexes. Isomerism; Thermodynamics: Introduction to meaning and uses of Internal Energy, Enthalpy, Entropy and Gibbs Energy to ideal gas processes and chemical reactions. Electrochemistry of cells, Nernst Equation. Kinetics; order, molecularity and rate equations. Enthalpy and Entropy of activation; Synthesis and Reactions of functionalised organic compounds. Introduction to Aromatic Chemistry. A practical course of 72 hours.

Evaluation:

- Final Written Examination (2 hours) 75%
- Course Work: 25%
    - In-course Tests 10%
    - Practical Work 15%

Practical work is assessed throughout the duration of the course. Students whose practical work is considered to be unsatisfactory are required to sit a practical examination of not more than six hours. Candidates must provide the ORIGINAL worksheets of their laboratory work at the practical examination. These must be certified by the laboratory course Supervisor and may be taken into consideration by the Examiners.

CHEM2010 **CHEMICAL ANALYSIS A**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901- Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** FOUN1014/FOUN1019**.**

Course Content:
The analytical process and approaches to management of analytical laboratories: identifying and quantifying errors, statistical tests; Introduction to analytical electrochemistry: redox titrations, electrochemical cells and electrode potentials, the Nernst equation, pH and ion-selective electrodes; Introduction to chromatography: basic principles and types e.g. planar and column chromatography including high performance liquid chromatography and gas chromatography. Factors affecting separations Instrumental components and sample requirements, techniques for qualitative and quantitative chromatographic analysis; Introduction to analytical molecular absorption spectroscopy: Beer-Lambert's law, instrumentation and applications.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 20%
    - Assignments 20%

CHEM2011 **CHEMICAL ANALYSIS LABORATORY I**

(2 Credits) (Level 2) (Semester 1)

Pre-requisites:

CHEM1901- Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** FOUN1014/FOUN1019 **AND** permission of Head of Department.

Co-requisite:

CHEM2010 - Chemical Analysis A.

Course Content:

Laboratory experiments designed around some Fundamental conventional and instrumental analytical procedures such as but not limited to redox titrations, spectrophotometric analyses, analyses with electrodes and chromatographic separations; Workshops on effective approaches to scientific and technical writing.

Evaluation:

- Laboratory Skills 25%
- Writing Exercises 25%
- Laboratory Reports 50%

CHEM2110 **INORGANIC CHEMISTRY A**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

CHEM1901-Introductory Chemistry A **AND** CHEM1902 - Introductory Chemistry B.

Course Content:

Structure and Bonding: Review of Crystal Field Theory. Ligand Field Theory. Spectroscopic and Magnetic properties of complexes; Chemistry of transition metals; Mechanisms of inorganic reactions: Substitution and electron transfer reactions; Transition metal organometallics: metal carbonyls, metal alkyls, cyclopentadienyl and arene complexes; Catalysis.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%

CHEM2111 **INORGANIC CHEMISTRY LABORATORY I**
(2 Credits) (Semester 2) (Level 2)

Pre-requisites:
CHEM1901-Introductory Chemistry A **AND** CHEM1902 - Introductory Chemistry B.

Co-requisite:
CHEM2110 - Inorganic Chemistry A.

Course Content:
This lecture/laboratory-based course is designed to develop skills in inorganic chemistry, including synthetic reaction procedures, isolation, and employment of spectroscopic techniques for the identification of compounds. It provides students with hands on training necessary to develop skills in problem-solving, manipulation of equipment, critical thinking, data collection, processing and analysis, synthesis, experimental design, team work, time management, and oral and written communication. In addition, it exposes students to international laboratory safety standards. The lectures will cover aspects of UV/Vis spectroscopy of transition metal complexes as well as their magnetic properties.

Evaluation:
- In-course Tests 20%
- Laboratory Reports 80%

CHEM2210 **ORGANIC CHEMISTRY A**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A **AND** CHEM1902 - Introductory Chemistry B.

Course Content:
1. **The Application of Spectroscopic Techniques in Organic Chemistry:** electronic, infrared, proton and carbon-13 magnetic resonance spectroscopy, mass spectrometry. Their utility in elucidating the structure of organic compounds.
2. **Carbocyclic and Heterocyclic Aromatic Compounds:** Review of the concept of aromaticity. Electrophilic and nucleophilic substitution in benzenoid systems. Polycyclic aromatic compounds: naphthalene,

anthracene and phenanthrene. Selected reactions of simple heterocycles.

3. **Overview of the Main Types of Organic Reactions:** substitution, addition, elimination, cyclization. Reaction mechanisms and methods of determining them. Generation, structure and fate of reactive intermediates (carbocations and carbanions). The role of carbanions in carbon-carbon bond formation: reactions of enolate ions and organometallic compounds. Diels Alder reactions.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%

<u>CHEM2211</u> **<u>ORGANIC CHEMISTRY LABORATORY I</u>**

(2 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A **AND** CHEM1902 - Introductory Chemistry B.

Co-requisite:
CHEM2210 - Organic Chemistry A.

Course Content:
Isolation of natural products; synthetic techniques (including chemoselectivity, aldol reactions, electrophilic aromatic substitution, aromatic diazonium chemistry, heterocyclic synthesis, molecular rearrangement); Organic stereochemistry; Principles of green chemistry; Characterisation of unknown organic compounds; Thin layer chromatographic analysis.

Evaluation:

- In-course Tests 20%
- Laboratory Reports 80%

CHEM2310 **PHYSICAL CHEMISTRY A**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A **AND** CHEM1902 - Introductory Chemistry B.

Course Content:

1. First and Second Laws of thermodynamics applied to phase equilibria of a pure substance, homogeneous and heterogeneous mixtures and chemical equilibria. Free energy and chemical potentials. Phase Rule. Chemical equilibrium. Liquid/vapour phase diagrams for binary mixtures. Dilute solutions. Colligative effects. Electrolyte solutions: Debye-Hückel theory.
2. Thermodynamics of galvanic cells. Nernst equation. Potentiometric determination of thermodynamic properties of redox processes. Equilibrium constants, potentiometric titration, disproportionation. Liquid junctions. Membrane potentials. Ion-selective electrodes. Theory of ionic transport in aqueous solutions and its applications.
3. Elementary reactions. Rate equations. Multi-step mechanisms. Steady-state and equilibrium approximations. Chemical oscillators. Flow methods and relaxation methods. Activated-complex theory and the Eyring equation. Primary kinetic salt effect. Photochemical processes.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%

CHEM2311 **PHYSICAL CHEMISTRY LABORATORY I**

(2 Credits) (Level 2) (Semester 2)

Pre-requisite:
CHEM2310 - Physical Chemistry A.

Course Content:
This laboratory course is designed to develop laboratory skills in physical chemistry, including proper use of instruments, data collection and analysis, estimation of errors and scientific report writing. Specific areas to be focused on include: Chemical thermodynamics, Electrochemistry, Quantum mechanics, Atomic spectroscopy, Molecular spectroscopy and Chemical kinetics.

Evaluation:

- In-course Tests 20%
- Laboratory Reports 80%

CHEM2402 **CHEMISTRY IN OUR DAILY LIVES**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** Permission of Head of Department.

Course Content:
The role of chemistry in producing consumer products. Chemistry of textiles and, clothing, sport and crime. Applications of chemistry to the arts, crime-fighting and law enforcement, economics and politics. Chemistry and the environment.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - In-course Tests 20%
    - Assignments 30%

CHEM2402 is open to FST students at the Advanced level who have successfully completed Level 1 (CHEM1901 and CHEM1902) Chemistry courses. This course cannot be counted towards a major or minor in Chemistry. The course can, however, be counted as advanced credits within these degrees.

CHEM2410 **WATER TREATMENT**
(4 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** Permission of Head of Department.

Co-requisites:
CHEM2010 - Chemistry Analysis A **AND** CHEM2011 - Chemical Analysis Laboratory 1.

Course Content:
Water for industrial, agricultural, and domestic purposes: distribution, quality, environmental contamination. Water re-use and recycling; Water quality

standards: regulations for industrial effluents, potable water, sewage effluents and their receiving bodies (river, wells and coastal waters). Water quality monitoring; Treatment and disposal of Wastewater, Domestic Sewage and Industrial Wastes: characterization of potable, raw, waste and receiving waters; A practical course of 48 hours.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - In-course Tests 20%
    - Laboratory Reports 20%
    - Field Trip Reports 10%

CHEM2510 **FOOD PROCESSING PRINCIPLES I**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

CHEM1901 - Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** Permission of HOD. *Preference will be given to students majoring in Food Chemistry.*

Course Content:

Basic principles, technologies and applications involved in the processing of foods; Processing at ambient temperatures: Characteristics of raw food, material transfer and fluid flow, heat transfer, spoilage and deterioration mechanisms, food preservation, effect of processing on sensory and nutritional properties, microbial risks and food safety issues; Raw material preparation: size reduction, mixing and forming, separation, fermentation and enzyme technology, pickling and curing; Processing by removal of heat: Refrigeration, chilling and refrigerated storage, freezing, freeze drying and concentration; Modified atmosphere storage and packaging, material handling, storage and distribution.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (*an assignment may be given*) 40%

CHEM2511 **FOOD PROCESSING LABORATORY**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** Permission of HOD. *Preference will be given to students majoring in Food Chemistry.*

Co-requisites:
CHEM2512 - Food Processing Principles II.

Course Content:

Practical exposure to the skills required to function effectively in a food manufacturing facility; Handling, preparation, processing, and packaging of selected food products; Food processing operations involving ambient, thermal and non-thermal unit operations will be carried out and/or observed; Laboratory activities will be carried out in teams, and reports will be individually produced.

Evaluation:

• Oral Presentation	10%
• Research Paper Assignments	15%
• Laboratory and Field Trip Reports	75%

CHEM2512 **FOOD PROCESSING PRINCIPLES II**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
CHEM1901 - Introductory Chemistry A, CHEM1902 - Introductory Chemistry B **AND** Permission of Head of Department. *Preference will be given to students majoring in Food Chemistry.*

Course Content:
Thermal Processing (Steam, Hot Air and Oil) and Packaging Operations: Blanching; pasteurization. Heat sterilization: retorting; ultra-high temperature (UHT) and aseptic processes. Evaporation and Distillation: Boiling point elevation types of evaporators, selection of evaporators, vapour compression, simple distillation systems, continuous and batch systems. Hot Air Psychrometrics: Properties of dry air, properties of water vapour, air-vapour mixtures, dew-point, humidity ratio, relative humidity, wet bulb temperature, psychrometric chart. Dehydration: Drying process, moisture diffusion, drying rate curves, drying time

predictions, mass and energy balances, drying systems. Other Processing Methods: Frying, irradiation, electric fields and high pressure, packaging operations and principles.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (*an assignment may be given*) 40%

CHEM3010 **CHEMICAL ANALYSIS B**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
CHEM2010 - Chemical Analysis A.

Course Content:
The process approach to quality management; the collection and analysis of real samples; Quantifying and reporting data quality; Advanced Chromatography principles; Gas and high performance liquid chromatographies; Tandem techniques (GC-MS, HPLC-MS); Developing chromatographic techniques; Analytical Atomic Spectrometry: Atomic Emission Spectrometry: the Boltzmann equation, instrumental components, applications. Flame and Electrothermal Atomic Absorption Spectrometries; X-ray Fluorescence, Instrumental Neutron Activation Analysis and Inductively Coupled Plasma Spectrometries: theories, instruments, advantages and disadvantages.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests/Assignments 40%

CHEM3011 **CHEMICAL ANALYSIS LABORATORY II**

(2 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2010 - Chemical Analysis A **AND** CHEM2011 - Chemical Analysis Laboratory I *(Pass or Fail but not Fail Absent).*

Co-requisite:
CHEM3010 - Chemical Analysis B.

Course Content:
A laboratory-based project centred on the application of one or two instrumental analytical techniques to the analysis of a real sample: hypotheses, project planning, sampling, sample preparation, instrumental analyses, Evaluation of data quality, interpretation, report preparation. Students work in groups of two or three; A series of workshops on effective oral communication skills; An oral presentation of the laboratory project.

Evaluation:
- Laboratory Skills 25%
- Speaking Exercises 25%
- Laboratory Reports 50%

CHEM3110 **INORGANIC CHEMISTRY B**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
CHEM2110 - Inorganic Chemistry B.

Course Content:
1. **Structure and Bonding.** Introduction to Group Theory. Symmetry elements and operations. Point groups. Construction of character tables. Application of Group Theory to Bonding. Energy level of diagrams for octahedral transition metal complexes.

2. **Main Group Elements:** Hydrogen and its compounds, Oxides and oxyacids. Halogens and halides. Main Group organometallic compounds.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%

CHEM3111 **INORGANIC CHEMISTRY LABORATORY II**
(2 Credits) (Level 3) (Semester 1)

Pre-requisite:
CHEM2111 - Inorganic Chemistry Laboratory I.

Co-requisite(s):
CHEM3312 - Chemistry of Materials **AND/OR** CHEM3112 - The Inorganic Chemistry of Biological Systems.

Course Content:
Experimental techniques used in the synthesis and characterization of inorganic compounds (X-ray diffraction, NMR, and electronic spectroscopy, etc.); Synthesis of super conductors; Synthesis of organometallic compounds and their use as catalysts; Synthesis of transition metal complexes and their use as mimics of enzymes; Quadruple M-M bonds: Preparation of chromium (II) acetate dimer.

Evaluation:
- In-course Tests 20%
- Written Laboratory Reports 80%

CHEM3112 **THE INORGANIC CHEMISTRY OF BIOLOGICAL SYSTEMS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
CHEM2110 - Inorganic Chemistry A **AND** CHEM3110 - Inorganic Chemistry B.

Course Content:
Amino acids, peptides and proteins; Metal storage & transport: Fe, Cu, Zn and V. Molecular dioxygen, O_2; Biological redox processes; The Zn^{2+} ion: Nature's Lewis acid; Metal complexes used for diagnosis and treatment in medicine.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - Assignments 10%
  - In-course Tests 30%

CHEM3210 **ORGANIC CHEMISTRY B**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
CHEM2210 - Organic Chemistry A (Pass or Fail but NOT Fail Absent).

Course Content:
Target oriented organic synthesis. An introduction to retrosynthetic analysis. Reagents and methods for effecting carbon-carbon single and double bond formation, oxidation, reduction and cyclization; Mechanisms of carbocation and related rearrangements, substitution and elimination reactions; Stereochemistry of organic molecules. Static and dynamic aspects; The chemistry of carbohydrates- the synthesis and properties of mono- and disaccharides. The chemistry of amino acids, peptides and proteins.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - In-course Tests 40%

CHEM3211 **ORGANIC CHEMISTRY LABORATORY II**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2211 - Organic Chemistry Laboratory I **AND** permission of Head of Department.

Co-requisite(s):
CHEM3212 **-** Natural Products Chemistry **AND/OR** CHEM3213 **-** Applications of Organic Chemistry in Medicine and Agriculture.

Course Content:
Synthesis of selected herbicides, insecticides, antibiotics and anticonvulsants; reactions of carbohydrates, lipids, terpenoids and steroids; column chromatographic purification; spectroscopic analysis.

Evaluation:
- Laboratory Reports 80%
- In-course Tests 20%

CHEM3212 **NATURAL PRODUCTS CHEMISTRY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2210 - Organic Chemistry A, CHEM3210 - Organic Chemistry A **AND** permission of Head of Department.

Course Content:
Biosynthesis of Natural Products; Structural diversity in Natural Products Chemistry; Methods used in the elucidation of biosynthetic pathways; Advanced Spectroscopy: Mass spectrometry; instrumentation, isotope abundances and HRMS; Uses of MS other than for structure elucidation; Carbon-13 nuclear magnetic resonance spectroscopy; Instrumentation; Spectral interpretation; Uses of C-13 NMR other than for structure determination; The Synthesis and Chemistry of Natural Products; Linear versus convergent syntheses; Retrosynthetic analysis; Study of selected syntheses and synthetic transformations of natural products - terpenoids, alkaloids, phenolics.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%

CHEM3213 **APPLICATIONS OF ORGANIC CHEMISTRY IN MEDICINE AND AGRICULTURE**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
CHEM2210 - Organic Chemistry A **AND** CHEM3210 - Organic Chemistry A.

Course Content:
1. **Organic Chemistry in Medicine:** Drug classification, the concept of receptor sites; An introduction to quantitative aspects of drug receptor interactions; Drug administration, distribution and metabolism; Anti-infective agents, anti-allergenic and anti-ulcerative agents; Central Nervous System depressants: analgesics.
2. **Organic Chemistry in Agriculture:** Use of organic compounds for the control of pests; Stages in the research and development of pesticides; An examination of insecticides, herbicides and fungicides with respect to structure, mode, of action, metabolism, synthesis, and environmental impact.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%

CHEM3310 **PHYSICAL CHEMISTRY B**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

CHEM2310 - Physical Chemistry A (Pass or Fail but NOT Fail Absent)

Course Content:

Quantum mechanics: The Schrödinger wave equation, Simple harmonic motion; Rotation: Orbital and spin angular momentum. Vibrational and rotational spectra of diatomic molecules; Microstates of matter; Boltzmann entropy formula; Connection between molecular properties and macroscopic behaviour; Applications to ideal gases. Maxwell-Boltzmann distribution; Configurational partition functions of non-ideal fluids. Structural phase transitions. Electronic spectra of atoms; Electronic spectra of molecules. Selection rules. Nuclear Magnetic Resonance (NMR). Electrons and nuclei in magnetic fields. Proton-NMR spectra.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Written Assignments 10%
    - In-course Tests 30%

CHEM3311 **PHYSICAL CHEMISTRY LABORATORY II**

(2 Credits) (Level 3) (Semester 1)

Pre-requisites:

CHEM2311 - Physical Chemistry Laboratory I **AND** permission of Head of Department.

Co-requisite(s):

CHEM3312 - Chemistry of Materials **AND/OR** CHEM3313 - Topics in Advanced Physical chemistry.

Course Content:
Polymer viscosity; Surface chemistry micellization; X-ray diffraction; Polymer synthesis and characterization magnetic properties of solutions.

Evaluation:

• In-course Tests	20%
• Laboratory Reports	80%

CHEM3312 **CHEMISTRY OF MATERIALS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2310 - Physical Chemistry A **AND** CHEM2110 - Inorganic Chemistry A **AND** permission of Head of Department.

Course Content:
1. **Polymers:** definitions, nomenclature, molecular architecture.
2. **Colloids and Surfaces:** liquid-gas and liquid-liquid interfaces, surface and interfacial tensions; Capillary action; Micelle formation; Adsorption isotherms; composition and structure of solid surfaces.
3. **The Structure of Solids:** Symmetry in crystals and their diffraction patterns. X-ray Diffraction: the Powder Method versus Single Crystal X-ray Diffraction.
4. **Semiconductors:** properties and types; optical and electrical properties, photoconductivity, luminescence; Applications.
5. **Classification of Nanomaterials:** Synthesis; structure and properties.
6. **Materials Characterisation:** Optical and Electron Microscopy: TEM, SEM; Surface and Bulk Characterisation Techniques.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• In-course Tests	20%
• Assignments	20%

CHEM3313 **TOPICS IN ADVANCED PHYSICAL CHEMISTRY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2310 - Physical Chemistry A **AND** CHEM3310 - Physical Chemistry A.

Course Content:

1. **Computational Methods**: Molecular orbital approximations; Molecular conformational energies; Charge distributions; Dipole moments.
2. **Molecular Interactions:** Electric dipole moments; Interaction between dipoles; Hydrogen bonding; Molecular recognition; Kinetic model for the perfect gas; Real gases; Molecular Interactions in liquids.
3. **Redox Processes and Advanced Electrochemistry:** Electron transfer; Marcus theory for electron transfer; Electrified interfaces; Diffusion and migration. Cell design; Liquid junctions; Butler-Volmer equation and Tafel plots; Polarography; Cyclic voltammetry and impedance methods.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Written Assignments 10%
    - In-course Tests 30%

CHEM3401 **PROJECT EVALUATION AND MANAGEMENT FOR SCIENCE BASED INDUSTRIES**
(4 Credits) (Level 3) (Semester 1)

This course is only available to students majoring in Applied Chemistry and Food Chemistry but students who do not have any overlapping Management Studies courses and are majoring in areas which have an industrial direction and have the approval of the Department within which they are majoring may be allowed to take this course.

Pre-requisites:
CHEM2510 - Food Processing Principles I **OR** CHEM2512 - Food Processing Principles II **AND** CHEM2511 - Food Processing Laboratory **OR** CHEM3402 - The Chemical Industries **AND** Permission of Head of Department.

Course Content:

1. **Economics:** Introduction to macro & micro- economics; Supply and demand, pricing policy, price elasticity, profit vs. revenue maximising decisions; production function, maturity of industry.
2. **Accounting:** Cost, volume and profit analysis; allocation of resources; preparation, analysis and reporting on management accounts.
3. **Project Evaluation and Management:** The project concept, project development and appraisals, discounting, risk analysis, project implementation and time management, critical path method.
4. **Team Building Workshops:** Teamwork, interpersonal skills, leadership, decision making, communication and conflict management.

Evaluation:

- Final Written Examination (2 hours) 75%
- Course Work: 25%
    - Team-based Project 25%

CHEM3402 **THE CHEMICAL INDUSTRIES**
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
Any two combinations:
CHEM2010 - Chemical Analysis A **AND** CHEM2011 - Chemical Analysis Laboratory I
OR
CHEM2110 - Inorganic Chemistry A **AND** CHEM2111 - Inorganic Chemistry Laboratory I
OR
CHEM2210 - Organic Chemistry A **AND** CHEM2211 - Organic Chemistry Laboratory I
OR
CHEM2310 - Physical Chemistry A **AND** CHEM2311 - Physical Chemistry Laboratory I

AND Permission of Head of Department.

Course Content:
This course will cover at least TWO of the following topics extensively:

1. **Bauxite/Alumina:** Bauxites: types and origins, mineralogy and process design. Bauxite processing by the Bayer process: Mining, desilication, digestion, the mud circuit, precipitation, calcination. Material flow

diagrams, analytical techniques, product quality and uses, waste disposal and environmental impacts.

2. **Petroleum and Petrochemical:** Crude oil and natural gas: formation, extraction, characterization, transportation and storage. Petroleum Refining; Analytical monitoring and quality control; Environmental impacts; Regulations and monitoring.
3. **Sugar Cane Processing:** Global and local industries; raw materials and their quality; cane preparation and milling; Clarification: reactions, equipment and effects of impurities; Evaporation; Crystallization. Product quality; By-products. Environmental regulations and waste management.
4. **Cement Manufacture:** Technologies, raw materials and products; Basic cement chemistry; Equipment; Measurement and control of fineness. CaO-SiO_2-Al_2O_3 ternary system; chemical, physical and mineralogical transformations; clinker quality, grinding and cement preparation; Energy re-use and environmental regulations.

Students are required to work for at least 8 weeks in an approved industrial setting during the summer following the theory component of the course.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Work Placement 25%
    - Assignments 25%

CHEM3403 **CHEMICAL PROCESS PRINCIPLES**

(8 Credits) (Level 3) (Semester 2)

Pre-requisites:

CHEM2310 - Physical Chemical A and CHEM2311 - Physical Chemistry Laboratory I **AND** Permission of HOD.

Course Content:

Process Material Balances; Heat Transfer Operations; Mass Transfer Processes; Applied Thermodynamics and Applied Kinetics; 72 hours of laboratory work.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 15%
    - Practical Work 25%

CHEM3510 **FOOD CHEMISTRY I**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

CHEM2010 - Chemical Analysis A **and** CHEM2011 - Chemical Analysis Laboratory I **AND** CHEM2210 - Organic Chemistry A **and** CHEM2211- Organic Chemistry Laboratory I **AND** Permission of Head of Department.

Course Content:

1. **Water:** Properties; water-solute interactions, ice-water interactions; water activity and food stability.
2. **Carbohydrates:** Structure and classification; starch, pectin, cellulose, gums and dietary fiber; effect of carbohydrates on properties of food; chemical reactions of carbohydrates in foods.
3. **Proteins:** Amino acid - structure and properties; proteins - structure and properties; interactions with other food components; effects of processing on protein structure, function and quality.
4. **Lipids:** Structure and classification; relationship between lipids and health; lipid degradation; hydrolysis and autoxidation; application of antioxidants; processing of lipids. Effects of processing on properties of food.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (*an assignment may be given*) 40%

CHEM3511 **FOOD CHEMISTRY LABORATORY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

Permission of Head of Department.

Co-requisites:

CHEM3510 - Food Chemistry I **AND** CHEM3512 - Food Chemistry II.

Course Content:

Analytical techniques and methodologies commonly used for the analysis of macro and micro food components including: spectrophotometry, polarimetry, titrimetry. Experiments will involve sample preparation, instrumental analyses, data analysis, and report preparation. Practical food analysis will be carried out in teams, and reports will be individually produced. Lecture sessions will address topics including research ethics, research methodology, laboratory safety, and good laboratory practices.

Evaluation:

- Course Assignment 10%
- Oral Presentation 10%
- Laboratory Skills 30%
- Laboratory Reports 50%

<u>CHEM3512</u> **<u>FOOD CHEMISTRY II</u>**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2010 - Chemical Analysis A and CHEM2011 - Chemical Analysis Laboratory I **AND** CHEM2210 - Organic Chemistry A **and** CHEM2211- Organic Chemistry Laboratory I **AND** Permission of Head of Department.

Course Content:

1. **Enzymes:** Nomenclature; catalysis; deactivation; applications in food processing; enzymes and health.
2. **Vitamins and Minerals:** Water and fat soluble vitamins; bulk and trace minerals; sources, functions and role in health; bioavailability, effects of processing; vitamin and mineral supplementation of foods; toxicity.
3. **Pigments and Flavours:** Natural and artificial colourants, dyes and lakes; flavours and flavourings; chemistry and physiology of taste and saporous substances; flavour enhancement.
4. **Food Additives:** Classes and applications; safety considerations.
5. **Toxicants and Allergens:** Sources, properties and chemistry; effects on consumer; effect of processing; measures for elimination or reduction of levels in foods.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - In-course Tests (*an assignment may be given*) 40%

CHEM3513 **FOOD SAFETY AND QUALITY ASSURANCE**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM2510 - Food Processing Principles I **or** CHEM2512 - Food Processing Principles II **AND** Permission of Head of Department. *Preference will be given to students majoring in Food Chemistry.*

Course Content:
1. **Quality Assurance and Quality Control:** Food laws and regulations; Codex Alimentarius; food standards; food quality and food safety.
2. **Quality Assurance Systems:** Total Quality Management; ISO9000; HACCP; Quality by Design (QbD).
3. **Prerequisite Programmes for Food Safety:** Good Manufacturing Practices; Sanitation; Facilities & equipment; Personnel training; Traceability & recall; Transport & receiving; Chemical control; Production & Process control.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - In-course Tests 20%
  - Assignment 20%

CHEM3610 **MARINE AND FRESHWATER CHEMISTRY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
CHEM2010 - Chemical Analysis A **and** CHEM2011 - Chemical Analysis Laboratory I **AND** any one of the following:
CHEM2110 - Inorganic Chemistry A, CHEM2210 - Organic Chemistry A,
CHEM2310 - Physical Chemistry A **or** CHEM3010 - Chemical Analysis B.
Preference will be given to students pursuing a major in Environmental Chemistry.

Course Content:
Introduction to the Evolution, Structure & Composition of Planet Earth; Water and Rock cycles; Biogeochemical cycles; Characteristics of water bodies; Acidity and metals: Acid-base properties of water bodies; the $CO_3^{2-}/HCO_3^-/CO_2$ (aq) system; Inorganic C speciation; Henry's law and its applications; pH of rain water; photosynthesis and ocean acidification; Redox equilibria; redox speciation

diagrams; Nutrients and Organics: Natural and anthropogenic sources; Adsorption - desorption processes; eutrophication; humic and fulvic acids; Persistent organic pollutants; emerging organic pollutants; Sampling and analytical methods.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests/Assignments 40%

CHEM3611 **ENVIRONMENTAL CHEMISTRY LABORATORY**
(2 Credits) (Level 3) (Semester 1)

Co-requisite:
CHEM3610 - Marine and Freshwater Chemistry **AND** Permission of Head of Department. *Preference will be given to students majoring in Environmental Chemistry.*

Course Content:
Interactive workshops on environmental sampling: sample preservation, conducting field observations and measurements, structuring of field reports; Guided review of the Hermitage Sewage Treatment plant and the UWI Water Re-use programme; Team-based collection of treated effluent samples from Lake Sidrack over a 4-week period and cycling through various analyses (to include P, N, pH/ANC and cations); Collection of soil samples exposed to irrigation with tertiary-treated effluent and, for comparison, agricultural soil and soil exposed only to rainfall; Team-based analyses of soils over a 4-week period (to include: CEC and pH, P, N, Na, K, Ca, Mg, trace metals and heavy metals (via XRF & INAA), mineralogy (XRD), particle size and colour).

Evaluation:

- Laboratory Reports 60%
- Technical Reports (two at 20% each) 40%

CHEM3612 **ATMOSPHERIC CHEMISTRY AND BIOGEOCHEMICAL CYCLES**
(6 credits) (Level 3) (Semester 2)

Pre-requisites:
CHEM3610 - Marine and Freshwater Chemistry **AND** Permission of Head of Department. *Preference will be given to students majoring in Environmental Chemistry.*

Course Content:

1. **Atmospheric Chemistry:** Atmospheric composition and structure; Atmospheric pollution: Global warming; Acid rain; Photochemical mog; Ozone depletion and global treaties.
2. **Environmental Models, Management and Regulations:** Use of Models in Atmospheric Chemistry, Air pollution and management; Air quality standards and pollution monitoring pollution.
3. **Biogeochemical Cycles:** Nutrient cycles: P, N, Si, C, O. Metal cycles: toxic and essential metals; fluxes, residence times, sources and industrial uses; sampling and analytical methods.
4. **Organic Materials:** Biomolecules, their structure, degradation and impacts; pesticides, herbicides, fungicides and emerging pollutants.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Project 15%
    - Field Trip Report 15%
    - In-course Tests 20%

CHEM3621 **MARINE AND FRESHWATER CHEMISTRY FIELD COURSE**
(2 credits) (Semester 2) (Level 3)

Pre-requisites:
CHEM3610 - Marine and Freshwater Chemistry **AND** Permission of Head of Department. *Preference will be given to students majoring in Environmental Chemistry.*

Course Content:
An introductory workshop on the status of Jamaica's environment, objectives of the course and student responsibilities; A five-day encampment at the UWI Discovery Bay Marine Laboratory; Observation of environmental conditions and

biological activities within Discovery Bay; Collection and analysis of water samples in Discovery Bay; assessment of results; Study of the Rio Cobre between Ewarton and Spanish Town; Five days of analytical and field work while based on the Mona Campus; Analyse samples collected from the Rio Cobre; collate and assess water quality data; Field trip to the Port Royal mangroves. Take in-field measurements of water parameters; view and qualitatively assess sediment and biological activities.

Evaluation:

- Literature Review 10%
- In-course Test 20%
- Field Reports 30%
- Data Interpretation Reports 40%

CHEM3711 **CHEMISTRY UNDERGRADUATE RESEARCH PROJECT**
(6 Credits) (Level 3) (Semesters 1 & 2 or 2 & 3)

Pre-requisites:
Majoring in Chemistry; Completion of all compulsory Level 2 courses and at least 6 credits from Level 3 and Head of Department Approval. It is recommended that in the semester prior to enrolling in this course candidates discuss suitable topics with potential academic supervisors.

Course Content:
Research methods and Ethics. Use of chemical literature. Experiment design; Advanced instrumental and chemical investigation techniques. Investigation of an approved chemical research question; Preparation of written and oral scientific reports; Students will be required to spend at least 6 hours per week in the laboratory for about 22 weeks.

Evaluation:

- Course Work: 40%
    - Research Notebook 10%
    - 2 Progress Reports 10%
    - Supervisor's Assessment 20%
- Oral Examination 20%
- Research Report 40%

DEPARTMENT OF COMPUTING

PROGRAMMES

Majors and B.Scs.

1. Computer Science (Major)
2. Computer Studies (B.Sc.)
3. Computer Systems Engineering (B.Sc.)
   *Not being offered 2018/2019
4. Information Technology (B.Sc.)
5. Software Engineering (Major)

Minors

1. Computer Science
2. Information Technology
3. Software Engineering

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
LEVEL 1				
COMP1126	Introduction to Computing I	3	1 or 2	Any one of the following: CAPE (or A-level) Science subject ECON1003, Teacher's College Diploma or Assoc. Degree in Mathematics or Science or Information Technology
COMP1127	Introduction to Computing II	3	1 or 2	Any one of the following: CAPE (or A-level) Science subject ECON1003, Teacher's College Diploma or Assoc. Degree in Mathematics or Science or Information Technology
COMP1161	Object-Oriented Programming	3	1 or 2	COMP1126 and COMP1127
COMP1210	Mathematics for Computing	3	1 or 2	CSEC Mathematics
COMP1220	Computing and Society	3	1 or 2	None
LEVEL 2				
COMP2130	Systems Programming	3	2	COMP1126, COMP1127 and COMP1161

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
COMP2140	Software Engineering	3	1	COMP1126, COMP1127 and COMP1161
COMP2171	Object Oriented Design and Implementation	3	2	COMP2140
COMP2190	Net-Centric Computing	3	1	COMP1126, COMP1127, COMP1161, and (COMP1210 or MATH1152) May not be credited with COMP3150(CS32Q)
COMP2201	Discrete Mathematics for Computer Science	3	1	COMP1210 or MATH1152
COMP2211	Analysis of Algorithms	3	2	COMP1126, COMP1127, COMP1161 and COMP1210
COMP2340	Computer Systems Organization	3	2	COMP1126, COMP1127, COMP1161 and COMP1210
INFO2100	Mathematics And Statistics for IT	3	2	COMP1210
INFO2110	Data Structures for IT	3	1	COMP1126, COMP1127 and COMP1161
INFO2180	Dynamic Web Development 1	3	1	COMP1126, COMP1127 and COMP1161
LEVEL 3				

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
COMP3101	Operating Systems	3	1	COMP2340
COMP3161	Database Management Systems	3	2	COMP1210, COMP1126, COMP1127 and COMP1161
COMP3191	Principles of Computer Networking	3	1	COMP2190
COMP3192	Implementation of Computer Networks	3	2	COMP3191
COMP3220	Principles of Artificial Intelligence	3	1	COMP2211 and COMP2201
COMP3410	Introduction to Parallel Computing	3	2	COMP2211 or COMP2201 and COMP2340
COMP3652	Language Processors	3	1	COMP2211
COMP3702	Theory of Computation	3	2	COMP2201
COMP3801	Real-Time Embedded Systems	3	1	COMP2340 and COMP2140
COMP3901	Capstone Project	3	2 and 3	COMP2140, COMP2211, and Any 6 credits of Level 2 or 3 Computing code courses
COMP3911	Internship in Computing I	3	1, 2 or 3	Permission of the Head of Department
COMP3912	Internship in Computing II	6	1, 2 or 3	Permission of the Head of Department

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
INFO3105	Computer System Administration	3	1	COMP2340 and COMP2190
INFO3110	Information Systems	3	2	COMP2140 and COMP2190
INFO3155	Information Assurance And Security	3	2	COMP2190 and (COMP2201 or INFO2100)
INFO3170	User Interface Design For IT	3	1	COMP2140 or INFO2180
INFO3180	Dynamic Web Development II	3	2	INFO2180
INFO3435	Ecommerce	3	2	COMP2140 and INFO2180
SWEN2165	Requirements Engineering	3	2	COMP2140 or SWEN1007
SWEN3130	Software Project Management	3	1	COMP2140
SWEN3145	Software Modeling	3	1	COMP2140 and COMP2171
SWEN3165	Software Testing	3	2	COMP2140 and COMP2171
SWEN3185	Formal Methods And Software Reliability	3	2	COMP2201

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
LEVEL 1				
COMP1126	Introduction to Computing I	3	1 or 2	Any one of the following: CAPE (or A-level) Science subject ECON1003, Teacher's College Diploma or Assoc. Degree in Mathematics or Science or Information Technology
COMP1127	Introduction to Computing II	3	1 or 2	Any one of the following: CAPE (or A-level) Science subject ECON1003, Teacher's College Diploma or Assoc. Degree in Mathematics or Science or Information Technology
COMP1161	Object-Oriented Programming	3	1 or 2	COMP1126 and COMP1127
COMP1210	Mathematics for Computing	3	1 or 2	CSEC Mathematics
COMP1220	Computing and Society	3	1 or 2	None
LEVEL 2				
COMP2130	Systems Programming	3	2	COMP1126, COMP1127 and COMP1161

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
COMP2140	Software Engineering	3	1	COMP1126, COMP1127 and COMP1161
COMP2171	Object Oriented Design and Implementation	3	2	COMP2140
COMP2190	Net-Centric Computing	3	1	COMP1126, COMP1127, COMP1161, and (COMP1210 or MATH1152) May not be credited with COMP3150(CS32Q)
COMP2201	Discrete Mathematics for Computer Science	3	1	COMP1210 or MATH1152
COMP2211	Analysis of Algorithms	3	2	COMP1126, COMP1127, COMP1161 and COMP1210
COMP2340	Computer Systems Organization	3	2	COMP1126, COMP1127, COMP1161 and COMP1210
INFO2100	Mathematics And Statistics for IT	3	2	COMP1210
INFO2110	Data Structures for IT	3	1	COMP1126, COMP1127 and COMP1161
INFO2180	Dynamic Web Development 1	3	1	COMP1126, COMP1127 and COMP1161
LEVEL 3				

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
COMP3101	Operating Systems	3	1	COMP2340
COMP3161	Database Management Systems	3	2	COMP1210, COMP1126, COMP1127 and COMP1161
COMP3162	Data Science Principles	3	2	COMP2201 OR INFO2100 [and] COMP2211 OR INFO2110
COMP3191	Principles of Computer Networking	3	1	COMP2190
COMP3192	Implementation of Computer Networks	3	2	COMP3191
COMP3220	Principles of Artificial Intelligence	3	1	COMP2211 and COMP2201
COMP3410	Introduction to Parallel Computing	3	2	COMP2211 or COMP2201 and COMP2340
COMP3652	Language Processors	3	1	COMP2211
COMP3702	Theory of Computation	3	2	COMP2201
COMP3801	Real-Time Embedded Systems	3	1	COMP2340 and COMP2140
COMP3901	Capstone Project	3	2 and 3	COMP2140, COMP2211, and Any 6 credits of Level 2 or 3 Computing code courses

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
COMP3911	Internship in Computing I	3	1, 2 or 3	Permission of the Head of Department
COMP3912	Internship in Computing II	6	1, 2 or 3	Permission of the Head of Department
INFO3105	Computer System Administration	3	1	COMP2340 and COMP2190
INFO3110	Information Systems	3	2	COMP2140 and COMP2190
INFO3155	Information Assurance And Security	3	2	COMP2190 and (COMP2201 or INFO2100)
INFO3170	User Interface Design For IT	3	1	COMP2140 or INFO2180
INFO3180	Dynamic Web Development II	3	2	INFO2180
INFO3435	Ecommerce	3	2	COMP2140 and INFO2180
SWEN2165	Requirements Engineering	3	2	COMP2140 or SWEN1007
SWEN3130	Software Project Management	3	1	COMP2140
SWEN3145	Software Modeling	3	1	COMP2140 and COMP2171
SWEN3165	Software Testing	3	2	COMP2140 and COMP2171

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
SWEN3185	Formal Methods And Software Reliability	3	2	COMP2201
SWEN3920	Capstone Project (Software Engineering)	6	1 , 2 or 3	COMP2140, SWEN3130, SWEN3145,

COMPUTER SCIENCE (MAJOR)		
	A major in Computer Science requires a total of fifteen (15) Level 1 credits from:	
Introductory Courses (Level 1)	COMP1210	Mathematics for Computing
	COMP1220	Computing and Society
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	A major in Computer Science requires a minimum of thirty-nine (39) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	COMP2211	Analysis of Algorithms
	COMP2201	Discrete Mathematics for Computer Science
	COMP2140	Software Engineering
	COMP2340	Computer Systems Organization
	COMP2171	Object Oriented Design and Implementation
	COMP2190	Net-Centric Computing
	COMP3101	Operating Systems
	COMP3220	Principles of Artificial Intelligence
	COMP3161	Introduction to Databases
	COMP3901	Capstone Project

COMPUTER STUDIES (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Computer Studies requires a total of thirty-six (36) Level 1 credits from:**	
	COMP1220	Computing and Society (optional)
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	ECON1000	Principles of Economics I
	ECON1012	Principles of Economics II
	Either	
	ACCT1005 & ACCT1003 **OR**	Financial Accounting & Introduction to Cost & Management Accounting
	SOCI1002 & PSYC1002	Sociology for the Caribbean & Introduction to Industrial/Organizational Psychology
Advanced Courses (Levels 2 and 3)	**A B.Sc in Computer Studies requires a minimum of thirty-three (33) credits from Levels 2 and 3 and must include:**	
	COMP2211	Analysis of Algorithms
	COMP2201	Discrete Mathematics for Computer Science
	COMP2140	Software Engineering
	COMP2171	Object Oriented Design and Implementation
	COMP2190	Net-Centric Computing
	COMP2340	Computer Organization
	COMP3101	Operating Systems
	COMP3110	Information Systems
	COMP3161	Database Management Systems
	COMP3220	Principles of Artificial Intelligence
	COMP3901	Capstone Project

AND twenty-seven (27) credits from Levels 2 or 3 courses offered by Computing, Mathematics, Economics or Management Studies.

COMPUTER SYSTEMS ENGINEERING (B.Sc.) [Non-UGC Funded] *Not being Offered 2018/2019*		
Introductory Courses (Level 1)	**A B.Sc. in Computer Systems Engineering requires a total of thirty-four (34) Level 1 credits from:**	
		Semester 1
	ECNG1000	Mathematics for Computing
	ENGR1000	Introduction to Engineering
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	MATH1180	Engineering Mathematics 1
	COMP1220	Computing and Society
		Semester 2
	ECNG1012	Electrical Circuits
	ELET1400	Introduction to Electronics
	ELET1405	Practices in Basic Electronics
	ELNG1101	Physics for Engineers
	COMP1161	Object-Oriented Programming
Advanced Courses (Levels 2 and 3)	**A B.Sc. in Computer Systems Engineering requires a minimum of sixty-one (61) credits from Levels 2 and 3 credits and must include:**	
		Level 2: Semester 1
	ELET2405	Practices in Electronics Design I
	ELET2430	Digital Circuits and Microprocessors
	ELET2450	Embedded Systems
	COMP2190	Net-Centric Computing
	COMP2201	Discrete Mathematics for Computer Science
	COMP2140	Software Engineering
		Level 2: Semester 2
	INFO2180	Dynamic Web Development I
	COMP2211	Analysis of Algorithms

	MATH2201	Probability and Statistics for Engineers
	COMP2130	System Programming
	INFO3105	Computer Systems and Administration
	COMP3911 (summer school)	Internship in Computing I
	Level 3: Semester 1	
	ELET2460	Signal and Systems
	COMP3101	Operating Systems
	COMP3191	Principle of Computer Networking
	INFO3180	Dynamic Web Development II
	ECNG3021	Introduction to Engineering Management and Accounting Systems
	INFO3155 (elective)	Information Assurance and Security
	ELET3485 (elective)	Introduction to Robotics
	Level 3: Semester 2	
	COMP3801	Real Time Embedded Systems
	COMP3901	Capstone Project
	MGMT3136	New Venture Creation and Entrepreneurship
	ECNG3016 (elective)	Advanced Digital Electronics
	MATH2230 (elective)	Engineering Mathematics

INFORMATION TECHNOLOGY (B.Sc.)		
	A B.Sc. in Information Technology requires a total of fifteen (15) Level 1 credits from:	
Introductory Courses (Level 1)	COMP1210	Mathematics for Computing
	COMP1220 (elective)	Computing and Society
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	A B.Sc. in Information Technology requires a minimum of forty-two (42) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	INFO2100	Mathematics and Statistics for IT
	INFO2110	Data Structures for IT
	COMP2140	Software Engineering
	INFO2180	Web Design and Programming I
	COMP2190	Net-Centric Computing
	COMP2340	Computer Systems Organization
	INFO3105	Computer Systems and Administration
	INFO3110	Information Systems
	INFO3155	Information Assurance and Security
	COMP3161	Database Management Systems
	INFO3170	User Interface Design for IT
	INFO3180	Dynamic Web Development II
	COMP3901	Capstone Project
	AND three credits from Levels 2 or 3 courses offered by Department of Computing plus eighteen credits from any discipline including Computing.	

SOFTWARE ENGINEERING (MAJOR)		
Introductory Courses (Level 1)	**A major in Software Engineering requires a total of fifteen (15) Level 1 credits from:**	
	COMP1210	Mathematics for Computing
	COMP1220	Computing and Society
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
Advanced Courses (Levels 2 and 3)	**A major in Software Engineering requires a minimum of thirty-nine (39) credits from Levels 2 and 3 and must include:**	
	COMP2140	Software Engineering
	COMP2171	Object Oriented Design and Implementation
	COMP2190	Net-Centric Computing
	COMP2201	Discrete Mathematics for Computer Science
	COMP2211	Analysis of Algorithms
	SWEN3130	Software Project Management
	SWEN3145	Software Modeling
	SWEN3165	Software Testing
	SWEN3185	Formal Method and Software Reliability
	SWEN3920	Capstone Project (Software Engineering)
	COMP3911	Internship in Computing

COMPUTER SCIENCE (MINOR)		
Introductory Courses (Level 1)	**A minor in Computer Science requires a total of twelve (12) Level 1 credits from:**	
	COMP12	Mathematics for Computing
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP11	Object-Oriented Programming
Advanced Courses (Levels 2 and 3)	**A minor in Computer Science requires a minimum of fifteen (15) credits from Levels 2 and 3 and must include:**	
	COMP2201	Discrete Mathematics for Computer Science
	COMP2340	Computer Systems Organization
	AND any three courses from below:	
	COMP2010	Probability and Statistics for Computing
	COMP2120	Digital Logic Design
	COMP2130	Systems Programming
	COMP2140	Software Engineering
	COMP2171	Object Oriented Design and Implementation
	COMP2190	Net-Centric Computing
	COMP2211	Analysis of Algorithms
	COMP3101	Operating Systems
	COMP3911	Internship in Computing
	COMP3220	Principles of Artificial Intelligence
	COMP3652	Language Processors
	COMP3702	Theory of Computation
	COMP3801	Real-Time Embedded Systems

INFORMATION TECHNOLOGY (MINOR)		
Introductory Courses (Level 1)	**A minor in Information Technology requires a total of twelve (12) Level 1 credits from:**	
	COMP1210	Mathematics for Computing
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
Advanced Courses (Levels 2 and 3)	**A minor in Information Technology requires a minimum of fifteen (15) credits from Levels 2 and 3 and must include:**	
	INFO2110	Data Structures for IT
	COMP2190	Net-Centric Computing
	AND any three courses from below:	
	INFO2100	Mathematics and Statistics for IT
	INFO2180	Dynamic Web Development I
	INFO3105	Computer Systems and Administration
	INFO3155	Information Assurance and Security
	INFO3170	User Interface Design for IT
	INFO3180	Dynamic Web Development II
	INFO3435	eCommerce

SOFTWARE ENGINEERING (MINOR)		
Introductory Courses (Level 1)	**A minor in Software Engineering requires a total of twelve (12) Level 1 credits:**	
	COMP1210	Mathematics for Computing
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
Advanced Courses (Levels 2 and 3)	**A minor in Software Engineering requires a minimum of fifteen (15) credits from Level 2 and 3 and must include:**	
	COMP2140	Software Engineering
	COMP2171	Object Oriented Design and Implementation
	AND any three courses from below:	
	COMP2201	Discrete Mathematics for Computer Science
	SWEN3130	Software Project Management
	SWEN3145	Software Modeling
	SWEN3165	Software Testing
	SWEN3185	Formal Method and Software Reliability

COURSE DESCRIPTIONS

COMP1126 **INTRODUCTION TO COMPUTING I**
(3 Credits) (Level 1) (Semesters 1 or 2)

Pre-requisites:
A CAPE (Units 1 and 2 {or A-level}) Science subject, ECON1003, Teacher's College Diploma, Associate Degree in Mathematics or Science **OR** Information Technology.

Course Content:

1. **History of Programming Languages:** Brief survey of programming paradigms.
2. Building Abstractions.
3. **Computational Processes:** Primitive Operations, Special Forms for naming, conditional execution, Procedures as sequences of operations, Recursion and Iteration, Lexical scoping and Nested Procedures.
4. **Higher-order Procedures:** Customising Procedures with procedural arguments.
5. Creating new functions at run-time.
6. **Compound Data**: Pairs and Lists.

Evaluation:

- Final Examination (2 hours) 60%
- Coursework: 40%
    - 1 Quiz 5%
    - 1 In-course Test (1 hour) 10%
    - 5 Laboratories 10%
    - 1 Written Assignment/ Programming Project 15%

COMP1127 **INTRODUCTION TO COMPUTING I**

(3 Credits) (Level 1) (Semesters 1 or 2)

Pre-requisite:

A CAPE (Units 1 and 2 {or A-level}) Science subject, ECON1003, Teacher's College Diploma, Associate Degree in Mathematics or Science **OR** Information Technology.

Course Content:

1. **Building Abstractions:** Compound Data (Lists and Trees); Abstract Data Types.
2. **Controlling Interactions:** Generic operations; Self-Describing Data; Message Passing; Streams and Infinite Data Structures; Object-oriented Programming.

Evaluation:

- Final Examination (2 hours) 60%
- Coursework: 40%
  - 2 Quizzes 5%
  - 1 In-course Test (1 Hour) 10%
  - 5 Laboratories 10%
  - 1 Written Assignment/ Programming Project 15%

COMP1161 **OBJECT-ORIENTED PROGRAMMING**

(3 Credits) (Level 1) (Semesters 1 or 2)

Pre-requisites:

COMP1126 - Introduction to Computing I **AND** COMP1127 - Introduction to Computing II.

Course Content:

1. **Object-Oriented Programming:** Objects and Classes (Methods, Message Passing, Instance And Class Variables); Encapsulation and Information-Hiding; Imperative Control Structures, Assignment/State, Parameter Passing Models; Primitive Types, Inheritance, Polymorphism, Class Hierarchies; Object Composition; Abstract and Concrete Classes; Interfaces. Templates; Using APIS, Class Libraries, Modules/Packages; Array And String Processing; I/O Processing; Concept of Object References and Aliases; Collection Classes and Iterators; OO Testing. Debugging Tools.

2. **Graphics and GUI Programming, Web Concepts and Objects:** Introduction to GUI programming; Event-driven programming; Exception handling; Use of simple graphical libraries; and simple animation programming; Simple HTML-embedded objects such as applets.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - 3 Laboratories 5%
    - 2 In-course Tests (1 hour each) 15% (5% & 10%)
    - 3 Projects 30% (10% each)

COMP1210 **MATHEMATICS FOR COMPUTING**

(3 Credits) (Level 1) (Semesters 1 or 2)

Pre-requisite:

CSEC Mathematics.

Course Content:

Propositional Logic; Logical Connectives; Truth Tables; Normal Forms (Conjunctive And Disjunctive); Validity; Predicate Logic; Universal and Existential Quantification; Modus Ponens and Modus Tollens; Limitations of Predicate Logic; Functions (Surjections, Injections, Inverses, Composition); Relations (Reflexivity, Symmetry, Transitivity, Equivalence Relations); Sets (Venn Diagrams, Complements, Cartesian Products, Power Sets); Pigeonhole Principle; Cardinality and Countability; Finite Probability Space, Probability Measure, Events; Conditional Probability, Independence; Trees, Undirected Graphs, Directed Graphs, Spanning Trees/Forests.

Evaluation:

- Final Examination (2 hours) 60%
- Coursework: 40%
    - 1 In-course Test 10%
    - 3 Assignments/Quizzes 30% (10% each)

COMP1220 **COMPUTING AND SOCIETY**

(3 Credits) (Level 1) (Semesters 1 or 2)

Pre-requisite:
None.

Course Content:

1. **History of Computing:** History of computer hardware, software, networking; Regional computing history; Pioneers of computing. Contributions of region and of other developing countries.
2. **An Overview of Computing:** How hardware, software, and networks work at a conceptual level; use and high-level construction of computing artefacts, e.g. simple webpages, animations, robotics programs; Sub-disciplines within Computing: Computer Science, IT, IS, etc.; he global computing industry and its impact on industry and society; The use of computing in enterprise, entrepreneurship, various disciplines and careers.
3. **Social Context of Computing:** Social implications of computing and networked communication in general and on youth, e.g. cultural, self-image, possible effects of videogames; Understanding the social and cultural context of design; Understanding the potential of computing to transform society positively, globally or regionally, or to exacerbate inequalities or mask underdevelopment; Analysis of the government and business policies of developing and developed countries with successful computing industries; Accessibility issues in computing professions (e.g. class, culture, ethnicity, gender, disabled); Public policy issues (e.g. cyber-crime, privacy, electronic voting); Growth and control of and access to the Internet; Environmental Issues and Computing, e.g. e-waste, green computing.
4. **Professional Ethics in Computing:** Making and evaluating ethical choices and arguments, identifying assumptions and values; The nature of professionalism (including care, attention and discipline, fiduciary responsibility, and mentoring); Keeping up-to-date as a professional (in terms of knowledge, tools, skills, legal and professional framework as well as the ability to self-assess and computer fluency); Various forms of professional credentialing and the advantages and disadvantages; The role of the professional in public policy; Maintaining awareness of consequences of decisions; Introduction to ethics, ethical dissent and whistle-blowing; Codes of ethics, conduct, and practice (IEEE, ACM, SE, and so forth); Harassment and discrimination, “Acceptable use” policies for computing in the workplace; Healthy computing environment (ergonomics).

5. **Risks of Computing Products:** Historical examples of software risks (such as the Therac-25 case); Implications of software complexity on risk. The limits of computing.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - 2 Tutorial Presentations 20% (10% each)
    - 3 Written Assignments 30% (10% each)

COMP2130 **SYSTEMS PROGRAMMING**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I **AND** COMP1161- Object-Oriented Programming.

Course Content:

1. **Introduction to Computer Systems and UNIX Development Tools:** C Basics, UNIX development tool (gcc, gdb)**;** Using system libraries**;** Bits, bytes, and bitwise operators; Data structure and object implementation in C and C++; C pointers and arrays, C strings, malloc, realloc, and free as raw memory allocators Linked structures in C, C++; Data type and polymorphism, the void *, function pointers, and generic functions; Floating point representation.
2. **Assembly Code:** Introduction to IA32, ALU operations, addressing, arithmetic, opcodes; Using gcc to generate your compilation product; Analysing compiled programs with gdb to understand the layout of data, functions, function calls, parameters, dynamic memory, etc.; Control function calls, runtime stack, passing by value and by address; C++ methods, the this pointer, references, RTTI, runtime and memory model for C++ objects and methods; Calling service routines.
3. **Memory Layout, Synthesis, and Execution of a UNIX Process:** Address spaces, implementations of malloc, realloc, and free; The compilation tool chain, linkers, loaders, and address space; Memory hierarchies, caches, locality, and pipelining; Programming for optimal use of caches and virtual memory; Writing simple optimised code, using gdb and profilers to analyse simple optimised compile programs; Heap allocation, implementation, and garbage collectors.
4. **Foreign Function Calls,** e.g., Java Native Interface (JNI).

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - 5 Assessed Tutorials 5%
    - In-course Examination, (1 hour) 10%
    - 10 Assessed Laboratories 10%
    - 3 Programming Exercises 25%

COMP2140 **SOFTWARE ENGINEERING**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I **AND** COMP1161- Object-Oriented Programming.

Course Content:

1. **Software Design:** Fundamental design concepts and principles; The role and the use of contracts; Structured design; Design qualities; Internal - including low coupling, high cohesion, information hiding, efficiency; External - including reliability, maintainability, usability, performance.
2. **Using APIs:** Programming using APIs.
3. **Tools and Environments:** Programming environments; Requirements analysis and design modelling tools; Testing tools including static and dynamic analysis tools; Tools for source control, and their use in particular in team-work; Configuration management and version control tools; Tool integration mechanisms.
4. **Software Processes:** Software life-cycle and process models; Software process capability maturity models; Approaches to process improvement; Process assessment models; Software process measurements.
5. **Requirements Specifications:** Systems level considerations; Software requirements elicitation; Requirements analysis modelling techniques; Functional and non-functional requirements; Acceptability of certainty/uncertainty considerations regarding software / system behaviour; Prototyping.
6. **Software Verification Validation:** Distinguishing between verification and validation; Static approaches and dynamic approaches; Validation planning; documentation for validation; Different kinds of testing – human computer interface, usability, reliability, security, conformant to specification; Testing fundamentals, including test plan creation and

test case generation black-box and white-box testing techniques; Defect seeding; Unit, integration, validation, and system testing; Measurements: process, design, program; Verification and validation of non-code (documentation, help files, training materials); Fault logging, fault tracking and technical support for such activities; Regression testing; Inspections, reviews, audits.

7. **Software Evolution:** Software maintenance; Characteristics of maintainable software; Reengineering Legacy systems; Refactoring.
8. **SE/Software Project Management:** Team management; Team processes; Team organization and decision-making; Roles and responsibilities in a software team; Role identification and assignment; Project tracking; Team problem resolution; Project scheduling; Software measurement and estimation techniques; Risk analysis (The issue of security, High integrity systems, safety critical systems, The role of risk in the life cycle); Software quality assurance (The role of measurements); Software configuration management and version control; release management; Project management tools; Software process models and process measurements.
9. **Professional Ethics:** Community values and the laws by which we live; The nature of professionalism (including care, attention and discipline, fiduciary responsibility, and mentoring); Keeping up-to-date as a professional (in terms of knowledge, tools, skills, legal and professional framework as well as the ability to self-assess and computer fluency); Various forms of professional credentialing and the advantages and disadvantages**;** The role of the professional in public policy**;** Maintaining awareness of consequences**;** Ethical dissent and whistle-blowing**;** Codes of ethics, conduct, and practice (IEEE, ACM, SE, AITP, and so forth)**;** Dealing with harassment and discrimination**;** "Acceptable use" policies for computing in the workplace**;** Healthy computing environment (ergonomics).
10. **Risks:** Historical examples of software risks (such as the Therac-25 case); Implications of software complexity; Risk assessment and risk management; risk removal, risk reduction and risk control.

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%

  One Software Development Group Project
  - Requirements Documentation 15%
  - Design Model (e.g., UML diagrams) 15%
  - Presentations (10) using relevant tools, e.g. PowerPoint 15%
  - Final Presentation of Implemented System 15%

COMP2171 **OBJECT ORIENTED DESIGN AND IMPLEMENTATION**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
COMP1161 - Object-Oriented Programming **AND** COMP2140 - Software Engineering.

Course Content:

1. Fundamentals of Object Orientation, Abstraction, Encapsulation, Information hiding, Coupling, Cohesion, Law of Demeter.
2. **Identifying Classes**: Domain Analysis, Systems Analysis, Class/Responsibility/Collaboration Cards (CRC Cards), Noun Verb Analysis.
3. **Identifying Class Relationships**: Dependencies, Associations, Aggregations, Compositions, Association Classes.
4. **Objects and relationships between objects**: Links and object diagrams.
5. **Modelling**: History of Modelling, Modelling Benefits, Agile Modelling, UML Diagrams: Use Case, Sequence, Communication, State, Activity, Class, Component, Deployment, Timing etc., Views: 4+1 views, Dynamic vs. Static etc. Design Patterns, Object Constraint Language.
6. **Tools:** e.g. Rational Software Architect, StarUML, Enterprise Architect, Visual Paradigm, Validating models, Other useful features of modelling tools.
7. **Software Architecture**: Definition, rationale, benefits, business and technical impact etc., Architectural patterns Emerging Topics in Object Oriented Design, Model Driven Engineering.

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - Online Activities 10%
    - In-course Test 15%
    - Group Presentations 35%

COMP2190 **NET CENTRIC COMPUTING**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I, COMP1161 - Object-Oriented Programming **AND** COMP1210 - Mathematics for Computing **or** MATH1152 - Introduction to Formal Mathematics). May not be credited with COMP3150 - Computing Networking and Communications.

Course Content:

1. **Introduction:** Background and history of network and the Internet; Network architectures; Networks and protocols; Client/server and peer-to-peer paradigms; Mobile and wireless computing.
2. **Network Communication:** Network standards and standardization bodies; The ISO 7-layer reference model in general and its instantiation in TCP/IP; Overview of physical and data link layer concepts (framing, error control, flow control, and protocols); Data link layer access control concepts; Internetworking and routing (routing algorithms, internetworking, and congestion control); Transport layer services (connection establishment, performance issues, flow and error control); Web protocols with particular emphasis on HTTP.
3. **Distributed Computing.**
4. **Network Security:** Fundamentals of cryptography (Secret-key algorithms, Public-key algorithms); Authentication protocols, Network attack types, e.g., denial of service, flooding, sniffing, and traffic redirection; Basic network defence tools and strategies (Intrusion detection, Firewalls, Detection of malware, Kerberos, IPSec, Virtual Private Networks, Network Address Translation).
5. **Web Technologies:** Basic server-side programs (php, MySQL)**,** Basic client-side scripts (XHTML, XML, JavaScript, CSS)**,** Nature of the client-server relationship**,** Support tools for Web site creation and Web management.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
  - 7 Quizzes 5%
  - In-course Examination (1 hour) 10%
  - 2 Assignments 10%
  - 2 Projects 25%

COMP2201 **DISCRETE MATHEMATICS FORCOMPUTER SCIENCE**
(3 Credits) (Level 2) (Semester 1)

Pre-requisite:
COMP1210 - Mathematics for Computing **OR** MATH1152 - Introductions to formal Mathematics.

Course Content:

1. **Basics of Counting:** Arithmetic and geometric progressions; Fibonacci numbers; The pigeonhole principle; Basic definitions; Pascal's identity; The binomial theorem; The Master theorem.
2. **Asymptotic Analysis:** Limits; Orders of Growth (Big- oh O, Omega Ω and Theta Θ).
3. **Graph Theory:** Trees; Planarity; Eulerian and Hamiltonian Cycles; Matching and Colouring.
4. **Elementary Probability Theory:** Counting in event space; Probability Tree; Probability distributions; Finite probability space, probability measure, events; Conditional probability, independence, Bayes' theorem; Integer random variables, expectation; Law of large numbers.
5. **Generating Functions:** Convergence Properties; Convolution; Applications.
6. **Recurrence Relations.**
7. **Introduction to Automata, Grammars and Languages:** Finite-state machines; Context-free grammars**;** Language type classification and grammar type.

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
    - 2 Quizzes 5%
    - In-course Test (1 hour) 15%
    - 4 Assessed Homework Assignments 20%

COMP2211 **ANALYSIS OF ALGORITHMS**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I, COMP1161- Object-Oriented Programming **AND** COMP1210 - Mathematics for Computing.

Course Content:

Analysing algorithms (solving recurrence equations with the Master Theorem); Algorithm strategies (brute force, greedy, divide, and conquer, branch-and bound, heuristic; Iterated approximations (Newton = Raphson method, searching for roots of a polynomial {in one variable}); Fast exponentiation; Euclid's algorithm; Discrete logarithm; RSA cryptograph; Heaps as implementations for priority queues; Sorting; Binary search trees; Red-Black trees; Hashing; Graphs and graph algorithms; Distributed computing (introduction { consensus vs. election algorithms}); NP Basic Computability: uncomputable functions, the halting problem implicated of uncomputability.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - 1 In-course Examination 10%
    - 3 Written Homework Assignments 40%

COMP2340 **COMPUTER SYSTEMS ORGANIZATION**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I, COMP1161- Object-Oriented Programming **AND** COMP1210 - Mathematics for Computing.

Course Content:

1. **Data Representation and Digital Logic:** Overview of the history of the digital computer; Introduction to digital logic (logic gates, flip-flops, circuits); Representation of numeric data (floating point); Range, precision, and errors in floating-point arithmetic; Characters, pointers, strings, composite data (arrays, lists, objects).

2. **The Microarchitecture Level:** The functional units of the processor (adders, ALU's, registers, buses); Data paths, microinstructions, the control unit; Hardwired controllers and micro-coded controllers.
3. **Instruction Set Architectures:** Introduction to instruction set architecture, microarchitecture and system architecture; Processor architecture (instruction types, register sets, addressing modes); Processor structures (memory-to-register and load/store architectures); Instruction sequencing, flow-of-control, subroutine call and return mechanisms; Structure of machine-level programs; Limitations of low-level architectures; Low-level architectural support for high-level languages; Translation (compiling, assembling, linking, loading).
4. **Peripherals and Protocols:** I/O fundamentals: handshaking and buffering; polling; Interrupt mechanisms: vectored and prioritized, interrupt acknowledgment; Buses: protocols, arbitration, direct-memory access (DMA), Examples of modern buses: e.g., PCIe, USB, Hypertransport
5. **Memory**: Storage systems and their technology (semiconductor, magnetic, optical); Memory hierarchy, latency and throughput; Cache memories: operating principles, replacement policies, multilevel cache, cache coherency; Storage standards (CD-ROM, DVD); Sound and audio, image and graphics, animation and video; Multimedia standards (audio, music, graphics, image, telephony, video, TV); The significance of power dissipation and its effects on computing structures
6. **Input/Output Devices:** Input devices: mice, keyboards (text and musical), scanners, touch-screen, voice; Video displays and printers; Input transducers (temperature, pressure, position, movement).
7. **Parallelism:** Processor and system performance measures and their limitations ; Instruction pipelining and instruction-level parallelism (ILP); Superscalar architectures; vector processors; array processors; VLIW; Multicore and multithreaded processors; GPU's and special-purpose graphics processors; Flynn's taxonomy (Multiprocessor structures and architectures); Amdahl's law.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - 5 Quizzes 5%
    - 1 In-course Test 10%
    - 6 Laboratories 15%
    - 2 Assignments 20%

INFO2100 **MATHEMATICS AND STATISTICS FOR IT**
(3 Credits) (Level 2) (Semester 2)

Pre-requisite:
COMP1210 - Mathematics for Computing.

Course Content:
Describe the difference between stochastic and deterministic analysis; Explain the purpose and nature of statistical sampling; Distinguish between the concepts of mean, median and mode, and discuss the drawbacks of each as a descriptive statistic; Calculate the mean, median and mode of a given sample of data; Calculate the standard deviation of a given sample of data; Explain, with examples, the role of probability and statistics in IT; Perform a statistical analysis of a system's performance; Analyze a statistical analysis of a system's performance and recommend ways to improve performance; Randomness, finite probability space, probability measure, events; Conditional probability, independence, Bayes' theorem; Integer random variables, expectation; Formulation of hypotheses: null and alternate hypothesis; Parametric and non-parametric tests and their applicability; Criteria for acceptance of hypotheses, significance levels; t-test, z-test, Chi-square test, and their applicability; Correlation coefficients; Linear and nonlinear regression models; Stochastic versus deterministic analysis; Purpose and nature of sampling, its uses and applications; Mean, median, mode, variance, standard deviation.

Evaluation:
- Final Examination (2 hours) 60%
- Coursework: 40%
    - 1 In-course Test (1 hour) 10%
    - 3 Assignments/Quizzes 30% (10% each)

INFO2110 **DATA STRUCTURES FOR IT**
(3 Credits) (Level 2) (Semester 1)

Pre-requisite:
COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I **AND** COMP1161- Object-Oriented Programming.

Anti-requisite:
COMP2211 - Analysis of Algorithms.

Course Content:
Primitive types; Arrays; Records; Strings and string Processing; Data representation in Memory; Pointers and References; Linked Structures; Knowledge of Hashing Function; Use of Stacks, Queues; Use of Graphs and Trees; Strategies for choosing the right Data Structure.

Evaluation:

- Final Examination (2 hours) 60%
- Coursework: 40%
    - 1 In-course test (1 hour) 5%
    - 3 Written assignments 15% (5% each)
    - 2 Programming projects 20% (10 each)

INFO2180 **DYNAMIC WEB DEVELOPMENT I**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I **AND** COMP1161- Object-Oriented Programming.

Course Content:
Networking concepts, Internet protocols - TCP/IP. DNS, MIME types; XHTML, dynamic XHTML, CSS, DOM. XML, XSLT; Overview of website design principles (requirements, concept design, implementation, testing); Overview of website UI design: low-fidelity prototyping, layout, use of colour, fonts, controls; Server-side frameworks and languages, client-side languages. Basic session tracking; Introduction to three-tier architecture; Fundamental web frameworks and design patterns for the web; Overview of web server architecture and web services standards; Web database connectivity; Overview of principles, design and frameworks for e-commerce; Overview of network security issues, ethical and social issues; Introduction to multimedia for the web; Introduction to mobile and wireless web platforms.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - 1 In-course test (1 hour) 5%
    - 10 Laboratories 10% (1% each)
    - 5 Programming Projects 35% (7% each)

COMP3101 **OPERATING SYSTEMS**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:

COMP2340 - Computer Systems Organization.

Course Content:

1. **Overview of Operating Systems:** Role and purpose of the operating system; History of operating system development; Functionality of a typical operating system; Mechanisms to support client-server models, hand-held devices; Design issues (efficiency, robustness, flexibility, portability, security, compatibility); Influences of security, networking, multimedia, windows.
2. **Operating System Principles:** Structuring methods (monolithic, layered, modular, micro-kernel models); Abstractions, processes, and resources; Concepts of application program interfaces (APIs); Application needs and the evolution of hardware/software techniques; Device organization; Interrupts: methods and implementations; Concept of user/system state and protection, transition to kernel mode.
3. **OS/Concurrency:** States and state diagrams; Structures (ready list, process control blocks, and so forth); Dispatching and context switching; The role of interrupts; Concurrent execution (advantages and disadvantages) The “mutual exclusion” problem and some solutions; Deadlock: causes, conditions, prevention; Models and mechanisms (semaphores, monitors, condition variables, rendezvous); Producer-consumer problems and synchronization; Multiprocessor issues (spin-locks, re-entrancy).
4. **Scheduling and Dispatch:** Pre-emptive and non-preemptive scheduling; Schedulers and policies; Processes and threads; Deadlines and real-time issues.
5. **Memory Management:** Review of physical memory and memory management hardware; Paging and virtual memory; Multilevel paging; Working sets and thrashing; Caching.
6. **Security and Protection:** Overview of system security; Policy/mechanism separation; Security methods and devices; Protection, access control, and authentication.
7. **File Systems:** Files (data, metadata, operations, organization, buffering, sequential, non-sequential); Directories (Course Contents and structure)

   File systems (partitioning, mount/unmount, virtual file systems); Standard implementation techniques; Memory-mapped files; Special-purpose file systems; Naming, searching, access, backups.

8. **Device Management:** Characteristics of serial and parallel devices; Abstracting device differences; Buffering strategies; Direct memory access; Recovery from failures.
9. **System Performance Evaluation:** Policies for caching, paging, scheduling, memory management, security, and so forth; Evaluation models: deterministic, analytic, simulation, or implementation-specific; How to collect evaluation data (profiling and tracing mechanisms).
10. **Scripting:** Scripting and the role of scripting languages; Basic system commands; Creating and executing scripts, parameter passing.
11. **Trends in Operating Systems:** Overview of contemporary operating systems, mobile operating systems, Future trends in operating systems.

Evaluation:

• Final Written Examination (2 hours)	50%
• Coursework:	50%
• 2 Assignments (5% each)	10%
• 2 In-course tests (10% each)	20%
• 2 Projects (variable weighting)	20%

<u>COMP3161</u> <u>DATABASE MANAGEMENT SYSTEMS</u>

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

COMP1126 - Introduction to Computing I, COMP1127 - Introduction to Computing I, COMP1210 - Mathematics for Computing **AND** COMP1161- Object-Oriented Programming.

Course Content:

1. **Information Management Concepts:** Basic information storage and retrieval concepts; Information capture and representation.
2. **Database Systems:** Components of database systems; Database architecture and data independence; Use of a declarative query language (SQL).
3. **Data Modelling:** Relational data models; Object-oriented models; Semi-structured data models.
4. **Relational Databases:** Relational algebra; Relational database design; Functional dependency; Decomposition of a schema; Normal forms; Multi-valued dependency.
5. **Query Languages:** Overview of database languages; SQL (data definition, query formulation, update, constraints, and integrity); Select-project-join; Subqueries; Querying XML; Stored procedures.

6. **Views and Indexes:** Basic structure of an index; Creating indexes with SQL; Materialized Views.
7. **Transaction Processing:** Transactions; Failure and recovery; Concurrency control.
8. **Distributed Databases:** MapReduce processing model; NoSQL systems.
9. **Advanced Topics:** Security and user authorization**;** Recursion**;** On-line analytical processing (OLAP)**;** Query optimisation.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - 8 Quizzes (equally weighted) 5%
    - 1 In-course Test (1 hour) 10%
    - 4 Assignments (equally weighted) 10%
    - 1 Programming Project 10%
    - 4 Assessed Laboratories (equally weighted) 15%

COMP3162 **DATA SCIENCE PRINCIPLES**

(3 Credits) (Level 3) (Semester 2)

Pre-Requisite:

COMP2201-Dicreet mathematics for Computer Science OR INFO2100-Mathematics and Statistics for I.T [and] COMP2211-Analysis of Algorithms OR INFO2110- Data Structures for I.T

Course Content:

1. Mathematical background (sets, basic statistics: description, prediction, inference).
2. **Motivation and Introductory concepts:** What are data?
3. **Data Quality Criteria**: Validity (type, range, cross-field, other constraints), Accuracy, Completeness, Consistency, Uniformity.
4. **The Data Science Process. Applying the Data Science Process using a high level programming language:** Data Wrangling: extractions, parsing, joining, standardizing, augmenting, cleansing, consolidating and filtering.
5. **Data Cleaning (ETL):** Data Auditing: Analysis (mean, standard deviation, range), Eliminating Duplicates, Translation and Normalization – Data Smoothing Techniques.
6. **Describing data:** Exploratory Data Analysis (EDA) + Data Visualization: Summaries, aggregation, smoothing, distributions, accessing data via

different interfaces, Building structure from a variety of data forms to enable analysis.
7. **Modeling:** Linear and Stochastic (understand notions of uncertainty, simulations, random number generator, etc.).
8. **Simulation w/wo data:** probabilistic and/or resampling based Algorithms.
9. Data Science application areas and case studies.

<u>COMP3191</u> **<u>PRINCIPLES OF COMPUTER NETWORKING</u>**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
COMP2190 - Net Centric Computing.

Course Content:
1. **Architectural Principles:** Layering; Encapsulation; Packet switching; Naming; End-to-end principle; Finite state machines.
2. **Application Layer:** HTTP (caching and HTTP future); FTP; SMTP and electronic mail; DNS (recursion); Peer to peer applications; Socket programming in TCP and UDP.
3. **Transport Layer:** Connectionless transport: UDP, Principles of reliable data transfer; Connection-oriented transport (TCP, TCP Tahoe, TCP Reno, and TCP New Reno, Congestion Control (RTT estimation and Self-clocking), Rationale for AIMD; Networks and protocols; Client/server and peer-to-peer paradigms; Mobile and wireless computing.
4. **Network Layer:** Names and addresses: ARP, IPv4, IPv6, and NAT; Routing and flooding, source routing, and spanning trees; Routingalgorithms: Bellman-Ford, Dijkstra; Routing: Intra-AS routing (RIP and OSPF), Inter-AS routing (BGP), and multicast.
5. **Physical and Link Layers:** Shannon capacity and modulation; Bit errors; FEC and Reed-Solomon; MAC (ALOHA and Slotted ALOHA, CSMA/CD); Ethernet and Virtual LANs; Wireless (How it is different from wireline communication); Wireless principles (CSMA/CA and RTS/CTS; IEEE 802.11).
6. **Multimedia Networking:** Course Content-delivery networks; Queuing disciplines; Quality of service in computer networks.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - In-course Examination (1 hour) 10%
    - 7 Quizzes (equally weighted) 5%
    - 2 Individual written assignments 10%
    - 2 Individual projects (10% +15%) 25%

COMP3192 **IMPLEMENTATION OF COMPUTER NETWORKS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
COMP3191 - Principles of Computer Networking.

Course Content:

1. **Direct Link Networks:** Encoding; Framing; Error Detection; Reliable Transmission; SONET; FDDI; Network Adapters; Ethernet; 802.11 Wireless Networks.
2. **Packet and Cell Switching:** Concepts; ATM; Switching Hardware; Bridges & Extended LANs.
3. **Internetworking:** Internetworking Concepts; Global Internet; IPv6; Internet Multicast; Domain Name Services.
4. **End-to-End Protocols:** Concepts; UDP; TCP; APIs and Sockets; RPCs Performance.
5. **End-to-End Data:** Presentation Formatting; Data Compression; Security.
6. **Congestion Control:** Issues; Queuing Disciplines; TCP Congestion Control; Congestion Avoidance.
7. **High Speed Networking:** Performance Issues; Advanced Services; Experiences.
8. Voice Over IP: Overview; Peer to Peer calling; Call Managers; Call Signalling; PBX and Call Attendant Functionality.
9. **Routing Protocols:** IGPs and EGPs; Overview of RIP and OSPF; Introduction to BGP.

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
  - In-course Examination (1 hour) 10%
  - 13 Quizzes (equally weighted) 15%
  - 13 Laboratory Reports 20%
  - Weekly Participation 15%

<u>COMP3220</u> **<u>PRINCIPLES OF ARTIFICIAL INTELLIGENCE</u>**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
COMP2201 **-** Discrete Mathematics for Computer Science **AND** COMP2211**-** Analysis of Algorithms.

Course Content:

1. **Introduction to AI:** Overview and History of AI and Philosophical Issues in AI.
2. **Intelligent Agents:** Performance measures, Environment, Actuators and Sensors (PEAS); Environment types; Agent types.
3. **Search:** Uninformed Search Algorithms; Heuristic Search Algorithms; Iterative Improvement Algorithms; Game Playing.
4. **Knowledge Representation and Reasoning:** Logic; Production Rules; Differencing Mechanisms; Expert Systems.
5. **Current topics in AI:** Machine Learning; Neural Networks; Reasoning Under Uncertainty; Natural Language Processing; Speech Recognition; Robotics; Fuzzy Logic; Virtual Reality.

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
  - 1 In-course Test 10%
  - 1written Assignment 10%
  - 1 Programming Assignment 10%
  - 1 Research Paper 10%

COMP3410 **INTRODUCTION TO PARALLEL COMPUTING**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

COMP2201 - Discrete Mathematics for Computer Science **or** COMP2211 - Analysis of Algorithms **AND** COMP2340 - Computer Systems Organization.

Course Content:

1. **Basic Techniques (Parallel Computers):** The demand for computational speed, Potential for increased computational speed, Types of parallel computers, Cluster computing.
2. **Parallel Hardware & Parallel Software:** Von Neumann architecture, Processors, multitasking, and threads, Parallel hardware, Parallel software, Performance, Parallel program design, Writing and running parallel programs.
3. **Message-Passing Computing:** Basic message-passing programming, Using a cluster of computers, Evaluating parallel programs.
4. **Partitioning & Divide-and-Conquer Strategies:** Partitioning, Partitioning & Divide-and-conquer examples, Distributed-Memory Programming with Parallel Virtual Machine, Compilation and execution, PVM programs, SPMD programs, Communication, Performance Evaluation of PVM programs, Synchronous Computations, Synchronization, Barrier, Tree implementation, Butterfly barrier, Local synchronization, Deadlock.
5. **Sorting Algorithms:** Compare-and-Exchange sorting, algorithms, Bubble sort, Merge sort bitonic, Merge sort.
6. **Numerical Algorithms:** Matrices, Matrix addition, Matrix multiplication, Matrix-Vector multiplication, Implementing matrix multiplication, Solving a system of linear equations, Iterative methods.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - Group Programming Project 15%
    - Two Assignments 15%
    - Two Quizzes 20%

COMP3652 **LANGUAGE PROCESSORS**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
COMP2211 - Analysis of Algorithms.

Course Content:

1. **Syntactic Processing:** Context Free Grammars: Definition, BNF notation, ambiguity, parse trees and deriva-tions; Regular Expressions: Definition, JLex or JFlex (a lexing tool); Parsing (top down (recursive descent and LL (K)); Parsing (bottom up (LR (0), SLR, LALR (1) and LR (1) parsers).
2. **Semantic Representation and Processing:** Operational vs. Denotational semantics, POSTFIX: an example of a stack-based programming language, Syntax-directed interpretation (and translation), Abstract Syntax Trees as Intermediate Representations, Interpretation and translation by AST traversal.
3. **Features of Programming Languages:** Typin (static vs. dynamic); Scoping (static vs. dynamic); Evaluation (lazy vs. eager); Parameter passing conventions; Data allocation strategies; First class citizens (objects); Tail recursion; Garbage collection.

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - Written Homework Assignment 10%
    - Programming Assignment 20%
    - Project 30%

COMP3702 **THEORY OF COMPUTATION**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
COMP2201- Discrete Mathematics for Computer Science.

Course Content:

1. **Computability:** Regular Languages (DFA, NFA, Regular Expressions)**;** Context Free languages (CFGs, PDAs); Turing-recognisable Languages (Turing Machines) Church-Turing thesis (Lambda Calculus); Turing Reducibility and Mapping Reducibility; Undecidability.

2. **Complexity Theory:** Distinction between Time and Space complexity; Definitions of Complexity Classes: L, P, NP, PSPACE, EXPTIME; Effect of Nondeterminism on Space and Time Complexity; Polynomial Time Mapping Reducibility; Hardness and Completeness Relative to Various Complexity Classes (e.g. NP-hardness, NP-completeness); Example NP-complete problems.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - 1 In-course Test 10%
    - 5 Written Homework Assignment 40%

<u>COMP3801</u> **<u>REAL TIME EMBEDDED SYSTEMS</u>**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

COMP2340 - Computer Systems Organisation **AND** COMP2140 - Software Engineering.

Course Content:

1. **Sensors, Actuators and Electrical Components:** Analogue to Digital Conversion, Sensor Formatting Sensor Input Modules; Actuator Selection, Embedded hardware components Hardware components for signal processing.
2. **State, Control and Feedback:** State diagrams and Petri Nets; Control and Feedback; Controllers.
3. **Embedded Design:** Hardware/Software Co-design; Fault Tolerance.
4. Real Time Operating Systems: Real Time Operating Systems; RTOS Example, e.g.,VxWorks.
5. **Robotics and Multi-platform Programming:** Introduction to Robotics; Introduction to Mobile Programming with J2ME; Developing and deploying mobile applications; Load Balancing in Embedded Systems.

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - 1 In-course Test 10%
    - 2 Written Assignments 10%
    - 4 Group Projects 40%

COMP3901 **CAPSTONE PROJECT**
(3 Credits) (Level 3) (Semester 2 and summer)

Pre-requisites:
COMP2140 - Software Engineering, COMP2211 - Analysis of Algorithms,
AND Any 6 credits of Level 2 or 3 computing code courses.

Course Content:
The specific technical topics covered by each group will depend on the type of project. Common examples of such topics include (but are not limited to) Database Design, Web Programming, User-Interface Design Mobile Application Development, Algorithm Design.

Evaluation:
This course is assessed via a series of presentations and a demonstration, a written report and a webpage. The specific contribution of each component towards the overall grade for a group is as follows:

Coursework:	100%
• Midterm Presentation	10%
• Web Page	10%
• Final presentation	15%
• Final demonstration	15%
• Final Report	50%

The presentations, demonstrations and Web pages are assessed by the evaluation committee. Each group final report is assessed by its supervisor and group members peer-assess each other. This combined level of assessment allows for individual grading.

COMP3911 **INTERNSHIP IN COMPUTING I**
(3 Credits) (Level 3) (Semester 1, 2 and summer)

Pre-requisite:
Permission of the Head of Department.

Course Content:
The exact nature of the internship depends upon the interests of the student and the specific needs of the cooperating organisation. It is assumed and expected that the intern will be involved in some area of computing and thereby gain valuable experience in his/her selected field of study.

Internships contribute to the education of the whole person by emphasizing the importance of work and by providing opportunities for self-reflection. The internship should be chosen to build on the student's own interests and to relate what he/she has learned in school to its application in the workplace. In addition, the internship should help the student evaluate him/herself as a worker and as a potential employee in a particular professional field. Through the internship, the student will enhance his/her feelings of self-worth and confidence in performing in the workplace. While on the job, the student should not only apply lessons learned in school to his/her particular job tasks, but he/she should also explore vocational possibilities and seek to discover what kinds of work he/she enjoys. In addition, the student will be able to build on his/her résumé and professional portfolio. Internship experiences should also offer the student access to potential mentors in his/her professional field.

Responsibility of the Student:
The student is required to spend about l50 working hours (e.g. 12 hours per week for approximately 13 weeks during semester 1 or 2, or 40 hours per week for approximately 4 weeks) working on a project or projects of the participating organisation’s choice. Where the students are registered for the course in semester 1 or 2, the hours allotted for the internship exercise should be selected by the student, at times when no classes are scheduled.

The student must:

- meet regularly with the Departmental Internship Coordinator (IC) and periodically with fellow interns to discuss his/her internship experiences
- maintain a journal indicating dates and hours worked, and a brief description of the work performed
- submit a final report summarising and evaluating the internship experience; and
- complete a résumé and interview at the Office of Placement and Career Services, UWI (Mona)

Any problems encountered during the internship should be discussed immediately with the IC so that appropriate action can be taken.

Responsibility of the participating Organisation:
Participating organisations will be vetted by the Internship Coordinator to ensure that they are suitable.

The organisation will:

- provide a mentor and appropriate work environment
- expose the student to the type of work which he/she would encounter in an entry level professional position
- provide appropriate personnel to oversee the project(s) assigned to the student, and the resources needed to accomplish the work
- treat the student as it would any employee, and
- expect the same degree of responsibility from the student, even as the student is not an employee of the firm

The mentor will be asked to:

- provide a written evaluation of the student's performance to the IC at the end of the internship;
- provide the student with a periodic evaluation of his/her performance; and
- consult with the IC when and if necessary.

Although an internship is a learning experience, it is expected that the student will normally earn some compensation for work performed that may contribute to income generating activities, either in the form of a wage, stipend, or reimbursement of expenses.

Responsibility of the Internship Coordinator (IC):

The IC will:

- organise preparation seminars for students at the start of each semester., featuring presentations from the Office of Placement and Career Services, industry personnel and alumni
- arrange preliminary meetings with mentors where students are briefed on expectations and responsibilities specific to the organisation;
- meet/correspond with students: student group meetings (weekly) via online journal, videoconference, etc. for students to share experiences;
- review reports from the organisation;
- review reports from the student;
- serve as a liaison between the Department of Computing (DoC) and the participating organisation;
- oversee the progress of the intern ;
- make suggestions to both the student and the organisation on ways to enhance the benefits of the internship;
- meet regularly with the intern to discuss his/her experience;s
- help resolve any problems the organisation and the student might have; and

- review all the reports submitted by the participating organisation and the student.

Evaluation:
There will be two components of the course's assessment: the internship mentor's evaluation and the student's work during the internship and his/her final submission at the conclusion of the internship. Students must pass both aspects of the course.

The internship mentor will provide a written evaluation of the student's performance. This assessment will be done using a 5 point Likert scale**.** An assessment/evaluation form will be provided for this purpose, and the form will be returned to the DoC in a sealed envelope. The internship coordinator will assign a grade not exceeding 25% of the possible marks based on this assessment, and on the student's journal which would detail the tasks assigned to the student and their level of completion.

The student will be evaluated on:

- Quality of work;
- Use of time (efficient/effective use of time to complete tasks);
- Ability to take initiative (ability to work independently);
- Grasp of subject (understanding of applicable standards and procedures);
- Judgement skills (ability to make appropriate work-related decisions);
- Interpersonal relations/teamwork (effectiveness in working with peers and supervisors);
- Adaptability (ability to alter activities to accommodate change);
- Problem solving/critical thinking skills;
- Punctuality, attendance;
- Verbal and written communication skills;
- Whether the goals of the internship were met (qualitative response);
- What skills the student developed (qualitative response);
- The observed primary strengths of the intern (qualitative response);
- Recommendations for improvement (qualitative response);
- What is your overall assessment of the student's performance? (qualitative response); and
- Other relevant observations.

75% will be based on the following:

- Regular communication with the DIC (weekly reports) - 15%

- Attendance at and participation in required internship meetings (weekly) - 10%;
- Oral presentation summarizing the activities completed during the internship - 20%
- Documentation of the internship experience in an internship portfolio (30%) which includes:
    - A final report summarizing the internship, relating it to courses done, and reflecting on the experience. The final report will have an appendix containing the student's journal entries from the internship (guidelines will be provided).
    - An updated résumé that incorporates the internship experience.
    - A "company evaluation form" rating the participating organisation.
    - Proof of consultation/debriefing with the office of placement and career services, UWI (Mona).

COMP3912 **INTERNSHIP IN COMPUTING II**
(6 Credits) (Level 3) (Semester 1, 2 and summer)

Pre-requisite:
Permission of the Head of Department.

Course Content:
The exact nature of the internship depends upon the interests of the student and the specific needs of the cooperating organisation. It is assumed and expected that the intern will be involved in some area of computing and thereby gain valuable experience in his/her selected field of study.

Internships contribute to the education of the whole person by emphasizing the importance of work and by providing opportunities for self-reflection. The internship should be chosen to build on the student's own interests and to relate what he/she has learned in school to its application in the workplace. In addition, the internship should help the student evaluate him/herself as a worker and as a potential employee in a particular professional field. Through the internship, the student will enhance his/her feelings of self-worth and confidence in performing in the workplace.

While on the job, the student should not only apply lessons learned in school to his/her particular job tasks, but he/she should also explore vocational possibilities and seek to discover what kinds of work he/she enjoys. In addition, the student will be able to build on his/her résumé and professional portfolio. Internship experiences should also offer the student access to potential mentors in his/her professional field.

Responsibility of the Student:

The student is required to spend about l50 working hours (e.g. 12 hours per week for approximately 13 weeks during semester 1 or 2, or 40 hours per week for approximately 4 weeks) working on a project or projects of the participating organisation's choice. Where the students are registered for the course in semester 1 or 2, the hours allotted for the internship exercise should be selected by the student, at times when no classes are scheduled.

The student must:

- meet regularly with the Departmental Internship Coordinator (IC) and periodically with fellow interns to discuss his/her internship experiences
- maintain a journal indicating dates and hours worked, and a brief description of the work performed
- submit a final report summarising and evaluating the internship experience; and
- complete a résumé and interview at the Office of Placement and Career Services, UWI (Mona)

Any problems encountered during the internship should be discussed immediately with the IC so that appropriate action can be taken.

Responsibility of the participating Organisation:

Participating organisations will be vetted by the Internship Coordinator to ensure that they are suitable.

The organisation will:

- provide a mentor and appropriate work environment
- expose the student to the type of work which he/she would encounter in an entry level professional position
- provide appropriate personnel to oversee the project(s) assigned to the student, and the resources needed to accomplish the work
- treat the student as it would any employee, and
- expect the same degree of responsibility from the student, even as the student is not an employee of the firm

The mentor will be asked to:

- provide a written evaluation of the student's performance to the IC at the end of the internship
- provide the student with a periodic evaluation of his/her performance; and

- consult with the IC when and if necessary.

Although an internship is a learning experience, it is expected that the student will normally earn some compensation for work performed that may contribute to income generating activities, either in the form of a wage, stipend, or reimbursement of expenses.

Responsibility of the Internship Coordinator (IC):

The IC will:

- organise preparation seminars for students at the start of each semester., featuring presentations from the Office of Placement and Career Services, industry personnel and alumni;
- arrange preliminary meetings with mentors where students are briefed on expectations and responsibilities specific to the organisation;
- meet/correspond with students: student group meetings (weekly) via online journal, videoconference, etc. for students to share experiences;
- review reports from the organisation;
- review reports from the student;
- serve as a liaison between the Department of Computing (DoC) and the participating organisation;
- oversee the progress of the intern ;
- make suggestions to both the student and the organisation on ways to enhance the benefits of the internship;
- meet regularly with the intern to discuss his/her experiences ;
- help resolve any problems the organisation and the student might have; and
- review all the reports submitted by the participating organisation and the student.

Evaluation:

There will be two components of the course's assessment: the internship mentor's evaluation and the student's work during the internship and his/her final submission at the conclusion of the internship. Students must pass both aspects of the course.

The internship mentor will provide a written evaluation of the student's performance. This assessment will be done using a 5 point Likert scale**.** An assessment/evaluation form will be provided for this purpose, and the form will be returned to the DoC in a sealed envelope. The internship coordinator will assign a grade not exceeding 25% of the possible marks based on this assessment, and on the student's journal which would detail the tasks assigned to the student and their level of completion.

The student will be evaluated on:

- Quality of work;
- Use of time (efficient/effective use of time to complete tasks);
- Ability to take initiative (ability to work independently);
- Grasp of subject (understanding of applicable standards and procedures);
- Judgement skills (ability to make appropriate work-related decisions);
- Interpersonal relations/teamwork (effectiveness in working with peers and supervisors);
- Adaptability (ability to alter activities to accommodate change);
- Problem solving/critical thinking skills;
- Punctuality, attendance;
- Verbal and written communication skills;
- Whether the goals of the internship were met (qualitative response);
- What skills the student developed (qualitative response);
- The observed primary strengths of the intern (qualitative response);
- Recommendations for improvement (qualitative response);
- What is your overall assessment of the student's performance? (qualitative response); and
- Other relevant observations.

75% will be based on the following:

- regular communication with the DIC (weekly reports) - 15%
- attendance at and participation in required internship meetings (weekly) - 10%;
- oral presentation summarizing the activities completed during the internship - 20%;
- documentation of the internship experience in an Internship Portfolio (30%) which includes:
  - A final report summarizing the internship, relating it to courses done, and reflecting on the experience. The final report will have an appendix containing the student's journal entries from the internship (guidelines will be provided).
  - An updated résumé that incorporates the internship experience.
  - A "company evaluation form" rating the participating organisation.
  - Proof of consultation/debriefing with the office of placement and career services, UWI (Mona).

INFO3105 **COMPUTER SYSTEM ADMINISTRATION**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:

COMP2340 - Computer Systems Organization **AND** COMP2190 - Net-Centric Computing.

Course Content:

1. **Operating Systems:** Overview; Operating system principles; Concurrency, Scheduling and dispatch; Memory Management; Device Management; Security and Protection; File Systems; Real-time and embedded systems; Fault tolerance; Scripting; Virtualisation; Installation, Configuration and Maintenance of OS and Applications; Installation and Configuration; Maintenance (upgrades, patches, etc.); Server services (print, file, DHCP, DNS, FTP, HTTP, mail, SNMP, telnet); Application Management (database, web, network services, etc.); Deployment of a System Image using Imaging Software; Support and Licensing issues.
2. **Administration Activities:** Content Management; Content Deployment (file system planning and Structure); Server Administration and Management; User and Group Management; Backup Management; Security Management; Disaster Recovery; Resource Management; Automation Management (automatic job scheduling); Use of Site Management Logs; System Support.
3. **Administrative Domains:** Web; Network; OS; Support; Database.
4. **Power Management:** Power Requirements for Individual Systems; Heat and Power Budgets; Power Load Monitoring and Management.

Evaluation:

• Final Written Examination (2 hours)	50%
• Coursework:	50%
• 1 Programming Project	10%
• 5 Laboratories	20% (4% each)
• 2 Written Assignments	20% (10% each)

INFO3110 **INFORMATION SYSTEMS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

COMP2140 - Software Engineering **AND** COMP2190 - Net-Centric Computing.

Course Content:

1. **Characteristics of an Organization:** Business Functions; Management Hierarchy; Business Processes.
2. **Information Systems:** Types of Applications; Enterprise Systems; Supply Chain Management Systems; Customer Relationship Management Systems; Knowledge Management Systems.
3. **Information Systems and Business Strategy:** Corporate Strategy; Information Systems Strategy; Strategic Information Systems.
4. **Information Technology Infrastructure:** Computer Hardware; System Software; Data Management; Telecommunication Networks.
5. **IT for Business Intelligence Gathering:** Data mining; Artificial Intelligence Environment Scanning.
6. **Internet and Other IT Innovations:** E-Commerce; E-Business; Collaborative Commerce.
7. **Managing Information Systems:** Information Systems Security and Control; Disaster Planning and Recovery.

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
    - In-course Test 10% (4% each)
    - 3 Written Assignments 30% (10% each)

INFO3155 **INFORMATION SYSTEMS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

COMP2190 - Net-Centric Computing **AND** INFO2100 - Mathematics and Statistics for IT **or** COMP2201 - Discrete Mathematics for Scientist.

Course Content:

The reality for the growing need of security in our day to day tasks; Confidentiality, Integrity and Availability (the pillars of security); The ethical issues facing the Security Professional; Physical access to Information Resources (secure sites, security policies, backups, disaster recovery); The Human Factor (social engineering); Malware (viruses, worms, Trojan horses, mailers etc.); Penetration testing (threat discovery, assessment and system hardening); Confidentiality, integrity and non-repudiation (the use of cryptography in security (hash functions, message digests, public/private key cryptography)).

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
    - Programming Project 15%
    - 2 Assignments 25%

INFO3170 **USER INTERFACE DESIGN FOR IT**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

COMP2140 **-** Software Engineer **OR** INFO2180 **-** Dynamic Web Development I.

Course Content:

1. **Overview of HCI:** The Role of User Interfaces in Computer Applications; History of Human-Computer Interaction (HCI) and User Interface (UI) Systems; Human Factors (Perception, Movement, and Cognition); Ergonomics; Contextual Issues in HCI (Culture, Communication, and Organizations); HCI Models, UI Paradigms (Command, Graphical User Interface (GUI) etc., UI Guidelines).
2. **UI Environments:** Overview of graphics systems, display devices, input devices; GUI system architecture, event-driven interaction model; UI toolkits; Collaborative Systems. Embedded Systems.
3. **UI Development Methods:** UI development cycle (investigation, design, prototyping, evaluation, implementation); Developing UI requirements (inquiry methods, developing task and workflow models); Information collection and analysis methods; Prototyping (storyboarding, implementation); Evaluation methods (heuristic, observational, empirical).

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - In-course Test 5%
    - Programming Projects 45%

INFO3180 **DYNAMIC WEB DEVELOPMENT II**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
INFO2180 - Dynamic Web Development.

Course Content:
DOM. XML, XSLT, AJAX; Web Application Design Principles (requirements, concept design, implementation, testing); Web Application UI design (low-fidelity prototyping, layout, use of colour, fonts, controls); Further Server-Side Frameworks and Languages, Client-Side Languages; Session Tracking; *n*-tier Architecture for the Web; Service-oriented Architectures; Web Frameworks and Design Patterns for the Web; Web Server Architecture and Web Services Standards; Principles, Design and Frameworks for E-Commerce; Web Security Issues (Cross-site Scripting, SQL Injection, Phishing); Web Network Security Issues, Ethical and Social Issues; Multimedia for the Web; Mobile and Wireless Web Platforms.

Evaluation:

- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - In-course Test 5%
    - 10 Laboratories 10%
    - 5 Programming Projects 35% (7% each)

INFO3435 **ECOMMERCE**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
COMP2140 - Software Engineering **AND** INFO2180 - Dynamic Web Development

Course Content:
eCommerce Business Models and Concepts; The Internet and World Wide Web; eCommerce Infrastructure; Building eCommerce Web Site; eCommerce Website Evaluation and Usability Testing (Personalization & Customization); Online Security and Payment Systems; Ecommerce Marketing Concepts Ecommerce Marketing Communications; Ethical, Social, and Political Issues in Ecommerce; Online Retailing and Services; Online Content and Media; Social Networks, Auctions, and Portals; B2B Ecommerce (Supply Chain Management and Collaborative Commerce).

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
    - In-course Test 10%
    - 3 Assignments 30%

SWEN2165 **REQUIREMENTS ENGINEERING**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

COMP2140 - Software Engineering.

Course Content:

1. **Interacting with stakeholders**: dealing with uncertainty and ambiguity, negotiation, requirements attributes (complete, traceable, unambiguous, atomic), cognitive problem complexity elicitation tools and techniques under various development approaches (plan-driven, incremental, reuse, prototyping, and viewpoints).
2. **Requirements evolution:** prioritization, trade-off analysis, risk analysis, and impact analysis, evaluating cost-effective solutions, benefits realization, trade-off analysis, cost analysis, return on investment (ROI), change management, scope creep.
3. **Analyzing requirements:** safety, security, usability, performance, validating product quality, requirements interaction, functions, features, formal analysis.
4. **Requirements documentation:** types, audience, structure, quality, contemporary standards and best practices, software requirements specification techniques (decision tables, user stories, UML, Volere, behavioral specifications, goal-driven.
5. **Security in requirements analysis and specification.**
6. **Requirements engineering tools.**

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - One Group project 40%
    - Two Assignments (10% each) 20%

SWEN3130 **SOFTWARE PROJECT MANAGEMENT**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
COMP2140 - Software Engineering.

Course Content:

1. **The Role of Risk in the Software Life Cycle:** Risk categories including security, safety, market, financial, technology, people, quality, structure and process; Risk identification; Risk tolerance e.g., risk-adverse, risk-neutral, risk-seeking); Risk planning; Risk removal, reduction and control.
2. **Working in Teams:** Professional Ethics; Participation; Processes including responsibilities for tasks, meeting structure, and work schedule in a software team; Team Conflict Resolution; Virtual Teams (communication, perception, structure); Effort Estimation (at the personal level); Team Management including organisation, decision-making, role identification and assignment, individual and team performance assessment.
3. **Project Management:** Scheduling and Tracking; Project Management Tools; Cost/Benefit Analysis; Software Measurement and Estimation Techniques; Configuration Management and Version Control; Principles of Risk Management.

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
    - Group Assignments (20% each) 40%

SWEN3145 **SOFTWARE MODELING**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
COMP2140 - Software Engineering **AND** COMP2171 - Object Oriented Design and Implementation .

Course Content:
Requirements Specification Document Development (Precisely Expressing Requirements); Information Modeling (Entity-Relationship Modeling, Class Diagrams); Behavioral Modeling (Structured Analysis, State Diagrams, Use Case Analysis, Interaction Diagrams, Failure Modes and Effects Analysis); Structure

Modeling (Architectural); Domain Modeling (Domain Engineering Approaches); Functional Modeling (Component Diagrams).

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - 2 Assignments 20%
    - 1 Project 40%

SWEN3165 **SOFTWARE TESTING**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
COMP2140 **-** Software Engineering **AND** COMP2171 **-** Object Oriented Design and Implementation

Course Content:
Managing the Testing Process, Testing Principles and Techniques (Unit Integration, Systems, Acceptance; Testing Types (State Based, Regression, Configuration, Compatibility, Alpha, Beta, and Acceptance); Test Driven Development; Test Plan Development; Reporting, Tracking, and Analysis of Problems encountered during Development.

Evaluation

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - 2 Assignments 20%
    - 1 Project Report 40%

SWEN3185 **FORMAL METHODS AND SOFTWARE RELIABILITY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
COMP2201 **-** Discrete Mathematics for Computer Science.

Course Content:
Role of Formal Specification and Analysis Techniques in the Software Development Cycle; Software Reliability Engineering Concepts and Practices; Software Reliability Models; Introduction to Mathematical Models and Specification Languages (Alloy, Z, VDM); Pre and Post Conditions, Invariants;

Formal Approaches to Software Modeling and Analysis (Model Checkers, Model Finders); Tools in Support of Formal Methods.

Evaluation:

- Final Written Examination (2 hours) 40%
- Coursework: 60%
    - 2 Assignments 20%
    - 1 Project 40%

SWEN3920 **CAPSTONE PROJECT (SOFTWARE ENGINEERING)**
(6 Credits) (Level 3) (Semester 1, 2 and 3)

Pre-requisites:
COMP2140 **-** Software Engineering, SWEN3130 **-** Software Project Management **AND** SWEN3145 **-** Software Modeling.

Co-requisite:
SWEN3165 - Software Testing **AND** SWEN3185 - Formal Methods and Software Reliability.

Course Description:
This course is the required group project course for all students majoring in software engineering. It is intended to be a capstone course that will bring together many of the topics that were covered in the rest of the curriculum. For this reason, students will be expected to take this course in their final year, for a period of six months beginning in semester two and ending in semester three. The project must encompass all matters relating to the software engineering process: requirements, design, coding, working in teams and project management.

Evaluation:

- Presentation and Demonstration of Final Product 10%
- Project Management Charter and Plan 15%
- Architecture and Design 15%
- Software Requirements Specification 30%
- Software Artefacts 30%

DEPARTMENT OF GEOGRAPHY & GEOLOGY

PROGRAMMES

Majors

1. Geography
2. Geology
3. Geosciences

Minors

1. Geography
2. Geology
3. Human Geography

Special note on field trips and seminars for all geography and geology courses:

- Field trips are **MANDATORY**
- Field trips are held on weekends (Saturdays and Sundays)
- Seminars for specific courses may be scheduled on Saturdays

UNDERGRADUATE GEOGRAPHY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
LEVEL 1					
GEOG1131	Human Geography 1: Population, Migration & Human Settlement	3	1	1	FST Matriculation Requirements and Geography at CSEC or its equivalent
GEOG1132	Human Geography 2: World Economy, Agriculture & Food	3	2	1	FST Matriculation Requirements and Geography at CSEC or its equivalent
GEOG1231	Earth Environments 1: Geomorphology & Soils	3	1	1	FST Matriculation Requirements and Geography at CSEC or its equivalent
GEOG1232	Earth Environments 2: Climate & the Biosphere	3	2	1	FST Matriculation Requirements and Geography at CSEC or its equivalent
LEVEL 2					
GEOG2131	Urban Geographies	3	1	2	GEOG1131 and GEOG1132
GEOG2132	Geographies of Development	3	2	2	GEOG1131 and GEOG1132
GEOG2231	Earth Surface Processes	3	1	2	GEOG1231 and GEOG1232

UNDERGRADUATE GEOGRAPHY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
GEOG2232	Climate Change	3	2	2	GEOG1231 and GEOG1232
GEOG2331	Research Methods in Geography	3	1	2	GEOG1131 and GEOG1132 and GEOG1231 and GEOG1232
GGEO2233	Water Resources	3	1	2	[GEOG1231 and GEOG1232] or [GEOL1102 and GEOL1104]
GGEO2332	Introduction to Geographical Information Systems	3	2	2	Two of: [GEOG1131/GEOG1132/GEOG1231/GEOG1232] or Two of: [GEOL1101/GEOL1102/GEOL1103/GEOL1104]
GGEO3105	Applied GIS & Remote Sensing	3	Summer	2	GGEO2232 or HOD Approval
LEVEL 3					
GEOG3131	Tropical Agricultural & Development	3	1	3	GEOG2132
GEOG3132	Tourism Planning & Development	3	2	3	GEOG2131 or GEOG2132

UNDERGRADUATE GEOGRAPHY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
GEOG3331	Geography of the Caribbean	3	1	3	Three of: [GEOG2131/GEOG2132/GEOG2231/GEOG2232]
GEOG3333	Urban and Regional Planning	3	2	3	GEOG2131
GEOG3334	Tropical Land Management	3	1	3	GEOG2231, GEOG2232 and GEOG2132
GEOG3430	Geography Research Project	6	1 and 2	3	GEOG2331 and GGEO2332 and two from: [GEOG2131/GEOG2132/ GEOG2231/GEOG2232]
GGEO3231	Karst & Coastal Geomorphology	3	2	3	GEOG2231 or GEOL2202
GGEO3232	Climate Change in the Tropics	3	1	3	GEOG2232 or any one of, GEOL2201, GEOL2202, GEOL2203, GEOL2204, GEOL2205, or Permission of HOD
GGEO3233	Hydrology & Hydrological Modelling	3	2	3	GGEO2233

UNDERGRADUATE GEOGRAPHY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
GGEO3332	Disaster Management	3	2	3	GEOG2231 and GEOG2232 or any two of GEOL2201, GEOl2202, GEOL2203, GEOL2204, GEOL2205 or Permission of HOD
GGEO3401	Research Project in Geosciences	6	1 and 2	3	GEOL2204 and GGEO2332 and any three of GEOG2231, GEOG2232, GEOL2201, GEOL2205, GGEO2233 Students must be pursuing the Major in Geosciences

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
LEVEL 1					
GEOL1101	Earth Science 1: Earth Materials & Plate Tectonics	3	**1**	1	Two Science subjects at CAPE or equivalent
GEOL1102	Earth Science 2: Earth Processes & Earth History	3	1	1	Two Science subjects at CAPE or equivalent
GEOL1103	Earth Science 3: Minerals & Mineral Deposits	3	2	1	Two Science subjects at CAPE or equivalent
GEOL1104	Earth Science 4: Geological Maps & Environmental Geology	3	2	1	Two Science subjects at CAPE or equivalent
LEVEL 2					
GEOL2201	Palaeontology & the History of Life	3	2	2	[GEOL1101 and GEOL1102] or [BIOL1262 and BIOL1263]
GEOL2202	Sedimentary Geology	3	1	2	GEOL1101 and GEOL1102

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
GEOL2203	Petrology of Igneous & Metamorphic Rocks	3	2	2	GEOL1101 and GEOL1103
GEOL2204	Field Techniques for Geology	3	1 and 2	2	GEOL1101 and GEOL1102 and GEOL1104
GEOL2205	Plate Tectonics & Geological Structures	3	1	2	GEOL1101 and GEOL1102 and GEOL1104
GGEO2233	Water Resources	3	1	2	[GEOG1231 and GEOG1232] or [GEOL1102 and GEOL1104]
GGEO2332	Introduction to Geographical Information Systems	3	2	2	Two of: [GEOG1131/GEOG1132/GEOG1231/GEOG1232] or Two of : [GEOL1101/GEOL1102/GEOL1103/GEOL1104]
GGEO3105	Applied GIS & Remote Sensing	3	Summer	2	GGEO2232 or HOD Approval
LEVEL 3					

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
GEOL3100	Research Project in Field Geology	6	1 and 2	3	GEOL2204 and any three of: [GEOL2201/GEOL2202/GEOL2203/GEOL2205/GGEO2233]
GEOL3002	Capstone: Caribbean Geology	3	1	3	GEOL2205 and any one of: [GEOL2201/GEOL2202/GEOL2203/GEOL2204/GGEO2233]
GEOL3104	Sedimentology & Facies Analysis	3	2	3	GEOL2202 and any one of : [GEOL2201/GEOL2203/GEOL2204/GEOL2205/GGEO2233]
GEOL3105	Petroleum Geology	3	2	3	GEOL2204 and any one of: [GEOL2201/GEOL2203/ /GEOL2205/GGEO2233]
GEOL3107	Geophysics & Seismicity	3	1	3	GEOL2204 and any one of: [GEOL2201/GEOL2202/GEOL2203/GEOL2205/GGEO2233]
GEOL3108	Metallic Ores & Industrial Minerals	3	1	3	GEOL2203 and any one of: [GEOL2201/GEOL2202/GEOL2204/GEOL2205/GGEO2233]
GGE03231	Karst & Coastal Geomorphology	3	2	3	GEOG2231 or GEOL2202

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY					
CODE	**TITLE**	**CREDITS**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
GGEO3232	Climate Change in the Tropics	3	1	3	GEOG2232 or any one of, GEOL2201, GEOL2202, GEOL2203, GEOL2204, GEOL2205, or Permission of HOD
GGEO3233	Hydrology & Hydrological Modelling	3	2	3	GGEO2233
GGEO3332	Disaster Management	3	2	3	GEOG2231 and GEOG2232 or any two of GEOL2201, GEOl2202, GEOL2203, GEOL2204, GEOL2205 or Permission of HOD
GGEO3401	Research Project in Geosciences	6	1 and 2	3	GEOL2204 and GGEO2332 and any three of GEOG2231, GEOG2232, GEOL2201, GEOL2205, GGEO2233 Students must be pursuing the Major in Geosciences

GEOGRAPHY AND GEOLOGY MAJORS AND MINORS: Students are advised that compulsory field work and seminars in the Department of Geography and Geology is carried out on Saturdays and Sundays.

GEOGRAPHY (MAJOR)		
Introductory Courses (Level 1)	**A major in Geography requires a total of twelve (12) Level 1 credits from:**	
	GEOG1131	Human Geography 1 Population, Migration and Human Settlement
	GEOG1231	Earth Environments 1 Geomorphology and Soils
	GEOG1132	Human Geography 2 World Economy, Agriculture and Food
	GEOG1232	Earth Environments 2 Climate and the Biosphere
Advanced Courses (Levels 2 and 3)	**A major in Geography requires a total of thirty (30) credits from Levels 2 and 3, fifteen (15) of which must be Level 3 and must include:**	
	GEOG2131	Urban Geographies
	GEOG2132	Geographies of Development
	GEOG2231	Earth Surface Processes
	GEOG2232	Climate Change
	GGEO2232	Geography Research Project
	GGEO2233	Water Resources
	GEOG3430	Introduction to Geographical Information Systems
	and a minimum of nine (9) credits from below:	
	GEOG3131	Tropical Agriculture and Development
	GEOG3132	Tourism Planning and Development
	GEOG3331	Geography of the Caribbean
	GEOG3333	Urban and Regional Planning
	GEOG3334	Tropical Land Management
	GGEO3231	Karst and Coastal Geomorphology
	GGEO3232	Climate Change in the Tropics
	GGEO3332	Disaster Management

GEOLOGY (MAJOR)		
	A major in Geology requires a total of twelve (12) Level 1 credits from:	
Introductory Courses (Level 1)	GEOL1101	Earth Science 1: Earth Materials and Plate Tectonics
	GEOL1102	Earth Science 2: Earth Processes and Earth History
	GEOL1103	Earth Science 3: Minerals and Mineral Deposits
	GEOL1104	Earth Science 4: Geological Maps and Environmental Geology
Advanced Courses (Levels 2 and 3)	**A major in Geology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:**	
	Level 2: 18 credits	
	GEOL2204	Field Methods for Geology (compulsory)
	and a minimum of five courses from below:	
	GEOL2201	Palaeontology
	GEOL2202	Sedimentary Geology
	GEOL2203	Igneous and Metamorphic Petrology
	GEOL2205	Plate Tectonics and Geologic Structures
	GGEO2233	Water Resources
	GGEO2332	Introduction to Geographical Information Systems
	Level 3: 21 credits	
	GEOL3100	Research Project in Field Geology (compulsory)
	GEOL3102	Caribbean Geology (compulsory)
	and a minimum of four (4) courses from below:	
	GEOL3104	Sedimentology and Facies Analysis
	GEOL3105	Petroleum Geology
	GEOL3107	Geophysics and Seismicity
	GEOL3108	Metallic Ores and Industrials Minerals
	GGEO3332	Disaster Management
	GGEO3231	Karst and Coastal Morphology
	GGEO3232	Climate Change in the Tropics
	GGEO3233	Hydrology and Hydrological Modelling

<table>
<tr><th colspan="3">GEOSCIENCES (MAJOR)</th></tr>
<tr><td rowspan="9">Introductory Courses (Level 1)</td><td colspan="2">A major in Geosciences requires a total of twenty-four (24) Level 1 credits from:</td></tr>
<tr><td>GEOL1101</td><td>Earth Science 1: Earth Materials and Plate Tectonics</td></tr>
<tr><td>GEOL1102</td><td>Earth Science 2: Earth Processes and Earth History</td></tr>
<tr><td>GEOL1103</td><td>Earth Science 3: Minerals and Mineral Deposits</td></tr>
<tr><td>GEOL1104</td><td>Earth Science 4: Geological Maps and Environmental Geology</td></tr>
<tr><td>GEOG1131</td><td>Human Geography 1 Population, Migration and Human Settlement</td></tr>
<tr><td>GEOG1231</td><td>Earth Environments 1 Geomorphology and Soils</td></tr>
<tr><td>GEOG1132</td><td>Human Geography 2 World Economy, Agriculture and Food</td></tr>
<tr><td>GEOG1232</td><td>Earth Environments 2 Climate and the Biosphere</td></tr>
<tr><td rowspan="17">Advanced Courses (Levels 2 and 3)</td><td colspan="2">A major in Geosciences requires a total of forty-two (42) credits from Levels 2 and 3 and must include:</td></tr>
<tr><td colspan="2">Level 2: 24 credits</td></tr>
<tr><td>GEOG2231</td><td>Earth Surface Processes</td></tr>
<tr><td>GEOG2232</td><td>Climate Change</td></tr>
<tr><td>GEOL2201</td><td>Palaeontology</td></tr>
<tr><td>GEOL2202</td><td>Sedimentary Geology</td></tr>
<tr><td>GEOL2204</td><td>Field Methods for Geology</td></tr>
<tr><td>GEOL2205</td><td>Plate Tectonics and Geologic Structures</td></tr>
<tr><td>GGEO2233</td><td>Water Resources</td></tr>
<tr><td>GGEO2332</td><td>Introduction to Geographical Information Systems</td></tr>
<tr><td colspan="2">Level 3: 18 credits</td></tr>
<tr><td>GGEO3401</td><td>Field Projects in Geosciences (compulsory)</td></tr>
<tr><td colspan="2">and a minimum of 12 credits, at least 6 must be GGEO from:</td></tr>
<tr><td>GEOL3104</td><td>Sedimentology and Facies Analysis</td></tr>
<tr><td>GEOL3105</td><td>Petroleum Geology</td></tr>
<tr><td>GGEO3231</td><td>Karst and Coastal Morphology</td></tr>
<tr><td>GGEO3232</td><td>Climate Change in the Tropics</td></tr>
</table>

	GGEO3233	Hydrology and Hydrological Modelling
	GGEO3332	Disaster Management

GEOGRAPHY (MINOR)		
	A minor in Geography requires a total of twelve (12) Level 1 credits from:	
Introductory Courses (Level 1)	GEOG1131	Human Geography 1 Population, Migration and Human Settlement
	GEOG1231	Earth Environments 1 Geomorphology and Soils
	GEOG1132	Human Geography 2 World Economy, Agriculture and Food
	GEOG1232	Earth Environments 2 Climate and the Biosphere
	A minor in Geography requires a total of fifteen (15) credits from Levels 2 and 3 (with at least nine (9)) credits from Level (3) from:	
Advanced Courses (Levels 2 and 3)	GEOG2131	Urban Geographies
	GEOG2132	Geographies of Development
	GEOG2231	Earth Surface Processes
	GEOG2232	Climate Change
	GGEO2233	Water Resources
	GGEO2232	Geography Research Project
	GEOG3131	Tropical Agriculture and Development
	GEOG3132	Tourism Planning and Development
	GEOG3331	Geography of the Caribbean
	GEOG3333	Urban and Regional Planning
	GGEO3231	Karst and Coastal Geomorphology
	GGEO3232	Climate Change in the Tropics
	GGEO3332	Disaster Management

GEOLOGY (MINOR)		
	A minor in Geology requires a total of twelve (12) Level 1 credits from:	
Introductory Courses (Level 1)	GEOL1101	Earth Science 1: Earth Materials and Plate Tectonics
	GEOL1102	Earth Science 2: Earth Processes and Earth History
	GEOL1103	Earth Science 3: Minerals and Mineral Deposits
	GEOL1104	Earth Science 4: Geological Maps and Environmental Geology
	A minor in Geology requires a total of fifteen (15) credits from among the following courses from Levels 2 and 3	
	Level 2: 2 or 3 courses from	
	GEOL2201	Palaeontology
	GEOL2202	Sedimentary Geology
	GEOL2203	Igneous and Metamorphic Petrology
	GGEO2233	Water Resources
	Level 3: 2 or 3 courses from	
Advanced Courses (Levels 2 and 3)	GEOL3104	Sedimentology and Facies Analysis
	GEOL3105	Petroleum Geology
	GEOL3107	Geophysics and Seismicity
	GEOL3108	Metallic Ores and Industrials Minerals
	GGEO3233	Hydrology and Hydrological Modelling
	GGEO3332	Disaster Management

HUMAN GEOGRAPHY (MINOR)		
Introductory Courses (Level 1)	**A minor in Human Geography requires a total of six (6) Level 1 credits from:**	
	GEOG1131	Human Geography 1 Population, Migration and Human Settlement
	GEOG1132	Human Geography 2 World Economy, Agriculture and Food
Advanced Courses (Levels 2 and 3)	**A minor in Human Geography requires a total of fifteen (15) credits from Levels 2 and 3 (with at least nine (9) credits from Level 3) from:**	
	GEOG2131	Urban Geographies
	GEOG2132	Geographies of Development
	GGEO2332	Introduction to Geographical Information Systems
	GEOG3131	Tropical Agriculture and Development
	GEOG3132	Tourism Planning and Development
	GEOG3331	Geography of the Caribbean
	GEOG3333	Urban and Regional Planning

GEOGRAPHY

GEOG1131 **HUMAN GEOGRAPHY 1: POPULATION, MIGRATION & HUMAN SETTLEMENT**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
Passes in at least two CAPE subjects **AND** Geography at CSEC or its equivalent.

Course Content:
Modern Approaches to the Study of Population Geography; The Human and Physical Factors determining Population Distribution and Dynamics; Theories of Population Change, including Malthus' and Neo-Malthusian Thoughts; The Demographic Transition Theory; The Sources of, and Problems associated with, Population Statistics; How to Measure Fertility, Mortality and Migration; Population Projection Techniques; Family Planning and Population Control Efforts around the World; The Status of Women and its Crucial Role in Population Dynamics; Major Causes of Death around the World, including AIDS; The Role of Migration in Population Dynamics; Culture, Population and the Environment. Historical and Contemporary Perspectives on Urbanization in both the Industrialized World and the Developing World, and Theories on the Geographical Distribution of Human Settlement.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Multiple-choice Review Test (1 hour) 10%
    - Tutorial Assignments 10%
    - 3 Practical Assignments 20%

GEOG1132 **HUMAN GEOGRAPHY 2: WORLD ECONOMY, AGRICULTURE & FOOD**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
Passes in at least two CAPE subjects **AND** Geography at CSEC or its equivalent.

Course Content:
The processes of economic development and globalization, and the economic interdependence of countries in the modern world; Basic theories, concepts, and methods for describing, measuring and analyzing patterns of economic and social development; The main factors that have contributed to uneven patterns of economic development, such as the distribution and exploitation of natural resources, and the process of industrialization, technological change and globalization; The section on agriculture and the food industry illustrates in depth many issues related to economic development and globalization, including the role of agribusiness in food production and food consumption, and the impacts of traditional and modern agricultural production systems on the environment; The geographical dimensions of world hunger and malnutrition in relation to the structure of the world economy and world agriculture; Prospects for future agricultural development.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - Multiple-choice Review Test (1 hour) 10%
  - Tutorial Assignments 10%
  - 3 Practical Assignments 20%

GEOG1231 **EARTH ENVIRONMENTS 1: GEOMORPHOLOGY & SOILS**

(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
Passes in at least two CAPE subjects **AND** Geography at CSEC or its equivalent.

Course Content:
Modern approaches to geomorphology and soil science; The main geomorphic processes in the context of endogenic and exogenic systems from a global perspective; The geomorphology section examines and describes endogenic systems and processes. The internal structure of the Earth and the geographic

patterns of global relief of the solid surface in the context of plate tectonics. The relationship between global tectonics and the patterns and styles of volcanic activity; The passive control of rock type and geological structure in relation to landscape form and process; The soils section examines and describes the main exogenic systems and processes; The geographical patterns and types of rocks. Aspects of soil science from a geographical perspective through an examination of the main soil-forming factors, and analysis of physical and chemical soil-forming processes; Exogenic systems in relation to the main geomorphic agents of water, wind and ice in the context of fluvial, slope, aeolian, karst, glacial and periglacial systems.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Multiple-choice Review Test (1 hour) 10%
    - Tutorial Assignments 10%
    - 3 Practical Assignments 20%

GEOG1232 **EARTH ENVIRONMENTS 2: CLIMATE & THE BIOSPHERE**
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
Passes in at least two CAPE subjects **AND** Geography at CSEC or its equivalent.

Course Content:
A modern holistic approach to the study of the earth system. Introduction to climate science: the processes operating within the atmosphere and biosphere, including general circulation of the atmosphere, ocean-atmosphere interactions, and global climate systems. Emphasis on the impacts and consequences of human-environment interactions. Spatial and temporal variability of these processes on local, regional and global scales. The primary causes, both natural and human, and consequences of climate change and the impact of a changing climate for communities both within and outside the Caribbean region. Particular emphasis on the impacts of climate change on the biosphere, as well as their implications for agricultural systems. Introduction to the study of biogeography, focussing on the geographical features of biodiversity at different geographical scales, and reviewing ideas about ecosystem processes and vegetation disturbance and succession.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Multiple-choice Review Test (1 hour) 10%
    - Tutorial Assignments 10%
    - 3 Practical Assignments 20%

GEOG2131 **URBAN GEOGRAPHIES**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1131 - Human Geography 1: Population, Migration & Human Settlement **AND** GEOG1132 - Human Geography 2: World Economy, Agriculture & Food.

Course Content:
An introduction to key concepts, theories and empirical studies in the field of urban geography; The course deals with a variety of contemporary and relevant issues pertaining to urban growth and development, including patterns and processes of global urbanization, urban housing challenges and solutions, global urban consumerism, neighbourhood dynamics and changes, urban governance and social justice, cities and climate change, migration, race and ethnicity, and the built environment; The course draws upon a variety of examples and case studies, especially from the developing world.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Tutorial Assignments 10%
    - In-course Test (1 hour) 20%
    - 2500 Word Project Report 20%

GEOG2132 **GEOGRAPHIES OF DEVELOPMENT**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
GEOG1131 - Human Geography 1: Population, Migration & Human Settlement **AND** GEOG1132 - Human Geography 2: World Economy, Agriculture & Food.

Course Content:
The course seeks to explain the dynamic nature of the development process and its impact on economies, societies and the environment in the context of an increasingly globalized world. It introduces relevant ideas, theories and concepts from social science disciplines, but focuses on how geographers bring spatial concepts and geographical models to bear on the theory and practice of development. It links theories and concepts with development policy through case studies. The spatial dynamics of the global economy are highlighted through the lens of economic globalization. Sections highlight world industrialization, international trade and trade liberalization, and rural development. Special emphasis is placed on the Caribbean region in relation to the problems of sustainable development in small island developing states; environmental issues such as environmental degradation and climate change; and tourism development models.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Tutorial Assignments 10%
    - In-course Test (1 hour) 20%
    - Internet-based Research Report 20%

GEOG2231 **EARTH SURFACE PROCESSES**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1231- Earth Environments 1: Geomorphology & Soils **AND** GEOG1232 - Earth Environments 2: Climate & The Biosphere.

Course Content:
The course examines modern approaches to the analysis and interpretation of geomorphic processes and landforms in the context of coastal, fluvial and slope

systems, and provides an in-depth examination of geomorphology in tropical settings.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 2, 1250 -Word Essays 10%
    - 2500-Word Field Report 10%
    - 2 Practical Assignments 10%
    - In-course Test (1 hour) 20%

GEOG2232 **CLIMATE CHANGE**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
GEOG1231- Earth Environments 1: Geomorphology & Soils **AND** GEOG1232 - Earth Environments 2: Climate & The Biosphere.

Course Content:
An interdisciplinary approach to the study of environmental change, looking at examples of the complex interactions between human activity and the different environmental spheres (geosphere, hydrosphere, atmosphere, and biosphere). Core components include global environmental change, sea-level change, natural climate variability, anthropogenic climate change, 21st-century climate projections, and tropical forest dynamics. The course examines the primary causes, both natural and human, and the consequences and impacts of environmental change both within and outside the Caribbean region.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 2 Group PowerPoint Presentation 20%
    - 2, 1500-Word Essay 30%

GEOG2331 **RESEARCH METHODS IN GEOGRAPHY**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1131 - Human Geography 1: Population, Migration & Human Settlement **and** GEOG1132 - Human Geography 2: World Economy, Agriculture & Food **AND** GEOG1231 - Earth Environments 1: Geomorphology & Soils **and** GEOG1232 - Earth Environments 2: Climate & The Biosphere.

Course Content:
The course aims to provide some basic knowledge of the key aspects of the history and philosophy of geographical enquiry, and to provide the theoretical and practical skills required to develop and conduct a research project in geography. Training in the application of geographical research methods and techniques, data collection, data and statistical analysis, and the technical presentation of results. Training in how to define a research topic, how to identify relevant literature, how to prepare a research proposal, and how to present data.

Evaluation:
- Course Work: 100%
  - In-course Test (1 hour) 25%
  - 5 Research Skills Assignments 75%

GGEO2332 **INTRODUCTION TO GEOGRAPHICAL INFORMATION SYSTEMS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
Two of:
GEOG1131 - Human Geography 1: Population, Migration & Human Settlement **and** GEOG1132 - Human Geography 2: World Economy, Agriculture & Food **OR** GEOG1231- Earth Environments 1: Geomorphology & Soils **and** GEOG1232 - Earth Environments 2: Climate & The Biosphere.
OR
Two of:
GEOL1101 - Earth Science 1: Earth Materials & Plate Tectonics **and** GEOL1102 - Earth Science 2: Earth Processes and Earth History **OR** GEOL1103 **-** Earth Science 3: Minerals and Minerals Deposits **and** GEOL1104 - Earth Science 4: Geological Maps and Environmental Geology.

Course Content:
The course introduces students to the theory and general principles of GIS and to practical skills and hands-on experience in its use: the fundamental concepts and basic functions of a GIS; the properties of GIS maps; the structure of a GIS database; coordinate systems and map projections; methods of performing simple vector and raster spatial analysis. In lab exercises students will work with ArcMap to visualize geographic data, create maps, query a GIS database, perform spatial analysis using common analytical tools, and solve geographical problems using a systematic approach. The course introduces the core functionality of GIS software packages such as ArcMap, ArcCatalog, and ArcToolbox.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - In-course Tests 20%
    - 6 Laboratory Assignments 30%

<u>GGEO3105</u> **<u>Applied GIS & Remote Sensing</u>**
(3 Credits) (Level 2) (Summer)

Pre-requisites:
GGEO2232 - Climate Change **OR** Head of Department approval.

Course Content:
Review of GIS principles, concepts and components; Spatial Data Representation models; Remote Sensing principles, concepts and components; GNSS principles, concepts and components; GNSS Geodata acquisition; Spatial data generation and acquisition; Geodatabase creation and population; Data Automation; Geodatabase query; Geo-visualization techniques; GIS Web Mapping; (Geospatial Web Services); Mobile GIS Solutions ; GIS Programming & Application Development; Geospatial data analysis; Spatial Statistics; FOSS; SDI & Geospatial standards

Evaluation:
Coursework:

- 4 Lab assignments (10% each) 40%
- 1 Major Project 60%

GGEO2233 **WATER RESOURCES**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1231- Earth Environments 1: Geomorphology & Soils **and** GEOG1232 - Earth Environments 2: Climate & The Biosphere **OR** GEOL1102 - Earth Science 2: Earth Processes and Earth History **and** GEOL1104 - Earth Science 4: Geological Maps and Environmental Geology.

Course Content:
An in-depth study of the hydrological cycle, evaporation/transpiration, and rainfall-runoff relationships in hydrogeology. The factors affecting evaporation and evapotranspiration from free water surfaces and soils. Different estimates and measurements of evaporation and evapotranspiration and soil moisture storage and movement. The nature and origin of different types of aquifers, their geological properties, the various types of groundwater flows to wells, flows within aquifers under steady/nonsteady conditions. Techniques of hydrogeological investigation, including drilling and pump testing. The hydraulics of surface water systems and seasonal variability of the flow pattern in streams and rivers. Flooding and drought. Special emphasis on the water resources of Jamaica and other Caribbean islands.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 2 In-course Test (1 hour) 20%
    - Practical Examination (2 hours) 30%

GEOG3131 **TROPICAL AGRICULTURAL & DEVELOPMENT**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
GEOG2132 - Geographies of Development.

Course Content:
1. **Global Change**: impacts of trade liberalization and climate change on export agriculture and domestic food production– includes case studies. Population growth and the diffusion of agricultural innovations - contrasting models of the dynamics of agricultural change.

2. **Economic and Behavioural Approaches to Decision Making among Small-Scale Farmers in Developing Countries** – includes approaches to risk reduction.
3. **The Role of Indigenous Knowledge in Traditional Agriculture** - includes case studies based on Jamaican research.
4. **Sustainable Rural Livelihoods and Sustainable Hillside Farming** - includes approaches to soil conservation and land management in hillside farming systems.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Field Project Report (2 hours) 25%
  - In-course Test (1 hour) 25%

GEOG3132 **TOURISM PLANNING & DEVELOPMENT**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
GEOG2131 - Urban Geographies **OR** GEOG2132 - Geographies of Development.

Course Content:
An overview of recreation and leisure; The connections between globalisation, mobility and tourism. And the growth of mass tourism; The urban tourism system including a classification of the main elements and its role in urban renewal; The goals, principles and practice of sustainable tourism including its emergence from the concept sustainable development; The characteristics of ecotourism and a critical assessment of selected case studies; A critical analysis an analytical framework for analysing the balance between resource use and sustainability in the Caribbean tourism; The changing approaches to tourism planning as well the main aspects on the planning process, including local community participation; An advanced insight into the contested nature of tourism developments and the ways that socio-political factors render some tourist spaces as zones of exclusion and marginalisation; Introduction to the components, goals and challenges associated with conducting an Environmental Impact Assessment. The role of certification programmes as measures of sustainability in tourist development practices; The nature and outcomes of connections between the agriculture and tourism sector with specific emphasis on the experiences of Jamaica; The role sex tourism plays in shaping social and

economic landscapes and, by extension, the identity of places; The concept of vulnerability from multiple perspectives including the vulnerability of the tourism industry to external shocks, natural hazards, the impact of crime and health related challenges.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Tutorial Essay 5%
  - Multimedia Presentation 5%
  - Tourism Development Plan 20%
  - In-course Test (1 hour) 20%

GEOG3331 **GEOGRAPHY OF THE CARIBBEAN**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

Any three of:

GEOG2131 - Urban Geographies, GEOG2132 - Geographies of Development, GEOG2232 - Climate Change **OR** GEOG2231 - Earth Surface Processes.

Course Content:

Introduction to Caribbean Geography; The Caribbean Environment; The Caribbean as a Social and Economic Space; Morbidity and Mortality: Geographical Dimensions of Caribbean Health.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - In-course Test (1 hour) 20%
  - Project 30%

GEOG3333 **URBAN & REGIONAL PLANNING**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
GEOG2131 - Urban Geographies.

Course Content:
Introduction to Urban & Regional Planning; History and Evolution of Planning in Britain ; The Seers Planning in the Americas; Theories of Planning; Water and Sanitation ; Strategies for Housing the Urban Poor; The Global Urban Energy Crisis; Urban Safety and Security; Adapting Cities to Climate Change.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Tutorial Multimedia Presentation 10%
    - In-course Test (1 hour) 15%
    - Written Tutorial Assignment 25%

GEOG3334 **TROPICAL LAND MANAGEMENT**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
GEOG2231 - Earth Surface Processes, GEOG2232 - Climate Change
AND GEOG2131 - Urban Geographies.

Course Content:
Soil Formation, Weathering Processes and Products in the Humid Tropics; Humid Tropical Soils and Land-Use Problems Semi-Arid Tropical Soils and Land-Use Problems; Desertification (Slope Failure and Tropical Land Management. Soil Erosion and Tropical Land Management); Land Degradation (Land Classification and Land Capability); Land Management and Environmental Change.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Practical Exercises 15%
    - Tutorial Essay Assignment 15%
    - Field Report 20%

GEOG3430 **GEOGRAPHY RESEARCH PROJECT**

(6 Credits) (Level 3) (Year-Long)

Pre-requisites:

GEOG2331- Research Methods in Geography **AND** GGEO2332 - Introduction Geographical Information System, **AND** at least two of:
GEOG2131 - Urban Geographies, GEOG2132 - Geographies of Development, GEOG2231 - Earth Surface Processes **AND** GEOG2232 - Climate Change.

Course Content:

The course involves a series of steps in which the student progress through the various stages of the formulation of a research project, the execution of the Project and presentation of results. At the first stage, students must complete a research proposal based on a literature search. The proposal involves the formulation of a research question, a statement of research design and methodology and includes details of any sampling methods, laboratory techniques and methods of analysis to be used. The proposal is assessed and the proposal must satisfy the assessors before the student can proceed to the next stage. At the second stage, the student is assigned to a supervisor who assists with the fine-tuning of the research design and methodology, before students proceeds to the field data collection stage. A third stage involves the submission of progress report to the supervisor, and the report includes an indication of a work plan to complete the data analysis and write up. The final stages of the course are the formal graded assessment of the project, and involve a multi-media presentation of the research results, and the submission of a dissertation.

Evaluation:

- Project Report (dissertation) 80%
- Course Work: 20%
    - Project Proposal: 0% (necessary to continue but zero-rated)
    - Progress Report: 0% (necessary to continue but zero-rated)
    - Oral Presentation 20%

GGEO3231 **KARST & COASTAL GEOMORPHOLOGY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

GEOG2231- Earth Surface Processes **OR** GEOL2202 - Sedimentary Geology.

Course Content:

Karst Rocks and Material Properties (Karst Processes and Controls, Karst

Landform Systems, Applied Karst Geomorphology); The Geomorphic Legacy of Sea-level Change and Paleo-Coastal Environments; Coastal Forces and Processes; Coastal Landform Systems; Applied Coastal Geomorphology.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Tutorial Essay Assignment 10%
    - Field Project Report 20%
    - In-course Tests (1 hour) 20%

<u>GGEO3232</u> **<u>CLIMATE CHANGE IN THE TROPICS</u>**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
GEOG2232 - Climate Change **OR any one** of GEOL2201- Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 -Petrology of Igneous & Metamorphic Rocks, GEOL2204 - Field Techniques for Geology, GEOL2205 - Plate Tectonics & Geological Structures **or** Permission of Head of Department.

Course Content:
A theoretical and practical basis for understanding present-day tropical environments and the causes of global environmental change, as well as for assessing the scale of human interference in natural environmental processes.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 1 Oral Presentation 10%
    - 1 Laboratory Reports 10%
    - 1 Critical Review (about 2500 words) 20%

GGEO3233 **HYDROLOGY & HYDROLOGICAL MODELLING**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

GGEO2233 - Water Resources.

Course Content:

1. Spatial and temporal variations in precipitation. Creation of rainfall maps using isohyetal, arithmetic mean and Theissen polygon method.
2. Statistical methods for calculating return periods for rainfall and flood data.
3. Hydrograph separation using computational methods and calculation of baseflow, inter and overland flow. Types of flooding and flood hazards in Jamaica. Climate change and hydrological hazards.
4. Hydrologic Simulation models, steps in watershed modelling, description of models principles, mainly HEC HMS models Flood plain hydraulics - principles and concepts of HEC RAS (1D) model including case studies.
5. Hydraulic properties of aquifers and their methods of determination. Groundwater flow calculations and flow variation under different climatic and non-climatic conditions.
6. Geophysical and geological investigations for groundwater sources. Groundwater contamination and transport model. Groundwater wells: types and methods of drilling.
7. Water resources of the Caribbean, with special emphasis on Jamaica. Climate change and challenges in the water sector: Jamaica and the Caribbean.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Field Trip Report 10%
    - 1 Laboratory Report 40%

GGEO3332 **DISASTER MANAGEMENT**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GEOG2231 - Earth Surface Processes **AND** GEOG2232 - Climate Change **AND** any three of:
GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological Structures **or** Permission of Head of Department.

Course Content:
An introduction to the basic principles and techniques in disaster management; A study of theory, hazards, vulnerability, response capability, risk Evaluation, disaster scenarios, disaster management, preparedness, prevention, emergency response, and simulation; Basic concepts of geology, geomorphology, tectonics and geophysics in the study of natural hazards, with special reference to the Caribbean; Hazards and risks related to volcanic activity, earthquakes, landslides, hydrometeorological processes; flooding and hurricanes; Hazard mapping. Approaches to natural hazard loss-reduction.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Multimedia Presentation 10%
    - Project Report 10%
    - 3 Practical Exercises 15%
    - Fieldwork 15%

GGEO3401 **RESEARCH PROJECT IN GEOSCIENCES**
(6 Credits) (Level 3) (Year-long)

Pre-requisites:
GEOL2204 - Field Techniques for Geology **AND** GGEO2332 - Introduction to Geographical Information Systems and **any Three of**:
GEOG2231 - Earth Surface Processes, GEOG2232 - Climate Change, GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2205 - Plate Tectonics & Geological Structures, GGEO2233 - Water Resources. Students must be registered for the Geosciences Major.

Course Content:
An approved research project in the field of Geosciences is undertaken in the summer preceding the final year of the programme. The course involves the formulation of a research project, the execution of the project and presentation of results. The final outcome involves a multi-media presentation of the research results, and the submission of a dissertation in Semester 2.

Evaluation:
- Project Report: (dissertation) 80%
- Course Work: 20%
    - Project Proposal: 0% (necessary to continue but zero-rated)
    - Progress Report: 0% (necessary to continue but zero-rated)
    - Oral Presentation: 20%

GEOLOGY

GEOL1101 **EARTH SCIENCE 1: EARTH MATERIALS & PLATE TECTONICS**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
Passes in at least two science subjects at CAPE **OR** equivalent.

Course Content:
An introduction to the study of earth materials and earth systems, giving an overview of how basic earth processes work and how rocks and minerals are formed; Introduces topics such as the structure of the Earth, its internal processes, and basic earth materials, minerals and rocks; A central focus is on plate tectonics, now seen as the unifying concept linking earth processes and materials in the rock cycle; Practical instruction will provide the basic skills of mineral and rock identification, and will also cover volcanic and seismic processes on broader regional and global scales.

Evaluation:
- Final Written Examination (2 hours) 50%
- Coursework: 50%
    - Field Trip 5%
    - 2 Tutorial Assignments 5%
    - In-course Test (1 hour) 10%
    - Practical Examination 30%

GEOL1102 **EARTH SCIENCE 2: EARTH PROCESSES & EARTH HISTORY**

(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
Passes in at least two science subjects at CAPE **OR** equivalent.

Course Content:
An introduction to the physical and chemical processes that operate within different environments and produce a range of geomorphological features on the Earth; Introductory aspects of physical geology, including: weathering and erosion; landforms (rivers, slopes, coastlines, arid lands, glaciated environments); and the use of topographic maps; An appreciation of the processes acting on the Earth's surface and how they can be used to interpret Earth history as critical guide to understanding the global distribution of rocks, geological features and earth resources; An introduction to historical geology - origin of the Earth, origin of life on Earth, the geological timescale - with an emphasis on using present geological processes to interpret the past.

Evaluation:

• Final Written Examination (2 hours)	50%
• Course Work:	50%
• Field Trip	5%
• 2 Tutorial Assignments	5%
• In-course Test (1 hour)	10%
• Practical Examination	30%

GEOL1103 **EARTH SCIENCE 3: MINERALS & MINERAL DEPOSITS**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
Passes in at least two science subjects at CAPE **OR** equivalent.

Course Content:
An introduction to crystal chemistry, crystallography, optical mineralogy and the geology of mineral deposits. The course is designed to develop the theoretical knowledge and critical practical expertise in observing, analyzing, describing and classifying minerals and rocks, using a hand lens to investigate hand specimens and a petrographic microscope to investigate thin sections. These basic skills are essential for the identification of ore and industrial minerals, as well as in the

investigation of sedimentary, igneous and metamorphic rocks that will be introduced in advanced level courses.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - 2 Tutorial Assignments 9%
  - In-course Test (1 hour) 11%
  - Practical Examination 30%

GEOL1104 **EARTH SCIENCE 4: GEOLOGICAL MAPS & ENVIRONMENTAL GEOLOGY**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:

Passes in at least two science subjects at CAPE **OR** equivalent.

Course Content:

An introduction to structural geology, geological maps and environmental geology. In structural geology, the student will learn how to describe measure and analyze planar and linear features in rocks, including folds, faults and fabrics. Geological map interpretation will allow the recognition of how rock relationships are depicted on maps, and practical classes will concentrate on the construction of geological cross-sections and the interpretation of geological histories. In environmental geology, the student will be introduced to the natural and anthropogenic physical and chemical factors that affect the environment, with topics including climatic change and the combustion of fossil fuels; ocean pollution; toxic and radioactive waste disposal; land use management; geological hazards; water resources; and energy resources.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - 2 Tutorial Assignments 5%
  - Field Trip 9%
  - 6 Laboratory Exercises 36%

GEOL2201 **PALAEONTOLOGY & THE HISTORY OF LIFE**
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
GEOL1101 - Earth Science 1: Earth Materials & Plate Tectonics **and** GEOL1102 - Earth Science 2: Earth Processes & Earth History **OR** BIOL1262 - Living Organism I **and** BIOL1263 - Living Organism II.

Course Content:
An overview of the most important fossil groups, and an introduction to modern palaeontological methods and research. The practical part of the course covers the fundamentals of fossilization and taphonomy and the morphology of common fossil groups within the major phyla. The lecture portion introduces the most important topics in palaeobiology, evolution, the species concept in palaeontology, phylogenetics, speciation and extinction. There will also be an overview of the major patterns in life history, covering large-scale biotic radiations and crises and their linkages to global environmental change.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Practical Examination (2 hours) 10%
    - 1200-1500 Word Tutorial Essay 20%
    - In-course Test (1hour) 20%

GEOL2202 **SEDIMENTARY GEOLOGY**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
GEOL1101 - Earth Science 1: Earth Materials & Plate Tectonics **AND** GEOL1102 - Earth Science 2: Earth Processes & Earth History.

Course Content:
The course provides the basic skills necessary to understand sedimentary rocks. Classification schemes for clastic and carbonate sedimentary rocks based on grain size, grain type and grain fabric, and their use in the field, in hand specimens and under the microscope. Sedimentary structures (erosional, depositional, post-depositional). Diagenetic features of rocks, and diagenetic pathways using sedimentary fabrics, stable isotopes and petrography.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Field Projects 10%
  - 4 Practical Assignments 40%

GEOL2203 **PETROLOGY OF IGNEOUS & METAMORPHIC ROCKS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
GEOL1101 - Earth Science 1: Earth Materials & Plate Tectonics **AND** GEOL1103 - Earth Science 3: Minerals & Mineral Deposits.

Course Content:
The course builds on the two major rock types (igneous and metamorphic) and rock-forming mineral identification introduced in GEOL1101 and GEOL1103, in the context of the mineralogy, chemical composition, petrology, field geology, tectonics (at the macro- and micro-scale), structure, and historical genesis of these rocks.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Field Projects 10%
  - 4 Practical Assignments 40%

GEOL2204 **FIELD TECHNIQUES FOR GEOLOGY**
(3 Credits) (Level 2) (Semester 1 & 2*)

Pre-requisites:
GEOL1101 - Earth Science 1: Earth Materials & Plate Tectonics**,** GEOL1102 - Earth Science 2: Earth Processes & Earth History **AND** GEOL1104 - Earth Science 4: Geological Maps & Environmental Geology.

Course Content:
Various techniques for collecting field data in geology, including geological mapping, collection of structural data, collection of data in a field notebook, and sedimentary logging. The course will distinguish between data (observation and recording of information) and interpretation of data. It will involve a 5-day MANDATORY residential field course and one-day field trips. One-day field trips

are held on Saturdays and/or Sundays. Field trips are MANDATORY. The course begins in week 7 of Semester 1 and ends in week 6 of Semester 2.

Evaluation:

- 2 Field Notebook Reports 20%
- Geological Field Map, Cross-sections, etc. 40%
- 8 Laboratory Exercises 40%

GEOL2205 **PLATE TECTONICS & GEOLOGICAL STRUCTURES**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOL1101 - Earth Science 1: Earth Materials & Plate Tectonics, GEOL1102 - Earth Science 2: Earth Processes & Earth History **AND** GEOL1104 - Earth Science 4: Geological Maps & Environmental Geology.

Course Content:
The course builds on the Level 1 course in plate tectonics and sets igneous, metamorphic and sedimentary rocks within their geological context. It will look at igneous suites and their geochemical characterization, and how this can be used to identify their plate tectonic setting. Metamorphic rocks will be used to infer geological indicators. The course will also build on the student's understanding of structural geology from GEOL1104, and explore the different tectonic styles found in different parts of the Caribbean and their importance to geological resources.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 2500-word Field Report 10%
    - 8 Laboratory Exercises 40%

GGEO2332 **INTRODUCTION TO GEOGRAPHICAL INFORMATION SYSTEMS**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
Two of:
GEOG1131 - Human Geography 1: Population, Migration and Human Settlement, GEOG1132 - Human Geography 2: World Economy, Agriculture & Food, GEOG1231 - Earth Environments 2: Geomorphology & Soil **and** GEOG1232 - Earth Environments I: Climate & the Biosphere.
OR
Two of:
GEOL1101- Earth Science 1: Earth Materials and Plate Tectonics, GEOL1102 - Earth Science 2: Earth Processes and Earth History, GEOL1103 - Earth Science 3: Minerals and Mineral Deposits **and** GEOL1104 - Earth Science 4: Geological Maps and Environmental Geology.

Course Content:
The course introduces students to the theory and general principles of GIS and to practical skills and hands-on experience in its use: the fundamental concepts and basic functions of a GIS; the properties of GIS maps; the structure of a GIS database; coordinate systems and map projections; methods of performing simple vector and raster spatial analysis. In lab exercises students will work with ArcMap to visualize geographic data, create maps, query a GIS database, perform spatial analysis using common analytical tools, and solve geographical problems using a systematic approach. The course introduces the core functionality of GIS software packages such as ArcMap, ArcCatalog, and ArcToolbox.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - In-course Test 20%
    - 6 Laboratory Exercises 30%

GGEO3105 **Applied GIS & Remote Sensing**
(3 Credits) (Level 2) (Summer)

Pre-requisites:
GGEO2232 - Climate Change **OR** Head of Department approval.

Course Content:
Review of GIS principles, concepts and components; Spatial Data Representation models; Remote Sensing principles, concepts and components; GNSS principles, concepts and components; GNSS Geodata acquisition; Spatial data generation and acquisition; Geodatabase creation and population; Data Automation; Geodatabase query; Geo-visualization techniques; GIS Web Mapping; (Geospatial Web Services); Mobile GIS Solutions ; GIS Programming & Application Development; Geospatial data analysis; Spatial Statistics; FOSS; SDI & Geospatial standards

Evaluation:
Coursework:

- 4 Lab assignments (10% each) 40%
- 1 Major Project 60%

GGEO2233 **WATER RESOURCES**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1231 - Earth Environments 2: Geomorphology & Soil **and** GEOG1232 - Earth Environments I: Climate & the Biosphere **OR** GEOL1102 - Earth Science 2: Earth Processes and Earth History **and** GEOL1104 - Earth Science 4: Geological Maps and Environmental Geology.

Course Content:
An in-depth study of the hydrological cycle, evaporation/transpiration, and rainfall-runoff relationships in hydrogeology; The factors affecting evaporation and evapotranspiration from free water surfaces and soils; Different estimates and measurements of evaporation and evapotranspiration and soil moisture storage and movement; The nature and origin of different types of aquifers, their geological properties, the various types of groundwater flows to wells, flows within aquifers under steady/non-steady conditions; Techniques of hydrogeological investigation, including drilling and pump testing. The hydraulics of surface water systems and seasonal variability of the flow pattern in streams

and rivers; Flooding and drought. Special emphasis on the water resources of Jamaica and other Caribbean islands.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Practical Examination (2 hours) 20%
    - In-course Test (1 hour) 30%

GEOL3100 **RESEARCH PROJECT IN FIELD GEOLOGY**
(6 Credits) (Level 3) (Year-long)

Pre-requisites:
GEOL2204 - Field Technique for Geology **AND** any three of:
GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological structures **and** GGEO2233 - Introduction to Geographical Information Systems.

Course Content:
A field-based research project to be undertaken in the summer preceding the final year of the programme, followed by laboratory analyses and report writing. The completed project report and an oral presentation will be required in Semester 2 of the final year.

Evaluation:

- Field and Laboratory Notes 10%
- Multimedia Presentation 10%
- Technical Report 80%

GEOL3102 **CAPSTONE: CARIBBEAN GEOLOGY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
GEOL2205 - Plate Tectonics & Geological Structures **AND** any one of:
GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology **and** GGEO2233 - Introduction to Geographical Information Systems.

Course Content:
Geological evolution of the Caribbean; Geology of Caribbean mainland and island countries, and the Caribbean seafloor.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Seminar Presentation (2 hours) 30%

GEOL3104 **SEDIMENTOLOGY & FACIES ANALYSIS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
GEOL2202 - Sedimentary Geology **AND** any one of:
GEOL2201 - Palaeontology & the History of Life, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological Structures **and** GGEO2233 - Introduction to Geographical Information Systems.

Course Content:
Advanced sedimentology; Facies analysis.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Field Notebook 10%
    - 4 Laboratory Practicals 40%

GEOL3105 **PETROLEUM GEOLOGY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GEOL2202 - Sedimentary Geology **AND** any one of:
GEOL2201 - Palaeontology & the History of Life, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological Structures **and** GGEO2233 - Introduction to Geographical Information Systems.

Course Content:

The concept of the Petroleum System. Source rock formation and evaluation. Chemical components of petroleum. Primary and secondary migration of hydrocarbons. Reservoirs traps and seals. Searching for hydrocarbons. Geophysical methods used in the search for hydrocarbons. Hydrocarbon provinces of the Caribbean and the Gulf of Mexico.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Field Notebook 10%
    - 4 Laboratory Practicals 40%

<u>GEOL3107</u> **<u>GEOPHYSICS & SEISMICITY</u>**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

GEOL2204 - Field Methods for Geology **AND** any one of:

GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2205 - Plate Tectonics & Geological Structures **and** GGEO2233 - Water Resources.

Course Content:

Introduction to Geophysics; Gravity Methods; Geomagnetics; Applied Seismology; Electrical Resistivity Methods. Electromagnetic Methods. Ground-Penetrating Radar. Case studies: Overview of geophysical techniques in engineering, environmental geology, oil exploration, archaeological studies and forensic applications; A field trip in which students will use Electrical Resistivity, Ground Penetrating Radar and Seismic Refraction survey techniques to identify subsurface geology, aquifers, lithological boundaries, and other engineering and environmental issues.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Field Report 10%
    - In-course Test 20%
    - Laboratory Assignments 20%

GEOL3108 **METALLIC ORES & INDUSTRIAL MINERALS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
GEOL2203 - Igneous & Metamorphic Petrology **AND** any one of:
GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological Structures **and** GGEO2233 - Introduction to Geographical Information Systems.

Course Content:
Definitions for resources and reserves; Abundances of metals in the Earth's crust; Overview of the natural processes that produce metallic mineral deposits; The metallic mineral potential of Jamaica and the Caribbean; How a geologist contributes to the development of metallic mineral occurrences: field mapping, sampling, core logging, data/information interpretation from field and laboratory, report writing; Rare Earth Elements; Construction materials (building stones, aggregates, cement); Industrial minerals. Resource assessments for metallic and industrial minerals.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory Exercises on mineral identification 10%
    - Laboratory Exercises on Resource Assessment 10%
    - Seminar and Class Discussion 30%

GGEO3231 **KARST & COASTAL GEOMORPHOLOGY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GEOL2202 - Sedimentary Geology **AND** GEOG2231 - Earth Surface Processes.

Course Content:
Karst Rocks and Material Properties; Karst Processes and Controls; Karst Landform Systems; Applied Karst Geomorphology; The Geomorphic Legacy of Sea-level Change and Paleo-Coastal Environments; Coastal Forces and Processes; Coastal Landform Systems; Applied Coastal Geomorphology.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Essay Assignments 10%
    - In-course Tests 20%
    - Field Project Report 20%

GGEO3232 **CLIMATE CHANGE IN THE TROPICS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
GEOG2232 - Climate Change **AND** any one of:
GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological Structures **or** Permission of Head of Department.

Course Content:
A theoretical and practical basis for understanding present-day tropical environments and the causes of global environmental change, as well as for assessing the scale of human interference in natural environmental processes.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Oral Presentation 10%
    - Laboratory Report (about 2500 words) 20%
    - Critical Review (about 2500 words) 20%

GGEO3233 **HYDROLOGY & HYDROLOGICAL MODELLING**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GGEO2233 - Water Resources.

Course Content:

1. Spatial and temporal variations in precipitation. Creation of rainfall maps using isohyetal, arithmetic mean and Theissen polygon method. Statistical methods for calculating return periods for rainfall and flood

data. Hydrograph separation using computational methods and calculation of baseflow, inter and overland flow.
2. Types of flooding and flood hazards in Jamaica.
3. Climate change and hydrological hazards. Hydrologic Simulation models, steps in watershed modelling, description of models, principles, mainly HEC HMS models. Floodplain hydraulics - principles and concepts of HEC RAS (1D) model including case studies.
4. Hydraulic properties of aquifers and their methods of determination. Groundwater flow calculations and flow variation under different climatic and non-climatic conditions. Geophysical and geological investigations for groundwater sources.
5. Groundwater contamination and transport model. Groundwater wells: types and methods of drilling. Water resources of the Caribbean, with special emphasis on Jamaica. Climate change and challenges in the water sector: Jamaica and the Caribbean.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Field Trip Report 10%
    - Laboratory Reports 40%

GGEO3332 **DISASTER MANAGEMENT**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GEOG2231 - Earth Surface Processes **AND** GEOG2232 - Climate Change **AND** any three of: GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2203 - Igneous & Metamorphic
Petrology, GEOL2204 - Field Methods for Geology, GEOL2205 - Plate Tectonics & Geological Structures or Permission of Head of Department.

Course Content:
1. An introduction to the basic principles and techniques in disaster management.
2. A study of theory, hazards, vulnerability, response capability, risk Evaluation, disaster scenarios, disaster management, preparedness, prevention, emergency response, and simulation.

3. Basic concepts of geology, geomorphology, tectonics and geophysics in the study of natural hazards, with special reference to the Caribbean.
4. Hazards and risks related to volcanic activity, earthquakes, landslides, hydrometeorological processes; flooding and hurricanes.
5. Hazard mapping. Approaches to natural hazard loss-reduction.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Multimedia Presentation 10%
    - Project Report 10%
    - 3 Practical Exercise 15%
    - Fieldwork 15%

GGEO3401 **RESEARCH PROJECT IN GEOSCIENCES**
(6 Credits) (Level 3) (Year-long)

Pre-requisites:
GEOL2204 - Field Methods for Geology **AND** GGEO2332 - Introduction to Geographical Information Systems **AND** any three of: GEOG2231- Earth Surface Processes, GEOG2232 - Climate Change, GEOL2201 - Palaeontology & the History of Life, GEOL2202 - Sedimentary Geology, GEOL2205 - Plate Tectonics & Geological **and** GGEO2233 - Water Resources. Students must be registered for the Geosciences major.

Course Content:
An approved research project in the field of Geosciences is undertaken in the summer preceding the final year of the programme. The course involves the formulation of a research project, the execution of the project and presentation of results. The final outcome involves a multi-media presentation of the research results, and the submission of a dissertation in Semester 2.

Evaluation:

- Project Report (dissertation) 80%
- Coursework: 20%
    - Project Proposal: 0% (necessary to continue but zero-rated)
    - Progress Report: 0% (necessary to continue but zero-rated)
    - Oral Presentation: 20%

DEPARTMENT OF LIFE SCIENCES

PROGRAMMES

Majors and B.Scs.

1. Animal Biology (Major)
2. Biology with Education (B.Sc.)
3. Experimental Biology (B.Sc.)
4. Environmental Biology (B.Sc.)
5. Horticulture (Major)
6. Marine Biology (Major)
7. Plant Biology (Major)
8. Terrestrial and Freshwater Ecology (Major)

Minors

1. Animal Biology
2. Coastal Ecosystems
3. Plant Biology
4. Terrestrial and Freshwater Ecology

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENTOF LIFE SCIENCES					
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**LEVEL**	**PRE-REQUISITES**
PRELIMINARY LEVEL					
BIOL0011	Preliminary Biology I	6	1	0	CSEC Biology or equivalent
BIOL0012	Preliminary Biology II	6	2	0	CSEC Biology or equivalent
LEVEL 1					
BIOL1017	Cell Biology	3	1	1	BIOL0011 and BIOL0012 OR CAPE Unit 1 & 2 ('A' level) Biology or equivalent
BIOL1018	Molecular Biology and Genetics	3	1	1	BIOL0011 and BIOL0012 OR CAPE Unit 1 & 2 ('A' level) Biology or equivalent
BIOL1262	Living Organisms I	3	2	1	BIOL0011 and BIOL0012 OR CAPE Unit 1 & 2 ('A' level) Biology or equivalent
BIOL1263	Living Organisms II	3	2	1	BIOL0011 and BIOL0012 OR CAPE Unit 1 & 2 ('A' level) Biology or equivalent

LEVEL 2 AND 3

Life Sciences Advanced courses are all 3 credits and will be offered as outlined in the tables below.

Pre-requisites for all Life Sciences Level 2 courses are:

BIOL1017, BIOL1018, BIOL1262, BIOL1263 or equivalent.

LEVEL 2 COURSES (10 courses of 3 credits each available)

ADVANCED COURSES OFFERED BY THE LIFE SCIENCES DEPARTMENT			
	6 Week Courses	**12 Week Courses**	**6 Week Courses**
Semester 1 **Week 1 - 6**	BOTN2401 Plant Form and Systematics	BIOL2401 Research Skills and Practices in Biology	BIOL2402 Fundamentals of Biometry
Semester 1 **Week 7 - 12**	BIOL2406 Eukaryotic Microbiology		BIOL2407 Biological Evolution
Semester 2 **Week 1 - 6**	BIOL2164 Principles of Molecular Biology	BIOL2403 Principles of Ecology	ZOOL2403 Maintenance Systems in Animals
Semester 2 **Week 7 - 12**	BOTN2402 Physiology of Plants		ZOOL2404 Coordination and Control in Animals
Summer: BIOL2408 - Diving for Scientists.			

LEVEL 3 COURSES					
Possible Combinations : A+B, A+C, B+C Impossible Combinations: A1+A2, B1+B2, C1+C2					
A1 **Tues/Thurs** **Mon/Fri**	**A2** **Tues/Thurs** **Mon/Fri**	**B1** **Fri/Mon**	**B2** **Fri/Mon**	**C1** **Mon**	**C2** **Mon/** **Fri**
BOTN3401 Principles of Plant Biotechnology	BOTN3402 Plant Breeding	ZOOL3404 Parasitology	ZOOL3409 Aquaculture	BIOL3407 Oceanography	BIOL3403 The Biology of Soil
BOTN3405 Plant Eco-Physiology	ZOOL3405 Vertebrate Biology	ZOOL3403 Entomology	BOTN3406 Tropical Forest	BIOL3408 Coastal Ecosystems	BOTN3403 Fundamentals of Horticulture
BIOL3404 Virology	ZOOL2402 Animal Physiology	BIOL3405 Pest Ecology & Management	BIOL3406 Freshwater Biology	ZOOL3408 Sustainable Use of Fishable Resources	ZOOL3407 Human Biology
AGCP3407 Post-Harvest Technology	BIOL3410 Water Pollution	ZOOL3406 Immunology	BIOL3400 Issues in Conservation Biology	BIOL3409 Caribbean Coral Reefs	BOTN3404 Economic Botany
AGBU3008 - Internship; AGBU3012 - Research Project; BIOL3412 - Internship; BIOL3413 - Biology Project; ZOOL3410 - Advanced Topics in Animal Science					

ANIMAL BIOLOGY (MAJOR)		
Introductory Courses (Level 1)	**A major in Animal Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A major in Animal Biology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:**	
	Level 2: minimum of twenty-one (21) credits from:	
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2404	Molecular and Population Genetics
	BIOL2407	Biological Evolution
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: minimum of fifteen (15) credits from:	
	ZOOL2402	Animal Physiology
	ZOOL3403	Entomology
	ZOOL3404	Parasitology
	ZOOL3405	Vertebrate Biology
	ZOOL3410	Advanced Topics in Animal Science
	And 3 credits from below:	
	BIOL3404	Virology
	BIOL3405	Pest Ecology and Management
	ZOOL3406	Immunology

BIOLOGY WITH EDUCATION (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Biology with Education requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
	MICR1010 - Introductory Microbiology and Molecular Biology 1 and BIOC1020 - Cellular Biochemistry are highly recommended.	
Advanced Courses (Level 2)	**A B.Sc. in Biology with Education requires a total of sixty-three (63) credits from Level 2 and must include:**	
	BIOL2401	Research skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2404	Molecular and Population Genetics
	BIOL2406	Eukaryotic Microbiology
	BIOL2407	Biological Evolution
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Please consult the Faculty of Humanities & Education regarding the selection of Education Courses.	

ENVIRONMENTAL BIOLOGY (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Environmental Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A B.Sc. in Environmental Biology requires a total of sixty-three (63) credits from Levels 2 and 3 and must include:**	
	Level 2: thirty (30) credits from:	
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2404	Molecular and Population Genetics
	BIOL2406	Eukaryotic Microbiology
	BIOL2407	Biological Evolution
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: At least thirty-three (33) credits from:	
	BIOL3400	Issues in Conservation Biology
	BIOL3406	Freshwater Biology
	BIOL3407	Oceanography
	BIOL3408	Coastal Ecosystems
	BIOL3409	Caribbean Coral Reefs
	BOTN3405	Plant Eco-physiology
	ZOOL3408	Sustainable Use of Marine Fishable Resources
	ZOOL3409	Aquaculture
	Including three (3) credits from:	
	BOTN3406	Tropical Forest Ecology
	ZOOL3403	Entomology
	Plus one (1) other advanced DLS course and either BIOL3413 - Biology Project OR BIOL3412 - Internship	

EXPERIMENTAL BIOLOGY (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc in Experimental Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Level 2 and 3)	**A B.Sc in Experimental Biology requires a total of sixty-three (63) credits from Levels 2 and 3 and must include:**	
	Level 2: thirty (30) credits	
	BIOL2401	Research skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2404	Molecular and Population Genetics
	BIOL2406	Eukaryotic Microbiology
	BIOL2407	Biological Evolution
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: At least thirty-three (33) credits from the three groups below with a minimum of three (3) credits from each group.	
	GROUP A	
	BIOL3402	Biology of Fungi (not offered in 2018/2019)
	BIOL3403	The Biology of Soil
	BIOL3404	Virology
	BIOL3405	Pest Ecology and Management
	GROUP B	
	BOTN3401	Principles of Plant Biotechnology
	BOTN3402	Introduction to Plant Breeding
	BOTN3403	Fundamentals of Horticulture
	BOTN3404	Economic Botany
	BOTN3405	Plant Eco-physiology
	GROUP C	
	ZOOL3403	Entomology
	ZOOL3404	Parasitology

	ZOOL3405	Vertebrate Biology
	ZOOL3406	Immunology
	ZOOL3407	Human Biology
	Plus BIOL3413 - Biology Project OR BIOL3412 - Internship	

HORTICULTURE (MAJOR)		
Introductory Courses (Level 1)	**A major in Horticulture requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A major in Horticulture requires a total of forty-two (42) Levels 2 and 3 credits and must include:**	
	Level 2: minimum of twenty- one (21) credits which must include:	
	AGSL2401	Management of Soil
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2404	Molecular & Population Genetics
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	Level 3: minimum of seventeen (17) credits from:	
	AGBU3008	Internship
	AGBU3012	Research Project
	AGCP3406	Fruit Crop Production
	AGCP3407	Post-harvest Technology
	AGLS3001	Irrigation and Drainage Technology
	And (six) 6 credits from:	
	BIOL3405	Pest Ecology and Management
	BOTN3402	Introduction to Plant Breeding
	BOTN3403	Fundamentals of Horticulture

MARINE BIOLOGY (MAJOR)		
Introductory Courses (Level 1)	**A major in Marine Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A major in Marine Biology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:**	
	Level 2: minimum of twenty-one (21) credits from:	
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2406	Eukaryotic Microorganisms
	BOTN2401	Plant Form and Systematics
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: minimum of fifteen (15) credits from:	
	BIOL3407	Oceanography
	BIOL3408	Coastal Ecosystems
	BIOL3409	Caribbean Coral Reefs
	ZOOL3408	Sustainable Use of Marine Fishable Resources
	ZOOL3409	Aquaculture
	And three (3) credits from:	
	BIOL3410	Water Pollution Biology
	ZOOL3405	Vertebrate Biology
	The following companion courses are strongly recommended:	
	BIOL2408	Diving for Scientists
	BIOL3413	Biology Project
	BIOL3412	Internship

PLANT BIOLOGY (MAJOR)		
Introductory Courses (Level 1)	**A major in Plant Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A major in Plant Biology requires a total of thirty-nine (39) credits from Level 2 and 3 and must include:**	
	Level 2: minimum of eighteen (18) credits from:	
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2404	Molecular and Population Genetics
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	Level 3: minimum of fifteen (15) credits from:	
	BIOL3403	The Biology of Soil
	BOTN3402	Introduction to Plant Breeding
	BOTN3404	Economic Botany
	BOTN3405	Plant Ecophysiology
	BOTN3406	Tropical Forest Ecology
	And six (6) credits from:	
	BIOL3404	Virology
	BIOL3405	Pest Ecology and Management
	BOTN3401	Principles of Plant Biotechnology
	BOTN3403	Fundamentals of Horticulture

TERRESTRIAL AND FRESHWATER ECOLOGY (MAJOR)		
Introductory Courses (Level 1)	**A major in Terrestrial and Freshwater Ecology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A major in Terrestrial and Freshwater Ecology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:**	
	Level 2: twenty-one (21) credits from:	
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2407	Biological Evolution
	BOTN2401	Plant Form and Systematics
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: twelve (12) credits from:	
	BIOL3400	Issues in Conservation Biology
	BIOL3406	Freshwater Biology
	BIOL3410	Water Pollution Biology
	BOTN3406	Tropical Forest Ecology
	And six (6) credits from:	
	BIOL3403	The Biology of Soil
	BIOL3405	Pest Ecology and Management
	BOTN3405	Plant Ecophysiology

ANIMAL BIOLOGY (MINOR)		
Introductory Courses (Level 1)	**A minor in Animal Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A minor in Animal Biology requires a total of fifteen (15) credits from Levels 2 and 3 and must include:**	
	Level 2: six (6) credits which must include:	
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: nine (9) credits from:	
	ZOOL2402	Animal Physiology
	ZOOL3403	Entomology
	ZOOL3404	Parasitology
	ZOOL3405	Vertebrate Biology
	ZOOL3406	Immunology

COASTAL ECOSYSTEMS (MINOR)		
Introductory Courses (Level 1)	**A minor in Coastal Ecosystems requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A minor in Coastal Ecosystems requires a total of eighteen (18) credits from Levesl 2 and 3 and must include:**	
	Level 2: nine (9) credits which must include:	
	BIOL2403	Principles of Ecology
	BIOL2406	Eukaryotic Microorganisms
	BOTN2402	Physiology of Plants
	Level 3: nine (9) credits which must include:	
	BIOL3408	Coastal Ecosystems

	BIOL3409	Caribbean Coral Reefs
	BOTN3405	Plant Ecophysiology

PLANT BIOLOGY (MINOR)		
Introductory Courses (Level 1)	**A minor in Plant Biology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses (Levels 2 and 3)	**A minor in Plant Biology requires a total of fifteen (15) credits from Levels 2 and 3 and must include:**	
	Level 2: nine (9) credits which must include:	
	BIOL2403	Principles of Ecology
	BOTN2401	Plant Forms and Systematics
	BOTN2402	Physiology of Plants
	Level 3: six (6) credits from:	
	BOTN3401	Principle of Plant Biotechnology
	BOTN3402	Introduction to Plant Breeding
	BOTN3403	Fundamentals of Horticulture
	BOTN3404	Economic Botany
	BOTN3405	Plant Ecophysiology

TERRESTRIAL AND FRESHWATER ECOLOGY (MINOR)		
Introductory Courses (Level 1)	**A minor in Terrestrial and Freshwater Ecology requires a minimum of twenty-four (24) credits from Level 1, eighteen (18) of which must be FST courses and must include:**	
	BIOL1017	Cell Biology
	BIOL1018	Molecular Biology and Genetics
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
Advanced Courses	**A minor in in Terrestrial and Freshwater Ecology requires a total of fifteen (15) credits from Levels 2 and 3 and must include:**	
	Level 2: six (6) credits which must include:	
	BIOL2403	Principles of Ecology
	BIOL2407	Biological Evolution
	Level 3: nine (9) credits from:	

(Levels 2 and 3)	BIOL3400	Issues in Conservation Biology
	BIOL3406	Freshwater Biology
	BOTN3406	Tropical Forest Ecology

COURSE DESCRIPTIONS

BIOL0011 **PRELIMINARY BIOLOGY I**
(6 P-Credits) (Level 0) (Semester 1)

Pre-requisite:
CSEC Biology **OR** equivalent.

Course Content:
1. Cell theory, structure & function; Physical & chemical basis of life (water, mixtures, biological macromolecules); Cellular processes (transmembrane transport; enzyme activity, cell division, DNA replication, protein synthesis).
2. Biological techniques.
3. Mendelian Genetics; Mutation; Genetic Engineering; Natural Selection; Variation; Mechanisms of Speciation; Taxonomy; Variety of life (bacteria, protists, fungi, plants and animals).
4. **Practical Work:** Experiments to demonstrate biochemical and biological processes, principles and techniques. Problem sets to illustrate major genetic concepts. Observation and illustration of living and preserved cells, and organisms to demonstrate diversity. Laboratory reports are submitted the end of the session.

Evaluation:
- Final Written Examination (2 hours) 30%
- Comprehensive Paper (2 hours) 30%
- Course Work: 40%
    - Laboratory Reports 10%
    - 2 In-course Practical Tests 20%
    - 2 In-course Theory Tests 20%

BIOL0012 **PRELIMINARY BIOLOGY II**
(6 P-Credits) (Level 0) (Semester 2)

Pre-requisite:
CSEC Biology **OR** equivalent.

Course Content:
1. **Systems in Angiosperms (Anatomy and Physiology):** Structure of roots, stems, leaves; Transpiration; Translocation; Photosynthesis.
2. **Metabolism:** Energy and Energetics; Cellular respiration

3. **Systems in Mammals (Anatomy and Physiology):** Nutrition and Digestion, Circulation, Respiration, Coordination and Control, Excretion and Osmoregulation; Movement and Support; Reproduction.
4. **Practical Work:** Gross and histological study of fresh and preserved angiosperms and mammals to demonstrate the relationship between form and function. Dissection of a mammal is included. Laboratory reports are submitted the end of the session.

Evaluation:

- Final Written Examination (2 hours) 30%
- Comprehensive Paper (2 hours) 30%
- Course Work: 40%
    - Laboratory Reports 10%
    - 2 In-course Practical Tests 20%
    - 2 In-course Theory Tests 20%

BIOL1017 **CELL BIOLOGY**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
A pass in one of the following:
BIOL0011 - Preliminary Biology I **AND** BIOL0012 - Preliminary Biology II,
CAPE (Units 1 and 2) Biology **OR** equivalent.

Course Content:

1. **Identify and Characterize various types of Cells and their levels of Biological Organization:** Mount living organisms for proper examination under the various types of light microscopes; Explain how the cellular components are used in the transfer and utilization of energy and information in cells; Interpret experimental data derived from hypothetical investigations into cell function; Analyse the effectiveness of the mechanisms utilized by cells to maintain internal thermodynamic stability; Apply their knowledge of cell biology to selected examples of response(s) that take place within cells consequent upon defined environmental or physiological changes; Outline the processes by which cells gather raw materials from the environment, construct out of these a new cell in its own image, complete with a new copy of the hereditary information; Describe the basic functional events involved in cell reproduction and the factors that regulate this process.

2. **Microscopical Techniques to study Living and Fixed Cells:** Structural organization of cells; specialization in cells; Basic functional processes in cells and their regulation; Mitosis and Meiosis.
3. **Practical Work:** Observation of living cells and permanent microscopical preparation; Making microscopical preparations;
Interpretation of electron micrographs.

Evaluation:

• Comprehensive Paper (2 hours)	50%
• Course Work:	50%
• Tutorial Attendance and Assignments	10%
• 1 In-course Test (1 hour)	20%
• Laboratory Reports	20%

BIOL1018 **MOLECULAR BIOLOGY AND GENETICS**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
A pass in one of the following:
BIOL0011 - Preliminary Biology I **AND** BIOL0012 - Preliminary Biology II,
CAPE (Units 1 and 2) Biology **OR** equivalent.

Course Content:
1. **Molecular Biology:** The nature of genes; DNA replication; Transcription; Protein synthesis; Control of gene expression; PCR, cloning and DNA sequencing.
2. **Genetics:** Mendelian Inheritance; Probability, binomial theorem and chi-square test; Quantitative traits; Linkage, crossing over and mapping; Sex linkage and sex determination; Gene frequencies in natural populations.
3. **Practical Work:** DNA isolation, restriction digestion and agarose electrophoresis; Exercises on Mendelian crosses and gene frequencies.

Evaluation:

• Comprehensive Paper (2 hours)	50%
• Course Work:	50%
• Tutorial Attendance and Assignments	10%
• 1 In-course Test (1 hour)	20%
• Laboratory Reports	20%

BIOL1262 **LIVING ORGANISMS I**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:

A pass in one of the following:

BIOL0011 - Preliminary Biology I **and** BIOL0012 - Preliminary Biology II,

CAPE (Units 1 and 2) Biology **OR** equivalent.

Couse Content:

1. **Evolutionary Concepts:** Archaebacteria & Eubacteria; Autotrophic protists; Phylogeny and classification of plants; Bryophytes; Seedless vascular plants; Seed plants – Gymnosperms; Seed plants – Angiosperms (form and function); Photosynthetic systems; Reproductive systems; Plant Ecology.
2. **Practical Work:** Structure of bacteria and protists; Classification of plants; Studies of the structure of the main groups of plants; Demonstrations of adaptive radiation of main groups of plants; The virtual and actual herbarium; The dichotomous key.

Evaluation:

- Comprehensive Paper (2 hours) 50%
- Course Work: 50%
    - Tutorial Attendance and Assignments 10%
    - 1 In-course Test (1 hour) 20%
    - Laboratory Reports (10 x 2% each) 20%

BIOL1263 **LIVING ORGANISMS II**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:

A pass in one of the following:

BIOL0011 - Preliminary Biology I **AND** BIOL0012 - Preliminary Biology II,

CAPE (Units 1 and 2) Biology **OR** equivalent.

Course Content:

Origin of animals; Evolution of diversity; Classification and phylogeny of animals; Ecological principles; Animal-like protists; Animal Architecture; Invertebrate animals; Vertebrate animals; Major groups of fungi; Classification of animals; Studies of the morphology of the main groups of animals and fungi; Dissection of selected animals to show internal anatomy and evolutionary development of the taxonomic group; Demonstrations of adaptive radiation of main groups of animals and fungi. Extensive practical/laboratory work illustrating all the various animal groups.

Evaluation:

- Comprehensive Paper (2 hours) 50%
- Course Work: 50%
    - Tutorial Attendance and Assignments 10%
    - 1 In-course Test (1 hour) 20%
    - Laboratory Reports (10 x 2% each) 20%

AGSL2401 **MANAGEMENT OF SOILS**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course Content:
Soil basics- texture and structure; Methods of land clearing and their effects on soil structure; Soil tillage and the management of soil structure for plant growth; Management of soil structure to improve water intake, transmission and storage;
Soil and crop water relations, water management for salinity control; soil erosion and the management of hillsides; Management of dry and wet lands; Management of forest soils; management of specific problem soils: Management for agriculture, soil management and its effects on microbes, microbial activity and soil fertility; Soil fertility management; soil quality, carbon sequestration; Soil management practices case studies.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Practical Test (2 hours) 20%
    - Laboratory Reports (5 x 4% each) 20%

BIOL2164 **PINCIPLES OF MOLECULAR BIOLOGY**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II OR equivalent.

Course Content:
This course provides an introduction to recombinant DNA technology, R-DNA cloning, and applications of R-DNA technology. It examines the importance of restriction endonucleases in gene cloning, methods of construction of vectors and their applications in developing gene libraries. The methods of screening and enrichment of libraries are also examined. The principles of the Polymerase Chain Reaction (PCR) and its applications including paternity testing and fingerprinting, are also discussed. The principles of sequencing and the expansion of next-generation sequencing techniques are examined. Approaches to locating genes, including map-based gene isolation, and methods of regulating gene expression, including RNAi, co-suppression, and over-expression are discussed using detailed examples. All techniques are further examined under general and holistic approaches to studying the genome, through forward and reverse genetics approaches, functional genomics, transcriptomics, proteomics and metabolomics. In this course, the theoretical principles discussed during the lectures are reinforced by practical activities that aid in student learning and understanding. As this is a practical – based course, activities in the lab, such as quizzes, lab reports and discussions are all assessed.

Evaluation:
- Written Final examination (2 hrs) 50%
- Course work 50%
  - Laboratory reports 10% (2 X 5%)
  - Case Studies 20% (2 X 10%)
  - MCQ Incourse test (2 hrs) 20%

BIOL2401 **RESEARCH SKILLS AND PRACTICES IN BIOLOGY**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II OR equivalent.

Course Content:
Transferable skills (time management, note taking, production of accurate illustrations of microscopic and macroscopic specimens, group dynamics and

coordination of group activities); Information technology and library resources; Bioethics: Plagiarism, fabrication and falsification of data; Scientific Communication; Laboratory techniques and procedures; Field work- approaches and procedures; Analytical skills; Collecting and identifying specimens; Manipulating and observing specimens; Basic analysis and presentation of data; Data handling, display and interpretation, and basic statistical analysis.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Literature Review 6%
    - Tutorial Exercises 6%
    - Oral Presentation and Poster 8%
    - Laboratory Reports 10%
    - MCQ In-course Test (1 hour) 20%

BIOL2402 **FUNDAMENTALS OF BIOMETRY**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course Content:

1. **Data in Biology:** Types of variables; accuracy and significant figures; data management.
2. **Populations and Samples:** Statistical populations; the need for samples; sampling procedures.
3. **Descriptive Statistics:** Frequency distributions; measures of central tendency; measures of dispersion.
4. **The Normal Distribution:** Probability density functions; properties of the normal distribution; the distribution of sample means; confidence intervals.
5. **Statistical Hypothesis Testing:** Making decision about populations based on samples; null and alternative hypotheses; alpha and beta error;
6. **One-Sample Hypotheses:** Hypotheses concerning population parameters; testing goodness of fit.
7. **Testing the relationship between two variables:** The nature of a statistical relationship; criteria used to select appropriate tests; overview of major tests.
8. **Applying tests for two variables:** Contingency tests; analysis of

variance; regression and correlation; rank tests; multiple comparisons; assessing validity of statistical assumptions.

9. **Tests for more than two variables:** Separating the influences of multiple independent variables on a dependent variable; statistical interaction.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Practical Test (2 hours) 20%
    - Laboratory Reports (4 x 5% each) 20%

BIOL2403 **PRINCIPLES OF ECOLOGY**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent. *This course may require participation in weekend field trips.*

Course Content:

Ecology and its domain; Geographic range habitat and niche, abiotic and biotic environment; Ecological role of abiotic factors (climatic and edaphic) on plant and animal populations Population performance along physical gradients; Population structure and demography; population change over time, growth models, dispersal, life tables and resource allocation patterns; Species interactions: competition, predation, herbivory, commensalism, ammensalism, protocooperation and mutualism; Communities; community classification, concepts and attributes; Island Communities; Primary and secondary ecological succession; Nutrient cycling and energy flow; Primary and secondary production, trophic levels and ecological efficiency.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test (1 hour) 10%
    - Practical Test (2 hours) 20%
    - Laboratory and Field Reports 20%

BIOL2406 **EUKARYOTIC MICROBIOLOGY**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** BIOC1020 - Cellular Biochemistry, BIOC1021 - Practical Biochemistry 1, MICR1010 - Introductory Microbiology & Molecular Biology **AND** MICR1011 - Practical Microbiology & Molecular Biology.

Course Content:

A study of the structure and function, taxonomy, reproduction, physiology and ecological applications of the protists and fungi inclusive of: The evolution of the eukaryotic condition; The biological diversity and phylogeny of the protists and fungi; The nutrition and adaptations within the protists and fungi; A systematic study of the major taxonomic groups: Diplomonads, Parabasilids, Euglenoids, Alveolates, Stramenopiles; The Algae: Cyanophyta; Glaucophyta; Rhodophyta; Chlorophyta, Streptophyte algae; The Fungi & fungal-like microorganisms; Reproduction in the protists and fungi; Ecology and economic importance of the protists and fungi;Management of the protists and fungi; Ecology, economic importance and management of the protists and fungi.Ecology and economic importance of the protists and fungi;Management of the protists and fungi.

Laboratory exercises include two group projects directed at the investigation of the morphology, physiology and ecology of selected protists and fungi involving the techniques of: light microscopy, isolation, inoculation techniques, aseptic technique and sterilization, making media, culture of microorganisms, and staining. Students are required to actively participate in interactive tutorial sessions in which they are required to apply their understanding of the material presented in lectures and demonstrate their understanding of the laboratory exercises.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Project Reports 10%
    - Practical Test (2 hours) 20%
    - Laboratory Reports 20%

BIOL2407 **BIOLOGICAL EVOLUTION**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course Content:

A historical perspective to evolution and variation; Hardy-Weinberg equilibrium, mutation, selection, migration, and genetic drift; non-random mating and inbreeding; Evolution below the species level, adaptation; Sex ratio, sexual selection, kin selection; Speciation, systematics, and the evolution of hominids.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory Reports (1 x 10%) 10%
    - MCQ In-course Test (2 x 20%) 40%

BOTN2401 **PLANT FORM AND SYSTEMATICS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course Content:

Plant body organization; Plant form and the environment structures involved in: Accessing raw materials from the environment, Structural support of the plant body; Anatomical specializations and structural adaptations of plants; Excretory processes; Plant reproduction; Plant habit types and their anatomical features; The evolution of plants; Plant life cycles; Plant systematics; Sources of taxonomic data; Contemporary taxonomic system and nomenclature of plants; Analysis and interpretation of taxonomic data; Herbaria and plant taxonomic research; Plant identification; Sporiferous non-vascular Plants: Anthocerotophyta, Hepaticophyta, Bryophyta; Sporiferous vascular plants: Pteridophyta; Sphenophyta; Seed-bearing plants: The seed habit, Gymnosperms, Angiosperms.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test 10%
    - Practical Test (2 hours) 20%
    - Laboratory Reports (4 x 5% each) 20%

BOTN2402 **PHYSIOLOGY OF PLANTS**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course Content:
How plants function at the level of cells, tissues, organs and the whole plant; Carbon fixation and the different photosynthetic pathways; Growth, development and differentiation of plant tissues and organs; Roles of Plant Growth Regulators in the physiology and biochemistry of cells and whole plants; Soil-plant relations, where and how water and nutrients are transported in plants; Source ink relations and translocation of photosynthates; Introduction to secondary metabolites and their roles in the physiology and the biochemistry of plants.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - In-course Test 10 %
    - Practical Test (2 hours) 20%
    - Laboratory Reports (4 x 5% each) 20%

ZOOL2402 **ANIMAL PHYSIOLOGY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals **OR** equivalent.

Course Content:

1. Digestive physiology; Exchange and transport of respiratory gases; Excretion of nitrogenous waste and salt and water balance; Generation

of nervous impulses and neuromuscular control; Hormonal control and homeostasis.

2. **Practical Work:** examination of anatomy relating to differing physiologies; experiments on organ system physiology under different conditions; research on applications of physiological knowledge, and, analysis of research papers.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Tests 10 %
    - Presentation/ Practical Test 12%
    - Laboratory Reports (4 x 7 % each) 28%

ZOOL2403 **MAINTENANCE SYSTEMS IN ANIMALS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course Content:

1. **Feeding and Digestion**: Structures a used for mastication, digestion, absorption and storage of food.
2. **Gut Systems:** types of gut systems, overview gut systems of vertebrates and invertebrates.
3. **Gaseous Exchange:** Important physical considerations: oxygen availability in different environments, diffusion of gases in air and water, impact of shape and size. Breathing in water and air, adaptations for diving.
4. **Circulatory Systems:** Comparison of gastrovascular and blood vascular systems; open and closed systems, Components of circulatory systems of selected invertebrates and vertebrates, Evolution of vertebrate circulatory system, microcirculation in vertebrates.
5. **Excretion and Osmoregulation:** Chemicals involved in excretion and osmoregulation, Contractive vacuoles, nephredia, malpighian tubules and nephrons, Secondary structures: salt glands, rectal glands, urate cells.

6. **Reproduction:** Comparison of asexual and sexual reproduction. Alternation of generations.Sexual and asexual reproduction various animal groups.
7. **Colonial Life:** Case studies from Prolifera and Cnidaria.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test 10 %
    - Practical Test (2 hours) 20%
    - Laboratory Reports (4 x 5% each) 20%

<u>ZOOL2404</u> **<u>COORDINATION AND CONTROL IN ANIMALS</u>**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

BIOL1017 - Cell Biology, BIOL1018 - Molecular Biology and Genetics, BIOL1262 - Living Organisms II **AND** BIOL1263 - Living Organisms II **OR** equivalent.

Course content:

1. **Embryonic Development and Structure of the Vertebrate and Invertebrate Nervous System:** Neurulation in the vertebrate, Regional specialization in the vertebrate brain, Meninges and tracts, Evolutionary trends in vertebrate brain development.
2. **Reflex Action and Autonomic Function:** Structural basis of visceral and somatic reflexes, Comparative anatomy of the autonomic nervous system in vertebrates, Development and evolution of the eye in animals considering mollusc and vertebrate eyes and the compound eyes of Arthropoda, The acoustic-lateralis system, Structure and functioning of hair cells in the teleost lateral line system and in the inner ear, Evolutionary development of the mammalian middle ear bones.
3. **The Structure of Selected Endocrine Glands and their Function:** Origins and embryonic development of the vertebrate hypophysis and adrenal gland, survey of the endocrine system of insects, crustaceans and cephalopods.
4. **Muscle Development and Function:** Embryological origins of the different muscle types their location and functions, Detail of the sliding filament theory of muscle contraction, The derivation of jaw muscles and facial muscles from the branchiometric musclature
5. **The Integument:** Formation of the integument in insects and vertebrates, Epidermal and dermal derivatives and their functions.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - MCQ In-course Test 10%
  - Practical Test (2 hours) 20%
  - 9 Laboratory Reports 20%

SUMMER SCHOOL ONLY:

BIOL2408 **DIVING FOR SCIENTISTS**
(3 Credits) (Level 2) (Semester 3 & 4)

Pre-requisites:
Lecturer's approval required. Students must have 24 first year credits in the FST, a certificate of "Fitness to Dive" from the University Health Centre and be able to pass a test of swimming competence. *This course may require participation in weekend field trips.*

Course Content:
Principles of diving including the properties of water, pressure and buoyancy, gas laws, and air consumption; Physiology of diving including the effect of pressure on the human body, adverse effects of gases, barotraumas, the role of nitrogen in decompression illness (DCI), signs and symptoms of DCI; Safe diving practices including the use of decompression tables, diver rescue techniques and emergency ascents; Diving Equipment; Diving as a tool for scientific research including an introduction to the fauna and flora of coral reefs; Underwater sampling and survey methods data collation and analysis.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - MCQ In-course Test 10%
  - Oral Presentation of research Project 10%
  - 5 Open Water Skills Test 30%

AGBU3008 **AGRICULTURE INTERNSHIP**
(4 Credits) (Level 3) (Summer)

Pre-requisites:
Lecturer's approval required.

Co-requisite:
AGBU3012 - Research Project.

Course Content:
The basics of scientific writing, experimental design, project reporting and presentation; Aims and means of assessing feasibility of projects; Techniques in data collection, collation and analysis; Investigation and written report on an approved topic.

Evaluation:
- Report Projects 50%
- Oral Examination 50%

AGBU3012 **RESEARCH PROJECT**
(4 Credits) (Level 3) (Semester 1&2)

Pre-requisites:
Lecturer's approval required.
Course Content:
The basics of scientific writing, experimental design, project reporting and presentation; Aims and means of assessing feasibility of projects; Techniques in data collection, collation and analysis; Investigation and written report on an approved topic.

Evaluation:
- Report Projects 50%
- Oral Examination 50%

NOTE: Students will be examined at the end of the Semester in which they are registered.

AGCP3407 **POSTHARVEST TECHNOLOGIES**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
BOTN2402 - Physiology of Plants.

Course Content:
Ripening and Senescence of Fruits; Maturation, Ripening, Senescence; Determinants of Readiness for Harvest; Maturation index, ripening index; Harvesting Practices; Manual harvesting, Mechanical harvesting; Best Agricultural Practices and harvesting; Preparation for Storage and Transport Transportation, Handling, Packaging; Storage Technologies Refrigeration, MA/CA packaging, Irradiation, Chemicals Other physical technologies (IR, UVc, hot water, etc.); Post-harvest Changes and Loss of Value.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Practical Test 15%
  - Field Exercise/Field Trip Report 15%
  - Research and Oral Presentation 20%

BIOL3400 **ISSUES IN CONSERVATION BIOLOGY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOL2403 - Principles of Ecology **AND** BIOL2407 - Biological Evolution. *This course may require participation in weekend field trips.*

Course Content:
Biological diversity and its values; Threats to biological diversity: habitat destruction, exotic species, pollution, global climate change, and over-exploitation; Conservation genetics and the population biology of threatened species; Managing threatened species: *in-situ* and *ex-situ* interventions; Establishing and managing protected areas; Social framework for the conservation of biodiversity.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work 50%

BIOL3401 **ENVIRONMENTAL MICROBIOLOGY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

BIOL2406 - Eukaryotic Microbiology.

Course Content:

1. **Cell Biology and Genetics:** Overview of the chemical composition of microbial cells, cell structure, genetic elements, mutation and genetic exchange, taxonomy and phylogeny.
2. **Biosynthesis:** Metabolism, anabolism, key enzymes, biosynthesis, nutrient assimilation, fuelling reactions, energetics.
3. **Metabolic Diversity:** Aerobic respiration, diversity of aerobic metabolism, fermentation, anaerobic respiration, anaerobic food chains, autotrophy, regulation of activity.
4. **Methods:** Sampling, detection, identification, enumeration.
5. **Populations, Communities, Ecosystems:** Interactions within and between populations, interactions with plants and animals, structure and dynamic of communities, abiotic factors.
6. **Applied Environmental Microbiology:** importance of microorganisms in bio-deterioration, solid and liquid waste (sewage) treatment, bioremediation, biodegradation, biological pest control and public health.
7. **Laboratory:** based exercises on the techniques necessary to grow and identify microorganisms, recognition and differentiation of microbial characteristics in culture, identification based on metabolic differences and nucleic acid based techniques.

Evaluation:

• Final Written Examination (2 hours)	50%
• Course Work:	50%
• Tutorial Participation	5%
• Laboratory Reports	15%
• Participation in Tutorials (Submission of PBL responses)	15%
• In-course Test	15%

BIOL3402 **BIOLOGY OF THE FUNGI**
(3 Credits) (Level 3) (Semester)

Pre-requisites:
BIOL2406 - Eukaryotic Microbiology.

Course Content:
The structural and ultra-structural characteristics and the ecological significance of the major groups of fungi of importance in the West Indies; The influence of genetic, nutritional and environmental factors on fungal growth, differentiation, reproduction and dispersal and germination of spores; The practical exploitation by man of fungal interactions (Fungi as sources of food, Fungal metabolite production, The roles of fungi in biotechnology); Prevention and control of fungal growth responsible for the bio-deterioration of commercial products; Collection, culture and preservation of fungi.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Oral Tutorial Presentation 10%
    - Laboratory Reports (5 x 4%) 20%
    - In-course Test 20%

BIOL3403 **THE BIOLOGY OF SOIL**
(3 Credits) (Level 3) (Semester)

Pre-requisites:
BIOL2403 - Principles of Ecology.

Course Content:
The soil environment; soil formation and soil abiotic components; soil organisms: prokaryotic and eukaryotic microorganisms, animals and plant parts; Biological processes occurring in soil; Environmental issues affecting life in the soil: acid rain, metal toxicity, salinity, radioactivity, pesticides, and the introduction of organisms; The impact of agricultural practices and climate change on soil ecology and biodiversity.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test 15%
    - Short-answer Test 15%
    - Laboratory and Field Reports (5 x 4%) 20%

BIOL3404 **VIROLOGY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOL2404 - Molecular and Population Genetics **OR** BIOL2312 - Molecular Biology I.

Course Content:
Fundamental concepts of virology; structure, replication cycles, transmission, epidemiology of human, animal, plant and microbial viruses; laboratory diagnostic techniques; laboratory-based exercises on the detection and basic characterization of viruses to include virus purification, bio-indexing, electron microscopy, serology, polymerase chain reaction and transmission.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Participation in Tutorials (Submission of PBL responses) 5%
    - Laboratory Reports 15%
    - In-course Test 20%

BIOL3405 **PEST ECOLOGY AND MANAGEMENT**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOL2401- Research Skills and Practices in Biology **AND** BIOL2403 - Principles of Ecology.

Course Content:
Pest evolution; Population dynamics of pest species; Pest-host and pest-natural enemies interactions; Insects and diseases; Assessing pest populations and related economic impact; The concept of pest management; Pest management strategies.

Evaluation:

- Final Written Examination (2 hours) 45%
- Course Work: 55%
    - Oral Presentation on Pest Survey 5%
    - Oral Examination 5%
    - Oral Presentations 5%
    - Insect Pest Collection 20%
    - Laboratory Reports (5 x 4%) 20%

BIOL 3406 **FRESHWATER BIOLOGY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
BIOL2403 - Principles of Ecology. *This course may require participation in weekend field trips.*

Course Content:
Lotic habitats; Physico-chemical characteristics; Concepts of subdivision of rivers and their applicability to tropical locations; The allochthonous food web; Resilience and refuge theory; Lentic habitats; Stratification and lake classification Productivity; Bio-manipulation and the cascade effect; Lake benthos; Field based collection of material and Evaluation of physico-chemical data Laboratory based identification of freshwater organisms.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Tutorial Participation 10%
    - Laboratory Reports 20%
    - Practical Examination 20%

BIOL3407 **OCEANOGRAPHY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
BIOL2403 - Principles of Ecology.

Course Content:
Ocean basins- their origin and structure; Chemical and physical properties of ocean water; Circulation and mixing: currents, waves and tides; Marine

sediments- their origin and deposition; Form and function of planktonic organisms; Distribution of planktonic organisms; Primary production and its measurement; Secondary production and its measurement; Food chains/food webs in the pelagic province; Ocean Nekton; Vertical migration and the deep sea pelagic area.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Oral Presentation of Tutorial Topics 5%
    - Practical Examination (5 x 5%) 20%
    - Laboratory Reports 25%

BIOL3408 **COASTAL ECOSYSTEMS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
BIOL2403 - Principles of Ecology.

Course Content:
An examination of the diversity, productivity and functions associated with: beaches and dunes; coral reefs; mangroves forests; seagrass beds; estuaries and wetlands; An examination of the range and impact of pollution affecting coastal ecosystems especially: organic; hydrocarbons; pesticides; heavy metals; physical and thermal pollution; Exercises in evaluation of: coastal surveys; environmental monitoring; water quality ranges and criteria; zoning, parks and protected areas as conservation options of coastal ecosystems.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Research Topic/Oral Presentation 10%
    - Laboratory and Field Report (5 x 5%) 20%
    - Practical Test 20%

BIOL3409 **CARIBBEAN CORAL REEFS**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:

BIOL2403 - Principles of Ecology. *Students may be required to demonstrate satisfactory competency in the water before embarking on this course.*

Course Content:

An introduction to the reef geography of the wider Caribbean and history of reef resource use in Caribbean; Coral Biology including taxonomy, anatomy and skeletal morphology, endosymbiosis with zooxanthellae, calcification and growth, nutrition, defensive behaviour, reproduction and recruitment; Environmental conditions required for coral reef formation, geological history of Caribbean reef formation and types of reefs; dynamics of reef structure formation and erosion; Reef community structure, zonation and dynamics; Major reef-associated organisms with attention to their ecological function; Uses including reef fisheries, tourism and recreation, biodiversity and marine products, and ecosystem services; Valuation including Total Economic Value, use values, option values and non-use values; The threats and future challenges to Caribbean coral reefs including natural disturbances and anthropogenic activities; Hurricanes, tsunamis, and earthquakes; Coral diseases and diseases of reef organisms; Overfishing, deterioration of water quality, physical destruction of reefs, climate change, invasive species; An introduction to monitoring methods and the ecosystem-based approach to reef management, including examples of mitigation actions appropriate to different geographic scales.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 1 In-Water Practical Test 10%
    - 1 Tutorial Research Essay 10%
    - 5 Laboratory and Field Report 30%

BIOL3410 **WATER POLLUTION BIOLOGY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals.

Course Content:
Sources and effects of water pollution; Biological monitoring of water quality; Toxicity of pollutants to aquatic organisms; Water pollution and public health; Water pollution control; Invasive species and their consequences to aquatic habitats.
Field and laboratory based exercises including examination of sources of pollution, conducting a bio-monitoring programme in Jamaican rivers, determining toxicity levels, determining coliform levels and BOD.

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Tutorials 10%
    - Laboratory Report 20%
    - Practical Examination 20%

BIOL3411 **RESEARCH PROJECT**

(6 Credits) (Level 3) (Semester 1 and 2)

Pre-requisite:
Approval from Head of Department.

Course Content:
Aims and means of assessing feasibility of projects; Techniques in data collection, collation and analysis; Ethical research, experimental design, project reporting and presentation; Scientific writing; Investigation and written report on an approved topic; Multi-media-based oral presentations.

Evaluation:
- Project Written Report 50%
- Oral Examination: 50%
    - Presentation 10%
    - Knowledge and Understanding 20%
    - Response to Questions 20%

BIOL3412 **INTERNSHIP**

(3 Credits) (Level 3) (Semester 3)

Pre-requisites:
BIOL2401 - Research Skills and Practices in Biology **AND** BIOL2402 - Fundamentals of Biometry; Internships are available to students doing BSc degrees in Life Sciences but placement is based on the availability of appropriate host companies. Head of department approval of course selection is therefore required.

Course Content:
On the job operations in a selected area of the Life Sciences disciplines; Daily log generation and production of written reports related to specially designed or general activities; Self-Evaluation of performance and operations in the work environment; Evaluation of the practices, efficiencies and suggest possible improvement of the operations for the main enterprise(s) at the host institution.

Note for Student:
The student is expected to spend 30 hours per week for approximately 6 weeks working in one of the pre-selected participating organisations. The student is required to: 1). Meet regularly with the Departmental Internship Coordinator to discuss the internship experience and any work-related or logistical issues 2). Maintain a daily log of hours worked and a brief description of the work performed 3). Submit a final report summarising and evaluating the internship experience; and 4). Complete a résumé and interview at the Office of Placement and Career Services, UWI (Mona).

Evaluation:
Internship report (graded by the Department coordinator) which summarize the activities carried out during the internship and how it relates to the BSc programme being pursued, documentation of the main operations and structure of the host organization, evaluation of the efficiency of the enterprise, and the student's own evaluation of the experience.

- Evaluation of Performance 25%
- Oral Presentation 25%
- The daily log of activities should be included as an appendix at the end of the report 50%

BIOL3413 **BIOLOGY PROJECT**

(3 Credits) (Level 3) (Semester 1, 2, 3)

Pre-requisites

BIOL2402 - Fundamental of Biometry **AND** Head of Department approval.

Course Content:

The basic elements of scientific method, experimental design, project reporting and presentation; Aims and means of assessing feasibility of projects; Techniques in conducting a scientific study: data collection, collation and critical analysis; Scientific report writing on an approved topic; Power point presentations; Review of research ethics.

Evaluation:

- Project Report (at least 2000 words) 75%
- Oral Examination (includes Power Point presentation) 25%

BOTN3401 **PRINCIPLES OF PLANT BIOTECHNOLOGY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

BOTN2402 - Physiology of Plants **OR** BIOL2312 - Molecular Biology I.

Course Content:

Fundamental concepts of plant biotechnology; plant tissue culture, transformation of plants or plant cells, stress, pathogen and herbicide tolerance, Improved nutritional content and functional foods, phytoremediation, forest biotechnology, plants as green factories; production of plastics, fats/oils, fibers, proteins and biofuels; GMO regulations; Laboratory-based exercises on plant micropropagation, transformation and molecular markers.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Participation in tutorials (PBL responses 5%
    - Laboratory Report (2 x 7.5%) 15%
    - In-course Test (1 hour) 20%

BOTN3402 **INTRODUCTION TO PLANT BREEDING**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOL2404 - Molecular and Populations Genetics.

Course Description:
This course will expose students to the achievements of plant breeding efforts from several countries and crops; discover the genetic basis of crop plant phenotypes; explore the wild and domesticated ancestors of our modern field crops as well as fruit and vegetable crops; design improvement strategies for self-pollinating, cross-pollinating and asexually propagated crops; run, work in a successful crop breeding program; develop molecular tools that will directly assist in the crop breeding process; formulate conservation strategies of the world's crop biodiversity through gene/germplasm banks.

Course Content:
Plant domestication and crop evolution; Reproduction in crop plants; Inheritance of quantitative characters and plant breeding; Breeding self-pollinated crops; Breeding cross-pollinated and clonally propagated crops; Breeding hybrid varieties by manipulation of fertility regulating mechanisms; Breeding for biotic and abiotic stress factors; Polyploidy and plant breeding; Germplasm resources, gene banks and conservation; New variety testing, release, maintenance and seed production; and Molecular breeding.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - Laboratory Report (5 x 2%) 10%
  - Mid-semester Examination (1 hour) 10%
  - Practical Examination 20%

BOTN3403 **FUNDAMENTALS OF HORTICULTURE**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
BOTN2401 - Plant Form and Systematics **AND** BOTN2402 - Physiology of Plants.

Course Content:

1. **Horticultural Plants** (as distinct from routine agricultural plants): morphology, taxonomy, environmental physiology.

2. **Propagation of Horticultural Plants**: Sexual propagation, Seed production and certification, methods of seeding, seed nursery, transplantation Asexual propagation: cuttings, grafting, budding, layering, specialised underground structures, micropropagation; Nursery Management.
3. **Controlled Environment Horticulture**: Greenhouse design and construction, Internal environment control, Light, irrigation, temperature, humidity, substrate, pot and bed culture.
4. **Out-door Environment Culture**: principles of landscaping, nursery production, bedding plants, ground cover/grasses, trees and shrubs.
5. **Growing Garden Crops**: ornamentals, vegetables, herbs, fruit trees; Post-Harvest Handling and Marketing of Horticultural Produce; Computers in Horticulture.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory and Field Trip Report 15%
    - Research and Oral Presentation 15%
    - Practical Test (2 hours) 20%

BOTN3404 **ECONOMIC BOTANY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BOTN2401 - Plant Form and Systematics **AND** BOTN2402 - Physiology of Plants.

Course Content:

1. Plant families of medicinal and economic importance.
2. Origin of Agriculture.
3. Ethnobotany:
    - **Medicinal Plants**: Herbs and spices; Phytochemicals; Nutraceuticals; Aromatherapy; Conventional and Alternative Medical Systems; Naturopathy; Integrative medicine; Traditional medical systems and botany.
    - **Social Uses of Plants**: Fumitories, Masticatories, Ethnic, cultural & religious influences on plant usage; Plant Products: flavours and fragrances, gums, resins, oils, fibres; Under-utilized tropical plant food; Timber and non-timber forest products; Economic uses of algae, bryophytes and pteridophytes; Conservation of medicinal and economically important plant genetic resources.

Evaluation:

• Final Written Examination (2 hours)	40%
• Course Work:	60%
• Field Projects	10%
• Laboratory Report (5 x 3%)	15%
• Oral Presentation and Tutorials	15%
• In-course Test (2 hours)	20%

BOTN3405 **PLANT ECOPHYSIOLOGY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
BOTN2401 - Plant Form and Systematics **AND** BOTN2402 - Physiology of Plants.

Course Content:
An examination of the physiological adaptations of tropical plants to their environments using the following as examples: Tropical Forests (the physiology of nutrient cycling and photosynthetic plastic response); Epiphytes and Lianas (the physiology of foliar absorption); Mangroves and salinas (the physiology of water uptake and salt extrusion); Aquatic habitats (respiration and photosynthesis underwater); Savannas, deserts and dunes (the physiology of C3, C4 CAM, CAM shifting and CAM idling).

Evaluation:

• Final Written Examination (2 hours)	50%
• Course Work:	50%
• Research Project with Oral Presentation	10%
• Practical Test (2 hours)	20%
• Laboratory and Field Report (5 x 4%)	20%

BOTN3406 **TROPICAL FOREST ECOLOGY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
BIOL2403 - Principle of Ecology. *This course may require participation in weekend field trips.*

Course Content:
Origins of tropical rain forests; Origins of tropical forest diversity; Characteristics of tropical rain forests; Tropical rainforest formations; Tropical dry forests;

Reproductive ecology of tropical rain forest trees; Reproductive ecology of tropical dry and moist forest trees; Principles of tropical forest hydrology; Tropical forest nutrient cycles; The effects of deforestation and habitat fragmentation; Payments of ecosystem services and REDD (reducing emissions from deforestation and forest degradation); Global climate change and tropical forest ecosystems.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Research Topic 10%
    - Fieldwork Report (2 hours) 30%

<u>ZOOL3403</u> **<u>ENTOMOLOGY</u>**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

BIOL2401 **AND** (ZOOL2403 - Maintenance Systems in Animals **and** ZOOL2404 - Coordination and Control in Animals) **OR** (BOTN2401 - Plant Form and Systematics **and** BOTN2402 - Physiology of Plants). *This course may require participation in weekend field trips.*

Course Content:

Biology of the insects including external and internal morphology in relation to taxonomy and evolution, life histories, social organizations where applicable, place in biosphere; Diversity of the insects including: taxonomy, an order-by-order survey with emphasis on Caribbean fauna and economically important groups; Examples of harmful groups including pests and vectors; Examples of beneficial taxa, such as those important for pollination, natural control of populations, and ecotourism; Practical Component: Laboratory exercises to study basic morphological structures as well as modifications; Exercises in taxonomy including use of binomial keys; Practice of techniques in the collection and curation of insects; Field trips to practice and evaluate various techniques; opportunities to collect insects and study their adaptations to a wide variety of habitats.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory Reports 10%
    - Oral Examination 15%
    - Insect Collection 25%

ZOOL3404 **PARASITOLOGY**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **and** ZOOL2404 - Coordination and Control in Animals **OR** BIOC2014 - Bioenergetics and Cell Metabolism, BIOL2312 - Molecular Biology I, **and** MICR2211 - Microbiology **AND** BIOL2406 - Eukaryotic Microbiology.

Course Content:
Fundamental concepts of parasitology; morphology, lifecycle, transmission, pathology and control of selected protist, helminth and arthropod parasites of humans and domesticated animals; laboratory diagnostic techniques; parasite ecology and evolution; parasite immunology; epidemiology of soil-transmitted helminth (STH) infections in the Caribbean region; Laboratory-based exercises to include recognition and diagnosis of a range of parasitic infections of humans and domesticated animals.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - Participation in Tutorials 5%
    - Visual Media Examination (2 hours) 15%
    - Laboratory Report (10x3%) 30%

ZOOL 3405 **VERTEBRATE BIOLOGY**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals. *This course may require participation in weekend field trips.*

Course Content:
Vertebrate relationships and basic structure; Diversity and radiation of fishes; Radiation of tetrapod; Avian specializations; Radiation and diversity of birds; The evolution and biogeography of mammals; Mammalian characteristics, specializations and diversity; Aquatic mammals. Primate evolution. Ecology and social behaviour of mammals and birds; Herbivory; Reproductive strategies and population dynamics of vertebrate populations; Commensal vertebrates and vertebrate pests; Practical Component: Field and laboratory-based exercises including, ecomorphology of fishes, lizard behaviour, composition of bird communities in different habitats, mammalian feeding strategies.

Evaluation:

- Final Theory Examination (2 hours) 60%
- Course Work: 40%
    - Tutorial Participation 5%
    - Laboratory Report (5 x 3%) 15%
    - Group Presentation 20%

ZOOL3406 **IMMUNOLOGY**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

ZOOL2403 - Maintenance Systems in Animals **and** ZOOL2404 - Coordination and Control in Animals) **OR** BIOC2014 - Bioenergetics and Cell Metabolism, BIOL2312 - Molecular Biology I, **and** MICR2211 - Microbiology).

Course Content:

1. **Basic Immunology**: Components of innate and acquired immunity; immunogens and antigens; antibody structure and function; antibody-antigen interactions; the complement system; ontogeny of immune cells; triggering the immune response; the major histocompatibility complex in immune responses; control mechanisms in the immune response.
2. **Immunity in Action**: Immunoassays, hypersensitivity reactions, disorders of the immune response, HIV infection, autoimmunity, transplantation immunology, tumor immunology.
3. **Laboratory Work**: Histology of lymphoid organs of the mouse; viable counts of splenic lymphocytes; precipitation & agglutination reactions; diagnostic immunology; problem-based learning exercises, etc.

Evaluation:

- Final Theory Examination (2 hours) 50%
- Course Work: 50%
    - 1 MCQ Paper (2 hours) 20%
    - Laboratory Reports (5 x 6% each) 30%

ZOOL3407 **HUMAN BIOLOGY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals **OR** BIOC2014 - Bioenergetics and Cell Metabolism, BIOL2312 - Molecular Biology I, **and** MICR2211 - Microbiology.

Course Content:
Human identity; Human development; Human functional systems; Musculo-skeletal; Neuro-sensory; Metabolic; Respiration; Circulatory; Urinary; Reproductive; Immune; Abnormalities e.g. cancer, congenital, autoimmune; Human heredity and genetics; aging; Human evolution; Man and the environment; Normative ethics; environmental ethics.

Evaluation:
- Final Theory Examination (2 hours) 50%
- Written Project 50%

ZOOL3408 **SUSTAINABLE USE OF MARINE FISHABLE RESOURCES**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals.

Course Content:
1. **Fish Biology:** External form and functional design; Locomotion; swim bladders; red muscle; Growth and estimation of growth rates, ageing techniques; reproduction & larval life.
2. **Fisheries Evaluation:** Fishing techniques; Fish population dynamics, stocks, populations, recruitment, mortality; Fish populations & exploitation, fishing effort, CPUE, yield, yield models, MSY, OEY; Introduction to fisheries modeling & Evaluation software.
3. **Caribbean Fisheries:** Jamaica reef fisheries; Pelagics; Guyana shelf fisheries; Lobster & queen conch industrial fisheries, Spearfishing.
4. **World Fisheries:** Case study- Peruvian anchoveta collapse, El Nino ENSO phenomenon; Lionfish invasive in Atlantic & Jamaica; Large marine mammal exploitation; Major harvesting methods.
5. **Fisheries Management**: Principles of fisheries management; Paradigm shifts in management; Marine Protected Areas/Fish Sanctuaries, Ecosystem Based Management (EBM).

6. **Practical Component:** Laboratory demonstration of fishable species showing variability and difficulties of exploitation; Investigation of Fishable resources of Kingston Harbour demonstrating gear operation, gear selectivity; ecological factors affecting resource distribution; Lionfish research at the Discovery Bay Marine Lab (DBML), St. Ann, management of invasives, lionfish behaviour and distribution studies; Caribbean Coastal Area Management Foundation (CCAMF), Salt River, Clarendon & fish sanctuary tour to demonstrate fisheries co-management issues, ecology of sanctuaries, reality of management of a major coastal zone.

Evaluation:

- Final Theory Examination (2 hours) 50%
- Course Work: 50%
    - In-course Test (2 hours) 25%
    - Practical Assignment (5 x 6% each) 25%

ZOOL3409 **AQUACULTURE**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals.

Course Content:

1. **Water Quality:** Dissolved gases, alkalinity and hardness, Nitrogen cycles, Phosphorus cycle, Sulphur cycles, iron cycle and Redox potential.
2. Hatchery Management Practices: Modern hatchery systems, fish seed production, hormonal treatment, fish propagation in hatcheries, fry handling and transportation.
3. **Pond Construction:** Site selection criteria, site surveying and pond design, water supply, pond management.
4. **Fish Culture, Nutrition and Diseases:** Fish culture, fish production principles, stocking rates, fertilization, food chemistry, feed composition, common diseases, prophyllaxis and treatment.
5. **Shrimp Culture and Oyster Culture:** Marine shrimps and freshwater prawns, lobsters, oyster culture, harvesting technologies.
6. **Practical Components:** Water quality on a commercial fish farm, monitoring and evaluation; Hatchery on commercial fish farm, Longville Park, Clarendon; Pond infrastructure and construction principles, surveying ponds, Twickenham Park Station, St. Catherine; Tilapia fry production, food fish production on commercial fish farm, Barton Isle,

St. Elizabeth; Oyster culture technologies and harvesting methods, Bowden Bay, St. Thomas.

Evaluation:

- Final Theory Examination (2 hours) 50%
- Course Work: 50%
    - In-course Test (2 hours) 20%
    - Practical Reports (5 x 6%) 30%

<u>ZOOL3410</u> **<u>ADVANCED TOPICS IN ANIMAL SCIENCE</u>**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND** ZOOL2404 - Coordination and Control in Animals.

Course Description:
This seminar course will provide students with advanced, transferrable, specialized or applied exposure to current topics in animal and human biology through a structured series of formal presentations by local and overseas experts in the industry. It aims to equip students with in-depth awareness of the relevance of a diverse array of topical issues to the Caribbean, and with such transferable skills prepare them for the industry, or advanced studies in the field of animal or human biology.

Course Content:
Loss of biodiversity and ecosystem balance; Ethical treatment of animals; Research ethics; Animal diseases; Rapid survey techniques; Horizontal gene transfer; Animal behaviour; Embryology; Climate change; diverse perspectives;

Overpopulation; Genetics and Epigenetics; Zoological gardens; Professional zoology; Paleozoology; Permitting of investigations; Logical framework approach; Euthanasia; Evolution of HIV; Taxonomic techniques; Thinking critically.

Evaluation:

- Reflective Journal Record (10 x 5%) 50%
- In-depth Analysis 50%
    - Oral 10%
    - Written 40%

DEPARTMENT OF MATHEMATICS

PROGRAMMES

Majors and B.Scs.

1. Actuarial Science (B.Sc.)
2. Mathematics (Major)
3. Mathematics with Education Studies (B.Sc.)
4. Mathematics and Modelling Processes (B.Sc.)
5. Mathematics of Finance (B.Sc.)
6. Mathematics and Economics **
7. Statistical Science (B.Sc.)

Minor

1. Mathematics

**** Economics can be pursued as a major or minor**

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
PRELIMINARY				
M08B/MATH0100	Pre-Calculus	6	1	CXC Mathematics or equivalent
M08C/MATH0110	Calculus And Analytical Geometry	6	2	CXC Mathematics or equivalent
LEVEL 1				
MATH1141	Introductory Linear Algebra And Analytic Geometry	3	1	CAPE or GCE A-Level Mathematics, or M08B/MATH0100 and M08C/MATH0110 or equivalent
MATH1142	Calculus I	3	1	CAPE or GCE A-Level Mathematics, or M08B/MATH0100 and M08C/MATH0110 or equivalent
MATH1151	Calculus II	3	2	Calculus I
MATH1152	Introduction To Formal Mathematics	3	2	CAPE or GCE A-Level Mathematics, or M08B/MATH0100 and M08C/MATH0110 or equivalent
MATH1185	Calculus For Scientists and Engineers	3	1	CAPE or GCE A-Level Mathematics, or M08B/MATH0100 and M08C/MATH0110 or equivalent
STAT1001	Statistics For The Scientists	3	1 or 2	CAPE or GCE A-Level Mathematics, or M08B/MATH0100 and M08C/MATH0110

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
				or equivalent
LEVEL 2				
MATH2401	Elements Of Mathematical Analysis	3	1	MATH1141, MATH1142, MATH1151 and MATH1152 or M10A, M10B
MATH2403	Multivariable Calculus	3	2	MATH1141, MATH1142 and MATH1151 or MATH1185 or M10A and M10B
MATH2404	Introduction To Probability Theory	3	1	MATH1141, MATH1142, MATH1151 & MATH1152 or M10A & M10B
MATH2407	Stochastic Modeling	3	2	MATH2404
MATH2410	A First Course In Linear Algebra	3	1	(MATH1141 & MATH1152) or (M10A & M10B)
MATH2411	Introduction To Abstract Algebra	3	2	(MATH1141 & MATH1152) or (M10A & M10B)
MATH2420	Ordinary Differential Equations	3	2	(MATH1141, MATH1142, MATH1151 & MATH1151) or (M10A & M10B)
MATH2421	Fourier Series And Integral Transforms	3	1	(MATH1141, MATH1142 & MATH1151) or (MATH1185) or (M10A & M10B)
MATH2430	Linear Optimization	3	2	(MATH1141 & MATH1152) or (M10A & M10B)
MATH2431	Non-Linear Optimization	3	1	(MATH1141 & MATH1142) or (M10A & M10B)

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
MATH2701	Financial Mathematics I	3	1	(MATH1141, MATH1142, MATH1151 & MATH1152) or (M10A & M10B)
MATH2702	Actuarial Mathematics I	3	2	MATH2701 and MATH2404
STAT2001	Inferential Statistics	3	2	STAT1001 or MATH2404
STAT2002	Discrete Statistics	3	2	STAT1001, MATH1142
STAT2003	Linear Models	3	2	STAT1001, STAT2001
STAT2004	Multivariate Methods	3	2	STAT1001, MATH1141, MATH2410
LEVEL 3				
MATH3155	Complex Variables	3	1	MATH2401
MATH3401	Introduction To The Theory Of Integration	3	1	MATH2401
MATH3402	A Course On Metric Spaces And Topology	3	2	MATH2401
MATH3403	Some Topics In Functional Analysis	3	2	MATH2401
MATH3404	Introduction To Differential Geometry With Computer Software	3	2	MATH2410, MATH2403
MATH3405	Number Theory	3	1	MATH2401, MATH2411
MATH3411	Advanced Abstract Algebra	3	2	MATH2411
MATH3412	Advanced Linear Algebra	3	1	MATH2410

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
MATH3414	Selected Topics In Operations Research	3	1	MATH2404
MATH3421	Partial Differential Equations	3	1	MATH2420
MATH3422	Mathematical Modelling	3	1	MATH2401, MATH2410, MATH2420
MATH3423	Research Project In Mathematics	3	2	MATH2401, MATH2420, Courses prescribed by the supervisor with the nature of the project
MATH3424	Numerical Methods	3	2	MATH2401
MATH3425	Techniques For Solving Advanced Mathematics Problems	3	1	MATH2401, MATH2410
MATH3801	Financial Mathematics II	3	1	MATH2701, MGMT2023, MGMT3048, MATH2404
MATH3802	Evaluation Actuarial Models	3	2	MATH2702, MATH2404, STAT2001
MATH3803	Models For Financial Economics	3	2	MATH3801
MATH3804	Actuarial Mathematics II	3	1	MATH2701, MATH2702
MATH3805	Mathematics of Pension Funds	3	2	MATH2701, MATH2702, MATH3804

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDIT**	**SEMESTER OFFERED**	**PREREQUISITES**
MATH3806	Topics In General Insurance	3	2	MATH2701, MATH2404
STAT3001	Regression Analysis	3	1	STAT2001 and MATH2410 (background)
STAT3002	Time Series	3	2	MATH2404, STAT2001
STAT3003	Design & Analysis of Experiments	3	2	STAT2001

ACTUARIAL SCIENCE (B.Sc.)		
	A B.Sc. Actuarial Science requires a total of thirty six (36) Level 1 credits from:	
Introductory Courses (Level 1)	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Objected Oriented Programming
	COMP1220	Computing and Society
	ECON1000	Principles of Economics I
	ECON1012	Principles of Economics II
	ACCT1003	Introduction to Cost & Management Accounting
	ACCT1005	Introduction to Financial Accounting
	A B.Sc. Actuarial Science requires sixty six (66) advanced credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	MATH2401	Elements of Mathematical Analysis
	MATH2404	Introduction to Probability Theory
	MATH2410	A First Course in Linear Algebra
	MATH2407	Stochastic Modelling I
	MATH2420	Introduction of Ordinary Differential Equations
	MATH2701	Financial Mathematics I
	MATH2702	Actuarial Mathematics I
	MGMT2023	Financial Management I
	STAT2001	Inferential Statistics
	MATH3801	Financial Mathematics II
	MATH3802	Construction and Evaluation of Actuarial Models
	MATH3803	Models for Financial Economics
	MATH3804	Actuarial Mathematics II
	MATH3805	Mathematics of Pension Funds
	MATH3806	Topics in General Insurance
	MGMT3048	Financial Management II
	STAT3001	Regression Analysis

	STAT3002	Time Series
	AND eleven (11) credits from:	
	COMP2140	Software Engineering
	COMP2180	Web Design and Programming I
	ECON2000	Intermediate Microeconomics I
	ECON2002	Intermediate Macroeconomics I
	ECON2001	Intermediate Microeconomics II
	ECON2003	Intermediate Macroeconomics II
	MATH2403	Multivariable Calculus
	MATH2430	Linear Optimization
	MATH2411	Introduction of Abstract Algebra
	MATH2431	Non-Linear Optimization
	SOCI2004	Introduction to Population
	COMP3110	Information Systems in Organisations
	COMP3180	Web Design and Programming II
	MATH3414	Selected Topics in Operations Algebra
	MATH3412	Advanced Linear Algebra
	MATH3421	Partial Differential Equations
	MATH3414	Selected Topics in Operations Algebra
	MATH3422	Mathematical Modelling
	MATH3423	Research Project in Mathematics
	MATH3424	Numerical Methods
	MATH3490	Complex Analysis
	SOCI3018	Demography I
	SOCI3021	Demography II

MATHEMATICS (MAJOR)		
Introductory Courses (Level 1)	**A major in Mathematics requires a total of twelve (12) Level 1 credits from:**	
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
Advanced Courses (Levels 2 and 3)	**A major in Mathematics requires a minimum of thirty-six (36) credits from Levels 2 and 3 and must include:**	
	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory
	MATH2410	A first course in Linear Algebra
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Ordinary Differential Equations
	MATH3155	Complex Variables
	MATH3402	A course on Metric Spaces & Topology
	MATH3412	Advanced Linear Algebra
	AND nine (9) credits from:	
	MATH3403	Some Topics in Functional Analyses
	MATH3404	Introduction to Differential Geometry
	MATH3411	Advanced Abstract Algebra
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3423	Research Project
	MATH3424	Numerical Methods
	STAT3002	Time Series

MATHEMATICS WITH EDUCATION STUDIES (B.Sc.)		
	INITIAL TEACHER TRAINING (Option 1)	
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	EDPS1003	Psychological Issues in the Classroom
	EDTL1020	Introduction to Teaching and Learning
	EDTL1021	Planning for Teaching
	Plus (6 credits optional) in-faculty courses.	
Advanced Courses (Level 2 and 3)	**Year 2**	
	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory
	MATH2410	A First Course in Linear Algebra
	MATH2420	Introduction of Ordinary Differential Equations
	STAT2001	Inferential Statistics
	EDMC2213	Children Learning Mathematics
	EDMA2216	Analysis and Teaching of Mathematics
	EDTL2021	School Based Experience 1
	Year 3	
	EDRS3019	Report
	EDTL3017	Field Study (School Based Experience 1)
	EDME3205	Teaching Mathematics in Grades 10 & 11
	EDMA3208 **or** EDMA3217	History & Development of Mathematical Ideas Pedagogical Issues for the Teaching of Mathematics
	MATH3402	A course on Metric Spaces & Topology
	MATH3423	Research Project (Mathematics)
	MATH3425	Techniques for Solving Advanced Problems
	Plus 3 Level 2 or 3 Mathematics courses	
	Plus a CORE math education course	

TRAINED TEACHER (Option 2)		
	Year 1	
Introductory and Advances Courses (Levels 1 and 2)	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	EDMC2213	Children Learning Mathematics
	EDMA2216	Analysis and Teaching of Mathematics
	MATH2401 (summer Term)	Elements of Mathematical Analysis
	MATH2410 (summer Term)	A first course in Linear Algebra
	Plus (6 credits optional) in-faculty level 1 courses.	
	Year 2	
Advanced Courses (Level 2 and 3)	MATH3402	A Course on Metric Spaces & Topology
	MATH2403	Multivariable Calculus
	MATH2404 (summer Term)	Introduction to Probability Theory
	MATH2420 (summer Term)	Ordinary Differential Equations
	MATH3423	Research Project Mathematics
	MATH3425	Techniques for Solving Advanced Problems
	STAT2001	Inferential Statistics
	EDRS3019	Report
	EDTL3020	Preparing for the Field: The Teacher as Researcher
	EDTL3021	In the Field: Teaching as Experiment
	EDME3205	Teaching Mathematics in Grade 10&11
	Plus any one Level 2 or 3 Mathematics Courses	
	Plus any 1 core math education course	

MATHEMATICS AND MODELLING PROCESSES (B.Sc.)		
Introductory Courses (Level 1)	**A BSc. Mathematics and Modelling Processes requires a total of twenty-four (24) Level 1 credits and include those listed below:**	
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
Advanced Courses (Levels 2 and 3)	**A BSc. Mathematics and Modelling requires a minimum of sixty advanced (60) credits from Levels 2 and 3 and <u>must</u> include the following:**	
	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory
	MATH2407	Stochastic Modelling
	MATH2410	A first course in Linear Algebra
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Introduction of Ordinary Differential Equations
	MATH2421	Fourier Series & Integral Transforms
	MATH2430	Linear Optimization
	STAT2001	Inferential Statistics
	MATH3155	Complex Variables
	MATH3402	A course on Metric Space & Topology
	MATH3412	Advance Linear Algebra
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3423	Research Project
	MATH3424	Numerical Methods
	AND nine (9) credits from:	
	MATH3401	Introduction to the Theory of Integration
	MATH3403	Some topics in Functional Analysis
	MATH3404	Introduction to Differential Geometry
	MATH3411	Advanced Abstract Algebra
	MATH3414	Selected Topics in Operations Research
	STAT3001	Regression Analysis

	STAT3002	Time Series

MATHEMATICS OF FINANCE (B.Sc.)

	A BSc Mathematics of Finance requires thirty-three (33) credits are required as follows:	
Introductory Courses (Level 1)	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	PH10B	Ethics & Applied Ethics
	ECON1000	Principles of Economics I
	ECON1012	Principles of Economics II
	ACCT1003	Introduction to Cost & Management Accounting
	ACCT1005	Introduction to Financial Accounting
	Advanced Courses	
Advanced Courses (Levels 2 & 3)	**A total of sixty-six advanced credits are required as listed below:**	
	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory
	MATH2410	A First Course in Linear Algebra
	MATH2407	Stochastic Modelling I
	MATH2420	Introduction of Ordinary Differential Equations
	MATH2701	Financial Mathematics I
	MGMT2068	Risk & Treasury Management
	MGMT2023	Financial Management I
	STAT2001	Inferential Statistics
	MATH3801	Financial Mathematics II
	MATH3802	Construction and Evaluation of Actuarial Models

	MATH3803	Models for Financial Economics
	MGMT3048	Financial Management II
	STAT3002	Time Series
	ECON3005	Monetary Theory & Policy
	ECON3072	Financial Markets
	MATH3423	Research Project (Mathematics)
	Plus 9 credits from the following (electives):	
	MATH3412	Advanced Linear Algebra
	MATH3421	Partial Differential Equations
	MATH3424	Numerical Methods
	MATH3414	Selected Topics in Operations Research
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	ECON3007	International Finance
	COMP3161	Database Management Systems

MATHEMATICS (MAJOR) AND ECONOMICS (MAJOR)		
	This double major requires students satisfying both faculty requirements. They are required to satisfy the following Level 1 courses.	
Introductory Courses (Level I)	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	STAT1001	Statistics for Scientists
	ECON1001	Principles of Economics I
	ECON1012	Principles of Economics II
	COMP1126 Or COMP1220	Introduction to Computing I Computing & Society
Advanced Courses (Levels 2 and 3)	**Level II courses**	
	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory

	MATH2410	A First Course in Linear Algebra
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Ordinary Differential Equations
	MATH3155	Complex Variables
	MATH3412	Advanced Linear Algebra
	ECON2000	Intermediate Microeconomics I
	ECON2001	Intermediate Microeconomics II
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	Level III courses	
	MATH3400	Complex Variables
	MATH3402	A Course on Metric Space & Topology
	MATH3402	Metric Spaces & Topology
	ECON3049	Econometrics
	Plus three economics electives from Level II/III	
	Plus 2 economics electives from Level III	
	Plus 3 mathematics electives	

MATHEMATICS (MAJOR) AND ECONOMICS (MINOR)		
	Level I courses	
Introductory Courses (Level I)	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	ECON1001	Principles of Economics I
	ECON1012	Principles of Economics II
	COMP1126 Or COMP1220	Introduction to Computing I Computing & Society
	STAT1001	Statistics for Scientists
	Level II courses	
Advanced Courses	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus

(Levels 2 and 3)	MATH2404	Introduction to Probability Theory
	MATH2410	A first course in Linear Algebra
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Ordinary Differential Equations
	ECON2000	Intermediate Microeconomics I
	ECON2001	Intermediate Microeconomics II
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	Level III courses	
	MATH3155	Complex Variables
	MATH3402	A course on Metric Spaces & Topology
	MATH3412	Advanced Linear Algebra
	Plus Three mathematics electives	
	One economics elective from Level III (students are encouraged to do ECON3049: Econometrics	

STATISTICAL SCIENCE (B.Sc.)		
	A B.Sc. in Statistical Science requires a total of twenty (24) Level 1 credits including the list below:	
Introductory Courses (Level 1)	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	STAT1001 (Elective)	Statistics for Scientists
	This programme requires sixty (60) advanced credits from Levels 2 and 3 and must include:	
Advanced Courses (Level 2 and 3)	MATH2401	Elements of Mathematical Analysis
	MATH2404	Introduction to Probability Theory
	MATH2407	Stochastic Modelling
	MATH2410	A First Course in Linear Algebra
	STAT2001	Inferential Statistics
	STAT2002	Discrete Statistics
	STAT2003	Linear Models
	STAT2004	Multivariate Methods
	MATH3423	Research Projects
	STAT3001	Regression Analysis
	STAT3002	Time Series
	STAT3003	Design and Analysis of Experiments
	AND twelve (12) credits from:	
	MATH2403	Multivariable Calculus
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Ordinary Differential Equations
	MATH2421	Fourier Series and Integral Transforms
	MATH2430	Linear Optimization
	MATH2431	Non-Linear Optimization
	MATH2702	Actuarial Mathematics I
	MATH3155	Complex Variables
	MATH3410	Advanced Linear Algebra
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations

	MATH3422	Mathematical Modelling
	MATH3424	Numerical Methods
	MATH3801	Financial Mathematics II
	MATH3802	Evaluation of Actuarial Models
	MATH3803	Models for Financial Economics
	MATH3804	Actuarial Mathematics II
	MATH3805	Mathematics of Pension Funds
	MATH3806	Topics in General Insurance

MATHEMATICS (MINOR)		
	A minor in Mathematics requires a total of twelve (12) Level 1 credits from:	
	MATH1141	Introductory Linear Algebra and Analytic Geometry
Introductory Courses (Level 1)	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	A minor in Mathematics requires a minimum of eighteen (18) credits from Levels 2 and 3 and must include:	
	MATH2401	Elements of Mathematical Analysis
	MATH2410	A First Course in Linear Algebra
	MATH3155	Complex Variables
	MATH3412	Advanced Linear Algebra
Advanced Courses (Levels 2 and 3)	**AND six (6) credits from:**	
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory
	MATH2407	Stochastic Modelling
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Ordinary Differential Equations
	MATH2421	Fourier Series and Integral Transforms
	MATH2431	Non-Linear Optimization
	MATH2702	Actuarial Mathematics I
	STAT2001	Inferential Statistics
	MATH3401	Introduction to the Theory of Integration

	MATH3402	A Course on Metric Space & Topology
	MATH3403	Some Topics in Functional Analysis
	MATH3404	Introduction to Differential Geometry
	MATH3411	Advanced Abstract Algebra
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3424	Numerical Methods
	STAT3001	Regression Analysis
	STAT3002	Time Series

COURSE DESCRIPTIONS

MATH0100 **PRE-CALCULUS**
(6 P-Credits) (Level 0) (Semester 1)

Pre-requisite:
CSEC Mathematics **OR** equivalent.

Course Content:

1. **Algebra:** Real numbers, surds; complex numbers; linear, quadratic, and polynomial equations; inequalities; functions and their graphs; transformations and periodic functions; inverse functions; logarithms and exponentials.
2. **Trigonometry:** The six trigonometric functions and their interrelations; the addition formulas; the double- and half-angle formulas; trigonometric identities; the inverse trigonometric Functions; the solution of triangles.

Evaluation:

- Final Written Examination (3 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 30%

MATH0110 **CALCULUS AND ANALYTICAL GEOMETRY**
(6 P-Credits) (Level 0) (Semester 2)

Pre-requisite:
CSEC Mathematics **OR** equivalent.

Course Content:

1. **Function Theory:** Limits, continuity; implicitly defined functions; review of inverse function theory.
2. **Differentiation:** Definition of the derivative, examples; the derivative of a sum, difference, product, and quotient of two functions; the chain rule; derivatives of polynomials, the trigonometric functions, logs, exponentials, and the inverse trigonometric functions; higher-order derivatives; first-order separable differential equations.
3. **Applications of the Derivatives:** Local maxima and minima; the second-derivative test; global maxima and minima; maximization on a closed interval; curve sketching.

4. **The Definite Integral**: Definition of the integral, examples; the Fundamental Theorem of Calculus; antiderivatives; u-du substitutions; integration by parts; changes of variable for the definite integral.
5. **Applications of the Integral**: Volumes by cross sections and cylindrical shells; arc-length; surface areas of revolution.

Evaluation:

- Final Written Examination (3 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 30%

Successful completion of M08B/MATH0100 and M08C/MATH0110 is not sufficient for entry to the BSc Degree programme in Engineering. Students can apply for a transfer to the Faculty of Engineering on the successful completion of M10A/MATH1140 and M10B/MATH1150.

MATH1141 **INTRODUCTORY LINEAR ALGEBRA AND ANALYTIC GEOMETRY**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
CAPE **or** GCE A-Level Mathematics, **OR** MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry **OR** equivalent.

Course Content:

1. **Function:** Definition, inverse function, graphs of some elementary functions and elementary transformations of the graphs. Systems of linear equation: solutions of systems of linear equations, the Gauss-Jordan elimination algorithm; inconsistent and over determined systems; homogeneous systems of equations; row and column vectors.
2. **Matrices:** Elementary matrix operations, determinant, Cramer's rule and linear systems of equations. Vector geometry.
3. **Vectors in 2 and 3 Dimensions**: Vector equations of lines and planes; dot products, cross products.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work 30%

MATH1142 **CALCULUS I**

(3 Credits) (Level 1) (Semester 1)

Pre-requisites:

CAPE **or** GCE A-Level Mathematics, **OR** MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry **OR** equivalent.

Course Content:

1. **Limits and Continuity:** Limit of function, continuity and properties of continuous functions.
2. **Differentiability and Application of Derivatives:** Derivatives of functions, product, quotient and chain rule, application of derivatives, L'Hospital's rule, Taylor's formula and Taylor polynomials; maxima, minima and inflection points; detailed investigation of a function and construction of its graph.
3. **Integration:** The definite integral as a Riemann sum and properties of the definite integral; fundamental theorem of calculus, the indefinite integral; methods of integration; applications of integration: areas and volumes.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work 30%

MATH1151 **CALCULUS II**

(3 Credits) (Level 1) (Semester 2)

Pre-requisite:

MATH1142 - Calculus I.

Course Content:

1. **More Methods of Integration:** Integration of expressions containing radicals, integration of expressions containing trigonometric functions and trigonometric substitution; application of integration in solving first order differential equations.
2. **Partial Differentiation:** Functions of several variables, gradient vector, directional derivatives, and the tangent plane, variation of parameters; polar, cylindrical and spherical coordinate; constrained and unconstrained optimization, including Lagrange multipliers.
3. **Multiple Integrals:** Double integrals, heuristics and reversing the order of integration; line, surface and volume integrals.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work 30%

MATHEMATICS

<u>MATH1152</u> **<u>INTRODUCTION TO FORMAL MATHEMATICS</u>**

(3 Credits) (Level 1) (Semester 1)

Pre-requisites:

CAPE **or** GCE A-Level Mathematics, **OR** MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry **OR** equivalent.

Course Content:

1. **Formal Symbolic Logic:** Statement, negation, truth tables, case-by-case analysis, proof by contradiction. Sets, Relations and Equivalence.
2. **Relations:** Basic set theory, relations and their properties, equivalence relations, equivalence classes.
3. **Binary Operations:** Operations as mappings, associativity and commutativity, identity elements and inverses. Natural numbers: the axioms, addition, multiplications of natural numbers, elementary proofs, the Principle of Mathematical Induction.
4. **The Integers:** The axioms, elementary proofs, divisibility, the unique prime factorization of an integer, reminder classes.
5. **The Real Numbers:** The axioms of addition and multiplications, the distributive law, the axioms of order and completeness.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work 30%

MATH1185 **CALCULUS FOR SCIENTISTS AND ENGINEERS**
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
CAPE **or** GCE A-Level Mathematics, **OR** MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry **OR** equivalent.

Course Content:
Limits, Continuity and Differentiability; Application of derivatives; Integration; Ordinary differential equations; Functions of several variables; Multiple integrals; Series.

Evaluation:
- Final Written Examination (2 hours) 70%
- Course Work 30%

STAT1001 **STATISTICS FOR THE SCIENTISTS**
(3 Credits) (Level 1) (Semester 1 or 2)

Pre-requisites:
CAPE **or** GCE A-Level Mathematics, **OR** MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry **OR** equivalent.

Course Content:
Summarising and Interpreting Data. Random Variables. Probability and Probability Distribution. Elementary ideas of sampling methods. Sampling and Estimation. Confidence Intervals. Hypothesis Testing; Chi-square Test. Introduction to Simple Linear Regression.

Evaluation:
- Final Written Examination (2 hours) 70%
- Course Work 30%

MATH 2401 **ELEMENTS OF MATHEMATICAL ANALYSIS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I, MATH1151 - Calculus II **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Sequences:** The least upper and the greatest lower bounds; the Completeness axiom, sequences, limits; bounded, monotone and Cauchy sequences; Convergence theorem; subsequence; the Bolzano-Weierstrass theorem; limsup, liminf.
2. **Limits and Continuity:** The limit of functions, left and right limits, properties; lim sin x/x, and lim (1+x)^x; continuity, different types of discontinuity; properties of continuous functions on close interval; intermediate and extreme values; uniform continuity.
3. **Differentiability:** Derivative; the Mean-Value theorem; inverse function.
4. **Infinite Series**: Convergence of infinite series; the divergence test, positive series tests (comparison, limit comparison, ratio, root); absolute convergence; alternating series; Cauchy criterion for convergence.
5. **Sequence and Series of functions:** The pointwise convergence of a sequences of functions; uniform convergence of sequences of functions; uniform convergence of series of functions; convergence of power series; Abel's and Weierstrass's tests; functions defined by power series; Taylor series.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 20%
    - 2 Written Assignments 10%

MATH 2403 **MULTIVARIABLE CALCULUS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I, MATH1151 - Calculus II **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:
1. **Parametric and Polar curves:** Parametric Equations - Polar coordinates - Conic sections.
2. **Vectors and Vector valued Functions:** Vectors in 2D and 3D, dot and cross products, Lines and curves in space, Calculus of Vector valued functions, Motion in space, Length of curves, Curvature and normal vector.
3. **Functions of Several Variables:** Planes and Surfaces, Graphs and level curves, Review: Limits, continuity and Partial derivatives, Directional derivatives and Gradient, Tangent planes, Maxima/Minima.
4. **Multiple Integration:** Review: Double and triple integrals, Polar, cylindrical and spherical coordinates.
5. **Vector Calculus:** Vector fields, Line integrals, Green's theorem, surface integrals, Stokes theorem, Divergence theorem.

Evaluation:
- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 30%

MATH2404 **INTRODUCTION TO PROBABILITY THEORY**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I, MATH1151 - Calculus II **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:
1. **Review of Basic Notions of Probability:** Notions of random phenomena, event, outcome, working definition of probability;

Combinatorial techniques, permutations and combinations; Probability of intersection and union of events; mutually exclusive and exhaustive events, complimentary events; Conditional probability, Independence, the total probability rule, Bayes' theorem.

2. **Discrete Random Variables:** Probability density function, cumulative distribution function; Binomial, uniform, geometric, Poisson distributions; Multidimensional random variables, joint density, marginal density; Independence; Expectation, moments, variance and standard deviation; Covariance and correlation coefficient. Uncorrelated random variables.
3. **Continuous Random Variables:** Probability density function, probability distribution function; Uniform, Normal, exponential and gamma distributions; Expectation, moments, variance and standard deviation; Moment generating function.
4. **Asymptotic Theory:** Chebishev's inequality; Weak Law of Large Numbers; Central Limit Theorem; Normal and Poisson approximations.

Evaluation:

- Final Written Examination (2 hours) 70%
- Coursework: 30%
    - 2 Assignments 15%
    - 1 In-course Test (1 hour) 15%

MATH2407 **STOCHASTIC MODELING**

(3 Credits) (Level 2) (Semester 2)

Pre-requisite:

MATH2404 - Introduction to Probability Theory.

Course Content:

1. **Introduction:** Significant discrete and continuous random variables and their probability distributions; Sums of random variables: convolution and their distribution; Conditional probability and conditional expectation; Introduction to stochastic processes: definition, time set & state space classifications.
2. **Markov Processes:** Time homogeneous and inhomogeneous Markov chain: one-step transition probabilities, one-step transition matrix, kth-step transition probabilities, limiting distributions; Random walk: absorbing states, first passage times, mean time to absorption, recurrence, Gambler’s Ruin problem; The homogeneous Poisson

process: exponential successive inter-arrival times; waiting times, sojourn times, transition times.

3. **Queues:** The Bernoulli single server queuing process: limited and unlimited capacity queues, arrival process, service process; M/M/1 queuing process, limiting distributions; M/M/k queuing process.
4. **Brownian Motion:** Motivation and definition; Properties: the reflection principle, first hitting times, zeros of Brownian motion; Brownian motion with drift.
5. **Laboratory Work:** Probability basics, random variables and distributions; Pseudo-random number generators; Markov chains, Poisson processes, queues and Brownian motion: applications and simulation; Supervised group project work.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Group Project 20%
    - 1 In-course Test (1 hour) 20%

MATH2410 **A FIRST COURSE IN LINEAR ALGEBRA**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

MATH1141 - Introductory Linear Algebra and Analytic Geometry **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Properties of Matrices and Determinants:** Review matrices and systems of linear equations, row equivalence, the sigma-notation definition, proof of familiar results.
2. **Vector Spaces:** Definition, independence, basis and dimension; Linear Transformations: Definition, Kernel and image, Invertible operators ;
   Inner Products: Definition, Cauchy-Scharz, orthogonality, projections, Gram-Schmidt.
3. **Eigenspaces:** Characteristic polynomials, Cayley-Hamilton, eigenvalues and eigen-vectors, diagonalization of matrices.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Graded Assignments 10%
    - Midterm Examination 20%

MATH2411 **Introduction to Abstract Algebra**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Permutations:** Order, parity, transpositions.
2. **Groups:** Definition and examples, Lagrange Theorem, Homomorphisms, Quotient Groups.
3. **Rings:** Definition and examples of rings.
4. **Fields:** Definition and examples, polynomials of fields.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Midterm Examination 30%

MATH2420 **ORDINARY DIFFERENTIAL EQUATIONS**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I, MATH1151 - Calculus II **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Classification of Differential Equations**: Ordinary and partial differential equations, systems of differential equations, order of a differential equation, linear and nonlinear equations, what is a solution of a differential equation.
2. **First Order Differential Equations:** Linear equations with variable coefficients, separable equations, test of exactness, non-exact differential equations and integrating factors, the existence and uniqueness theorems for first-order linear and nonlinear differential equations (without proofs), interval of definition, differences between linear and nonlinear equations, Picard's method of successive approximations.
3. **Higher Order Linear Equations:** Homogeneous equations with constant coefficients, fundamental solutions of linear homogeneous equations, linear independence and the Wronskian, complex roots of the characteristic equation, repeated roots, reduction of order, nonhomogeneous equations and general formula for the solution involving the Wronskian.
4. **Power Series Solutions:** Short review of power series and convergence tests, Taylor series and analytic functions, standard form of second order linear differential equations, ordinary and singular points, power series solution of second order linear differential equations around a regular point, recurrence relation, gymnastics in shifting the index of summation; regular and irregular singular points, method of Frobenius, the indicial equation and the exponents at the singularity.
5. **Legendre Polynomials and Bessel functions:** Fuchs theorem, general considerations on the convergence radius of series solutions for the Legendre and Bessel equations around an ordinary point, elementary and special functions, the Legendre equation: solutions around $x=0$, Legendre polynomials; Bessel equation of order ν, Bessel functions of fractional order, Bessel function of order zero of the first kind, Bessel function of order ν of the first kind and its asymptotic behaviour for large x, Gamma function and Bessel function of arbitrary order.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 30%

<u>MATH2421</u> **<u>FOURIER SERIES AND INTEGRAL TRANSFORMS</u>**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I **and** MATH1151 - Calculus II **OR** MATH1185 – Calculus for Scientist and Engineers **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Fourier Series:** Introduction, Fourier series expansion of a function and determination of Fourier coefficients, Continuous and discontinuous functions and its expansion in Fourier series, Existence of Fourier series of a function; Examples: Expressing the given function in terms of Fourier series; Fourier series - even and odd functions; Fourier series in an arbitrary interval; Even and odd periodic continuation - Half-range Fourier sine and cosine expansions.

2. **Laplace Transforms:** Introduction, Definition and properties of Laplace transforms; Laplace transform of some standard functions; Finding the transform of a given function - examples; Definition of inverse transform and properties; examples, convolution theorem, Applications of Laplace transforms in solving differential equations.

3. **Fourier Transforms:** Fourier integral theorem, Fourier sine and cosine integrals; Fourier transform and properties; Fourier sine and cosine transforms - properties; Inverse transforms - Finite Fourier transforms; Applications in solving Differential equations.

4. **Special Functions:** Gamma functions and properties; Beta function and properties; Relations between beta and gamma functions.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 Midterm Examinations 20%
    - 5 Take Home Assignments 20%

MATH2430 **LINEAR OPTIMIZATION**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

MATH1141 - Introductory Linear Algebra and Analytic Geometry **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Linear Programming Introduction and Formulation:** Introduction, Phases of Operations Research.
2. **Graphical Method:** Solving linear programming by graphical method and examples.
3. **Simplex Method:** Algorithm and algebraic interpretation; Examples general case and Special Cases.
4. **Big M Method:** Method and examples.
5. **Two Phase Method:** Method, Examples on different cases.
6. **Duality:** Dual form of given primal problem and examples; Duality theorems, Primal Dual relations; Complementary Slackness Theorem Proof, Applications;
7. **Sensitivity Analysis:** Sensitivity analysis with Graphical Method; Sensitivity analysis through simplex method.
8. **Transportation and Assignment Models:** Transportation Models introduction and modeling as a Linear programming Problem, initial solutions, Transportation simplex method; Introduction, examples of Assignment models , Hungarian method of solution and examples.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 30%

MATH2431 **NON-LINEAR OPTIMIZATION**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I **and** MATH1151 - Calculus II **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:
1. **Optimization of Functions of Several Variables:** Examples of optimization problems, unconstrained optima (first and second order conditions), constrained optima, the Lagrange method.
2. **Non-linear Programming problems:** Inequality constraints, Kuhn-Tucker Multipliers.

Evaluation:
- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Take Home Assignments 10%
    - 1 Midterm Examinations 20%

MATH2701 **FINANCIAL MATHEMATICS I**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry, MATH1142 - Calculus I, MATH1151 - Calculus II **and** MATH1152 - Introduction to Formal mathematics **OR** MATH0100 - Pre-Calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:
1. **Basic Interest Theory - Time Value of Money:** Interest rate, simple interest/discount, compound interest/discount, accumulation function. Future value, present value, net present value, discount factor; Convertible mth-ly, nominal rates of interest/discount; Inflation and real interest; force of interest; Equivalent interest measures, equation of value.
2. **General Cash Flow and Portfolios:** Yield rate/ rate of return, dollar-weighted rate of return, time-weighted rate of return, current value.
3. **Annuities with Non-contingent Payments:** Annuity immediate, annuity-due, perpetuity; Payable mth-ly, payable continuously; Level

payment annuity, arithmetic increasing/decreasing payment annuity, geometric increasing/decreasing annuity.

4. **Basic Applications:** Loans and amortization schedules; Valuation of bonds; Stock Valuation.

Evaluation:

- Final Written Examination (2 hours) 75%
- Course Work: 25%
    - Midterm Examinations 25%

MATH2702 **ACTUARIAL MATHEMATICS I**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
MATH2701 - Financial Mathematics I **AND** MATH2404 - Introduction to Probability Theory.

Course Content:

1. **Survival Models:** Decrements: Common decrements; select, ultimate and aggregate decrements and their applications (general population versus insured population, life insurance versus annuity; individual versus group life insurance; pricing versus valuation; historic versus projected; Models used to model decrements in insurance, annuities and investments; probabilities based on these models; time-to-decrement, age-to-decrement, and cause-of-decrement random variables; Density, distribution and survival functions: age at death, select and ultimate life tables, fractional ages (include linear, exponential, hyperbolic), mortality laws (uniform, exponential, Makeham, Gompertz); force of decrement.
2. **Life Insurances and Annuities:** Life insurance: actuarial present value function (apv), moments of apv, basic life insurance contracts, portfolio; Life annuities: actuarial accumulation function, moments of apv, basic life annuities. Non-interest-sensitive insurances (disability income, product warranty, defined benefit pension plans, health insurance); interest-sensitive insurances (universal life, variable annuities).
3. **Premiums:** Net annual premiums: actuarial equivalence principle, loss function, accumulation type benefits.

Evaluation:

- Final Written Examination (2 hours) 75%
- Coursework: 25%
    - Midterm Examinations 25%

STAT2001 **INFERENTIAL STATISTICS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

STAT1001 - Statistics for the Scientists **OR** MATH2404 - Introduction to Probability Theory.

Course Content:

1. **Sampling Distributions:** Distribution of the sample mean and proportion(large sample size):-Sum and differences of sample mean, Sum and difference of sample proportion, Hypothesis testing and confidence intervals; Distribution of the sample mean and variance(small sample size):- One-and two sample t-test, paired test, Test concerning variances, Hypothesis testing and confidence intervals.
2. **Parameter Estimation:** Unbiasedness, bias, mean square errorconsistency, efficiency, sufficiency, Minimum unbiased variance, Cramer- Rao lower bound, Likelihood and log-likelihood functions, maximum likelihood estimator, method of moments, properties of maximum likelihood, Rao-Blackwell theorem, Fisher-Neyman criterion, factorisation theorem.
3. **Interval Estimation:** Random intervals and sets, use of pivotal quantities, use of asymptotic results; Relationship between hypothesis tests and confidence intervals; graphical confidence interval.
4. **Hypothesis Testing:** Simple and Composite hypotheses, Types of Error, Power of test, p-value; Neyman-Pearson method, Generalised Likelihood Ratio Test; Use of asymptotic results to construct tests: - Central Limit theorem, asymptotic distributions of maximum likelihood estimator and generalised likelihood ratio test statistic.
5. **Goodness-of-fit Test:** goodness-of-fit test of standard distributions: - binomial, geometric, Poisson, negative binomial, truncated Poisson, uniform, normal, exponential and gamma to observed data.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Midterm Examinations 30%

STAT2002 **DISCRETE STATISTICS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
STAT1001 - Statistics for the Scientists **AND** MATH1142 - Calculus I.

Course Content:

1. **Introduction:** Advantages and Disadvantages of Nonparametric Methods.
2. **Scales of Measurements:** Nominal, Ordinal, Interval and Ratio; Weak measurement versus Strong statistics; Mosteller and Tukey Data Types.
3. **Inference on Location:** Signed test, Wilcoxon signed rank, Wilcoxon Sum rank, Mann-Whitney U.
4. **Inference on Dispersion:** Siegel-Tukey test, Freund-Ansari test and Mood's test.
5. **Rank Correlation:** Spearman's rank: - treatment of ties and no ties and Kendall's rank.
6. **Test of Randomness:** Run test, Chi-square test.
7. **Goodness of Fit:** Kolmogorov-Smnirov test, Lilliefor's test, Chi-square test.
8. **Design of Experiment:** Kruskal-Wallis test, Freidman's test, Kendall's concordance.
9. **Categorical Data:** Contingency tables, Fisher's exact test, McNemar test, Mantel-Haenszel test.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Midterm Examination 15%
    - Proper Papers/Laboratory Assignments 15%

STAT2003 **LINEAR MODELS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
STAT1001 - Statistics for the Scientists **AND** STAT2001 - Discrete Statistics.

Course Content:

1. **Exploratory Data Analysis:** numerical summaries:-mean, median, mode, trimmed mean,quartiles, range, variance, standard deviation, percentiles, skewness, kurtosis, semi-interquartile range, inter-quartile range, coefficient variation; graphical summaries:- Dotplot, Stem-and-Leaf diagram, Box-and-Whisker plot, Rootograms, Radar/Spider plots, Matrix plot; Quantile function:-theoretical distributions and empirical distributions, QQ plots; Parameter estimation: bootstrap method.
2. **Linear Regression:** Median polishing technique, Resistant method for fitting straight line, Additive models: - structure and fitting, Polynomial regression.
3. **Logistic Regression:** Introduction, fitting simple model, Inferences:- confidence interval, significance testing; Multiple Logistic regression, Odds ratios, Interpretation of fitted logistic models; Assessing model: Goodness-of-fit, Pearson's chi-square statistic and deviance, diagnostic measures, validation; Case-control studies Application.
4. **Analysis of Variance:** One-way and Two-way Analysis of variance with and without interaction, Additive models, Regression approach to ANOVA.

Evaluation:

- Problem Papers (about 2) 20%
- Project 1 40%
- Project 2 40%

STAT2004 **MULTIVARIATE METHODS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
STAT1001 - Statistics for the Scientists, MATH1141 - Calculus I **AND**
MATH2410 - A First Course in Linear Algebra.

Course Content:

1. **Introduction:** areas of application, organisation of data, graphical techniques, geometry interpretation.

2. **Matrix Algebra & Random Vectors:** Introduction, Review of matrix and vector algebra; Positive definite matrix; Random vectors and matrices; Mean vectors and Covariance matrices.
3. **Multivariate Normal Distribution:** Introduction, Density and its properties, Maximum likelihood estimators of μ and $\sum$.
4. **Inferences:** Sampling distribution of $\bar{X}$ and S , Hotelling's T^2 , and Confidence regions.
5. **Methods:** Principal Component Analysis, Discriminant Analysis, Factor Analysis, Canonical Correlation Analysis and Cluster Analysis.

Evaluation:

• Final Written Examination (2 hours)	70%
• Course Work:	30%
• Midterm Examination	15%
• Proper Papers/Laboratory Assignments	15%

MATH3155 **COMPLEX VARIABLES**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
MATH2401 - Element of Mathematical Analysis.

Course Content:
1. **Review of Complex Numbers:** Algebraic and geometric representation of complex numbers; Euler's formula; Rational powers and roots of complex numbers; Regions in the complex plane.
2. **Analytic Functions:** Limits, continuity and differentiability; Cauchy Riemann equations; Analytic and harmonic functions.
3. **Elementary Functions:** The complex exponential function; Trigonometric and Hyperbolic functions and inverses; The complex logarithm - definition, properties, branches and branch cuts; Complex powers.
4. **Integrals:** The contour integral - definition, properties, application;
5. Bounds on integrals; Antiderivatives; The Cauchy-Goursat theorem and the principal of deformation of path, Cauchy's integral formula; Cauchy's inequality and the Maximum Modulus Principle.
6. **Series:** Convergence of sequences and series; Power series - absolute and uniform convergence, integration and differentiation; Taylor and Laurent series;

7. **Residues and Poles:** Isolated singular points, residues and the Residue Theorem; Classifying isolated singular points; Residues at poles; Evaluation of improper real integrals by contour integration around poles.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• 1 In-course Test (10% each)	20%
• 2 Assignments	20%

MATH 3401 **INTRODUCTION TO THE THEORY OF INTEGRATION**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
MATH2401 - Element of Mathematical Analysis.

Course Content:

1. **Reimann Integral:** Definition and existence of the definite integral; Darboux sums; Upper and low sums; Mean Value theorems; Reimann integral as a function of the upper limit; The Dirichlet function.
2. **Measurable Sets on a Line:** Open and Closed Sets, Intuitive meaning of Lebesgue measure; Sets of Measure Zero; Compact Sets, Heine-Borel Theorem.
3. **Lebesgue Integral:** Step functions on an Interval, the integral of the step function; properties; upper functions on the interval; Lebesgue integrable functions on the interval; properties, Lebesgue integral on a set of measure zero; connection with Riemann integration; integral of the Dirichlet function.
4. **Monotone and Dominated Convergence Theorems:** Monotone convergence theorem for step functions, for upper functions and for Lebesgue integrable fuctions on the interval, Lebesgue's Theorem, consequences of Lebesgue's Theorem.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• 1 In-course Test (10% each)	20%
• 2 Assignments	20%

MATH 3402 **A COURSE ON METRIC SPACES AND TOPOLOGY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

MATH2401 - Element of Mathematical Analysis.

Course Content:

1. **Metrics:** Definition and examples, open neighbourhoods, continuity via neighbourhoods, neighbourhoods and convergence in metric spaces, limits, Cauchy sequences, completeness.
2. **Topology:** Definition of a topology, metric topologies, examples, continuous functions and closed sets, homeomorphisms, topological and non-topological properties, subspaces, product and, Hausdorff spaces.
3. **Compactness:** Definition using open sets, examples, the compact subsets of the real line, continuous images of compact sets, quotient spaces, continuous real valued functions on a compact space, the product of two compact spaces, the compact subsets of Euclidean space, sequential compactness.
4. **Connectedness:** Definition using open sets and integer valued functions, examples, components, path-connectedness.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (10% each) 20%
    - 2 Assignments 20%

MATH 3403 **SOME TOPICS IN FUNCTIONAL ANALYSIS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

MATH2401 - Element of Mathematical Analysis.

Course Content:

1. **Normed Vector Spaces:** Metric Spaces; Definition and examples of normed vector spaces, H¨older and Minkovkii inequalities; Completeness, Banach Space; finite dimensional vector spaces, C[a,b], Lp, lp spaces.
2. **Hilbert Spaces:** Definition of inner product, properties; Hilbert space, connection to Banach and metric spaces; examples, Orthogonality,

Cauchy-Schwartz inequality, Parallelogram rule; Theorem of Pythagoras; Bessels inequality.

3. **Linear Functionals:** Definition of linear functional, properties; Theorem of Hahn-Banach (real version); examples.
4. **Linear Operators:** Linear operators: examples; Continuous and bounded operators, Norm of operator, Space of operators.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (10% each) 20%
    - 2 Assignments 20%

MATH3404 **INTRODUCTION TO DIFFERENTIAL GEOMETRY WITH COMPUTER SOFTWARE**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
MATH2410 - A First Course in Linear Algebra **AND** MATH2403 -Multivariable Calculus.

Course Content:

1. **Introduction:** Curves and arc-length, parameterization of curves, closed curves, level curves, curvature, plane curves, space curves.
2. **Global Properties of Curves:** Simple closed curves, the isoperimetric inequality, the four vertex theorem.
3. **Surfaces in Three Dimensions:** Smooth surfaces, smooth maps, tangent, normals and orientability. Examples of surfaces: level surfaces, quadratic forms, surfaces of revolution, compact surfaces, triply orthogonal systems. The inverse function theorem and its applications.
4. **The First and Second Fundamental Forms:** Length of curves on surfaces, isometries of surfaces, conformal mappings of surfaces, equiareal maps and a theorem of Archimedes. The second fundamental form, the Gauss and Weingarten maps, curvature of curves on surfaces, normal and geodesic curvature, parallel transport and covariant derivatives.
5. **Lab Component:** Representation of surfaces and computation of curvature, torsion, geodesics, etc with computer software.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 1 In-course Test (10% each) 20%
  - 1 Group Project 20%

MATH3405 **NUMBER THEORY**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

MATH2401 - Element of Mathematical Analysis Course Content **AND**
MATH2411 - Introduction to Abstract Algebra.

Course Content:

1. **Divisors:** Elementary results on divisors, Bezout's Identity, Linear Diophantine Equations.
2. **Prime Numbers:** Prime-Power Factorizations, Distribution of Primes, Fermat and Mersenne Primes.
3. **Congruences:** Modular Arithmetic, Linear Congruences, Simultaneous Linear Congruences, Simultaneous Nonlinear Congruences, the extended Chinese Remainder Theorem.
4. C**ongruences with a Prime Power Modulus:** The arithmetic of Z_p, Pseudoprimes and Carmichael Numbers, solving Congruences mod p^n.
5. **Euler's Function:** Units, Euler's Function, Applications of Euler's Function.
6. **The Group of Units:** The group U_n, Primitive Roots, The group U_n when $n = p^k$ Applications of Primitive Roots.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 2 Midterm Test (20% each) 40%

MATH3411 **ADVANCED ABSTRACT ALGEBRA**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
MATH2411 - Introduction to Abstract Algebra.

Course Content:

1. **Rings:** Definition of a ring; classification of rings; elementary facts about rings; homomorphisms between rings; ideals and quotient rings; maximal ideals.
2. **Special Types of Rings:** Integral domains; elementary facts about integral domains; Euclidean rings; primes in a Euclidean domain; the g.c.d. in a Euclidean domain; the Euclidean algorithm. The rings ***R****[x]* and ***C****[x].*
3. **Field Theory:** Definition and examples of fields; extension fields, the degree of an extension; roots of polynomials; finite fields.

Evaluation:

• Final Written Examination (2 hours)	70%
• Course Work:	30%
• 1 In-course Test (10% each)	15%
• 3 Assignments	15%

MATH3412 **ADVANCED LINEAR ALGEBRA**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
MATH2410 - A First Course in Linear Algebra.

Course Content:

1. **Sector Spaces:** Vector spaces over an arbitrary field, subspaces of vector spaces, span and independence, bases and finite dimensional vector spaces, bases and infinite dimensional vector spaces, coordinate vectors.
2. **Linear Transformation:** Short introduction to linear transformations, range and kernel, correspondence and isomorphism theorems, matrix representation, algebra of L(V,W) and $M_{mn}(F)$, invertible transformations and matrices.
3. **Theory of Linear Operators:** invariant subspaces, cyclic operators, maximal operators on real and complex vector spaces.

4. **Inner Product Spaces:** inner product, geometry in inner product spaces, orthonormal sets and the Grahm-Schmidt process, orthogonal complements and projections, dual spaces, adjoints.
5. **Linear Operators on Inner Product Spaces:** self-adjoint and normal operators, spectral theorems, unitary and orthogonal operators, polar decomposition and singular value decomposition, trace of a linear operator.
6. **Bilinear Maps and Forms:** basic properties, symplectic spaces, quadratic forms and conic sections, Jordan canonical form.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (10% each) 20%
    - 4 Assignments (5% each) 20%

<u>MATH3414</u> **<u>SELECTED TOPICS IN OPERATIONS RESEARCH</u>**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
MATH2404 - Introduction to Probability Theory.

Course Content:

1. **The Theory of Holding Inventory:** Various inventory models are examined - both deterministic and stochastic.

2. **Queuing Theory:** Random walk process, The M/M/1/1, M/M/1/N, M/M/n/1, M/M/n/N; Models. Birth and death processes.

3. **Game Theory:** Two-person zero sum games - Games with and without saddle points. Dominance. The use of linear programming to solve games.

4. **Decision Theory:** Decision Trees. Maximizing expected return, EVPI and EVSI.

5. **Replacement Theory:** Optimal time to dispose of fixed assets that depreciate with time.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Computer-based Group Project (10% each) 10%
    - 4 Assignments (5% each) 20%

MATH3421 **PARTIAL DIFFERENTIAL EQUATIONS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
MATH2420 - Ordinary Differential Equations.

Course Content:

1. **Introduction:** Basic concepts and definitions, Strategies for studying PDEs: Well-posed problems, classical solutions, initial and boundary value problems; Typical difficulties.

2. **First Order PDEs:** Linear and quasi-linear PDEs, Method of characteristics, Nonlinear first-order PDE: Complete Integrals, envelopes, Characteristics, Charpit's and Jacobi's methods, Introduction to conservation laws.

3. **Second Order Linear PDEs:** Classification in the case of constant coefficients, Classification of general second order operators, Linearity and Superposition. D'Alembert solution of the Wave Equation, Propagation of discontinuities.

4. **Fundamental Properties of Elliptic and Parabolic Equations:** Laplace's equation, Green's theorem and uniqueness for the Laplace's equation, the maximum principle, the heat equation.

5. **Separation of Variables and Fourier Series:** The method of separation of variables, Orthogonality, Completeness and the Parseval's equation, The Riemann-Lebesgue lemma, Convergence of the trigonometric Fourier series, Uniform convergence, Schwarz's inequality and completeness, The heat equation revisited, Laplace's equation in a rectangle and in a circle, wave equation;

6. **Sturm-Liouville Theory:** Sturm-Liouville boundary value problems, Eigenvalues and Eigenvectors.

7. **Lab:** Solution of partial differential equations with the help of mathematical software package Maple or Matlab.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Mid-semester Examination 20%
    - 4 Assignments (5% each) 20%

MATH3422 **MATHEMATICAL MODELLING**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

MATH2401 - Element of Mathematical Analysis, MATH2410 - A First Course in Linear Algebra **AND** MATH2420 - Ordinary Differential Equations.

Course Content:

1. **Introduction to Modelling:** Purpose of modelling; Constructing a model - problem statement, formulation, solution, validation; Illustrative examples; Decision-making with mathematical models; Arms race models; Economic models of the effect of taxation.
2. **Discrete Models:** Discrete-time modelling; Discrete approximation of continuous-time models; Equilibria and long-run behaviour; Case studies.
3. **Continuous Models:** Modeling with a differential equation: Numerical Methods; Solving first order differential equation, generate solution curves and direction fields using mathematical software; case studies in applications to biology and epidemiology etc. Modelling with systems differential equations: modelling; Analysis of system of equations using software; Case studies.
4. **Lab Component:** Simulating the models using Mathematical software.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - 1 Group Project (5% each) 20%

MATH3423 **RESEARCH PROJECT IN MATHEMATICS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

MATH2401 - Element of Mathematical Analysis, MATH2420 - Ordinary Differential Equations **AND** Courses prescribed by the supervisor with the nature of the project.

Course Content:

Project topics will be decided upon by faculty members of the Department of Mathematics, if appropriate with input from students. Topics should reflect the area of expertise of the faculty member who will act as supervisor, the interests of the student, and the objectives of the student's chosen major. Projects may require the theoretical or computational investigation of a mathematical topic, the construction of a model for a real-world phenomenon using skills developed in the course of the students' studies. Reading projects centered on advanced mathematical topics are also acceptable. Ordinarily, the supervisor should be a member of the Department of Mathematics, however if appropriate a co-supervisor from another department may be appointed if successful completion of the project.

Evaluation:

- Written Thesis 70%
- Oral Examination 30%

The written component will be examined by the project supervisor. The oral component will be examined by a committee consisting of the project supervisor and two appointed internal examiners with an appropriate level of expertise in the subject matter. The format of the oral examination for each group will be as follows: each individual student will give an oral presentation lasting no more than 10 minutes, followed by questions from the examination committee. The oral examination will be chaired one of the appointed internal examiners.

MATH3424 **NUMERICAL METHODS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
MATH2401 - Element of Mathematical Analysis.

Course Content:

1. **Numerical Linear Algebra:** Matrices, vectors, and scalars; triangular systems; operation counts; the Cholesky decomposition; Gaussian elimination with partial pivoting; Diagonally dominant matrices; the Jacobi method; the Gauss-Seidel method.
2. **Nonlinear Equations:** The bisection method; error of approximation with the bisection method; Newton's method; the order of convergence of an algorithm; special computations (such as square roots and reciprocals).
3. **Polynomial Interpolation:** Lagrange polynomials; the existence and uniqueness of an interpolating polynomial; the Newton form of the interpolant; the divided differences table; evaluating the interpolating polynomial; errors of approximation.
4. **Numerical Integration:** The trapezoid rule; Simpsons rule; the composite Trapezoid and Simpson's rules; errors of approximation; Gaussian quadrature.
5. **Lab:** Practical implementation in the computer laboratory.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - 2 Laboratory Assignments (10% each) 20%

MATH3425 **TECHNIQUES FOR SOLVING ADVANCED MATHEMATICS PROBLEMS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
MATH2401 - Element of Mathematical Analysis **AND** MATH2410 - A First Course in Linear Algebra.

Course Content:

1. **Euclidean Geometry:** Triangle theorems, similarity as a problem-solving technique; circle theorems, including the chord-angle theorem and

theorems on triangles in a circle; problem-solving techniques using parallel lines on a circle.

2. **Modular Arithmetic:** The Principle of Induction as a problem-solving technique; advanced uses of the pigeon-hole principle; divisibility; solving problems with congruencies, and solutions of linear congruencies modulo *m*.
3. **Algebra:** Sums and differences of squares; non-linear systems of equations; the arithmetic-geometric-harmonic inequality; the Cauchy-Schwartz inequality, using pattern and symmetries in solving inequalities; techniques for finding extrema; isoperimetric problems; polygons inscribed and circumscribed in a circle.

Evaluation:

- Final Written Examination (2 hours) 55%
- Course Work: 45%
    - Group Presentation 45%

<u>MATH3801</u> **<u>FINANCIAL MATHEMATICS II</u>**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
MATH2701 - Financial Mathematics I, MGMT2023 - Financial Management I, MGMT3048 - Financial Management II **AND** MATH2404 - Introduction to Probability Theory.

Course Content:

1. **Bond Price Sensitivity:** Review bond valuation. Bond price sensitivity to changes in coupon rate, yield rate, and term to maturity.
2. **General Cash Flow and Portfolios:** Duration and convexity of a set of cash flows. Spot rates, forward rates, yield curve, bootstrapping.
3. **Immunization:** Cash flow matching, immunization, construction of investment portfolios.
4. **Introduction to Derivatives:** OTC market, ask/bid price, short selling, short/long position, credit risk, marking-to-market, margin; derivative: call/put option, European/American/Bermudan Option, covered call, naked writing, protective put, put-call-parity. Option Valuation (binomial model, Black-Scholes Model, Risk Neutral model …).

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Assignments (5% each) 10%
    - 1 In-course Test 20%

MATH3802 **EVALUTION ACTUARIAL MODELS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

MATH2702 - Actuarial Mathematics I, MATH2404 - Introduction to Probability Theory **AND** STAT2001 - Inferential Statistics.

Course Content:

1. **Loss Distributions and Reinsurance-**Pareto, Log-normal, Weibull and Burr distributions for modelling claims, Reinsurance arrangements, Reasons for reinsurance, Policy excesses.
2. **Individual Risk Models-**Properties of Conditional Expectations, Individual Risk Models, Relative Security Loading, Premiums.
3. **Collective Risk Models -** Cumulative generating functions, Properties of Compound distributions, Distribution of Aggregate Claims and approximations therefrom, Poisson Process.
4. **Ruin Theory-**Continuous Time Model, Discrete Time Model, Probability of Ruin, Claim Processes, Adjustment Coefficient, Lundberg's Inequality, Analysis of Reinsurance using Ruin Theory, First surplus below the initial level, Maximal Aggregate Loss.

Evaluation:

- Final Written Examination (2 hours) 75%
- Coursework: 25%
    - 2 Assignments (5% each) 10%
    - 1 In-course Test 15%

MATH3803 **MODELS FOR FINANCIAL ECONOMICS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
MATH3801- Financial Mathematics II.

Course Content:

1. **Rational Valuation of Derivative Securities:** European Option Valuation (binomial model, Black-Scholes Model, Risk Neutral model, State Price Vectors …); put-call-parity; Greeks, Explain the properties of a lognormal distribution and explain the Black-Scholes formula as a limited expected value for a lognormal distribution.
2. **Simulation:** Simulate lognormal stock prices. Variance reduction techniques for accelerated convergence.
3. **Risk Management:** Delta hedging.
4. **Hedging and Investment Strategies:** Hedging, arbitrage, hedging strategies.
5. **Futures and Forwards:** Forward contract, futures contract, forward price, no-arbitrage (theoretical) price.
6. **Swaps:** Simple swap, commodity swap, interest rate swap. Determine no arbitrage (theoretical) value of a swap.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Assignments (5% each) 10%
    - Mid-semester Examination 20%

MATH3804 **ACTUARIAL MATHEMATICS II**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
MATH2701 - Financial Mathematics I **AND** MATH2702 - Actuarial Mathematics I.

Course Content:

1. **Reserves:** Based on Single Decrement (Life) Table: Calculation of Reserves using Prospective and Retrospective methods, Recursive Formula, Policy Alteration.
2. **Joint Life Functions:** Study of T(*x*) and T (*y*), the complete future lifetimes of two lives (*x*) and (*y*), Joint Cumulative Function, Joint

Density Function, Joint survival function, Covariance of T*(x)* and T *(y),* Correlation coefficient of T(*x)* and T(*y),* Marginal distributions of T*(x)* and T(*y).*

3. **Study of the Joint Status (xy) and Last Survivor:** Definition of joint status (*x y)* and Last Status Survivor $\left(\overline{xy}\right)$, Full study of T *(x y)* including and T $\left(\overline{xy}\right)$, Cumulative Distribution Function, Probability Density Function, Expectation, Variance, Survival Function, Probabilities associated with T(*xy*) and T $\left(\overline{xy}\right)$, Force of failure of the status (*xy)* and status $\left(\overline{xy}\right)$. **Insurances and Annuities:** Problems on Insurances and Annuities based on Joint Life status and Last survivor status, Problems on Reversionary Annuities.
4. **The Common Shock Model:** Definitions, Modelling Dependence, Applications to all types of Insurance and Annuity Problems.
5. **MDT and ASDT:** Definitions, Complete study of MDT, Complete study of ASDT, Construction of MDT from ASDT and vice versa, Incorporating continuous and discrete decrements, Problems involving MDT and ASDT, Applications to Pensions Annuities and Insurances.

Evaluation:

- Final Written Examination (2 hours) 75%
- Course Work: 25%
    - 2 Assignments (5% each) 10%
    - Mid-semester Examination 15%

MATH 3805 **MATHEMATICS OF PENSION FUNDS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
MATH2701 - Financial Mathematics I, MATH2702 - Actuarial Mathematics I **AND** MATH3804 **-** Actuarial Mathematics II.

Course Content:

1. **General Points about a Pension Plan:** Definition of Pension, Possible sources of Pension, Need for a Pension, Approved Pension Plan, Non Approved Pension Plan, Government's Role, Taxation/Contributions, Investment Income, Types of Pension Plans, Trust Deed and Roles, Administration Contract, Investment Contract, Investment Policy, Risks affecting Pension Benefits, Role of employer, Design Issues, Usual

Benefits, Retirement Ages, Options at Retirement, Replacement Ratio, Quality of a Pension Regulatory Agencies.
2. **Actuarial Basis for Actuarial Valuation:** Purpose of Valuation, Demographic Basis, Financial/Economic Basis. **Cost Methods (I) -** Individual Cost Methods.
3. **Cost Methods (II):** Aggregate Cost Methods.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Assignments (5% each) 10%
    - Mid-semester Examination 20%

MATH 3806 **TOPICS IN GENERAL INSURANCE**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
MATH2701 - Financial Mathematics I **AND** MATH2404 - Introduction to Probability Theory.

Course Content:
1. **Ratemaking:** Premiums, Exposure, Losand Loss Adjustment Expenses, Underwriting Expense Provisions, Pure Premium Method, Loss Ratio Method, Final Rate Change.
2. **Estimating Claims Liabilities:** Claim Development Triangles, Unpaid Claims Estimates-Development technique, including case outstanding technique, Expected claim technique, Bornhuetter-Ferguson technique, Cape Cod technique, Frequency-Severity techniques, Effect of operating changes, Unpaid claim adjustment expenses.
3. **Solvency Issues:** Discuss the historic development of solvency regulation; describe current programs used to monitor solvency; Catastrophe Modelling.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 2 Assignments (5% each) 10%
    - Mid-semester Examination 20%

STAT3001 **REGRESSION ANALYSIS**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
STAT2001 - Inferential Statistics **AND** MATH2410 - A First Course in Linear Algebra.

Course Content:

1. **Introduction:** Recap of the following distributions, χ^2, t and F. Expectation, variance and covariance of linear functions; Correlation and hypothesis testing of r; Principles of least squares.
2. **Simple Linear Regression:** Basic underlying assumptions; Notations and Model fitting by least squares; Statistical properties of least square estimators:- expectation, variance, covariance; Estimation of σ^2; Partitioning the variability of the response; Inferences:- hypothesis testing, confidence interval and prediction interval; Coefficient of determination; ANOVA and F-test for simple linear regression model; Gauss Markov Theorem(BLUE); Computer outputs (SPSS, R, Minitab); Lack of fit; Regression through the origin.
3. **Residual Analysis:** Residual plots, Model Assumptions (constant variance, independence, normality), outlying and influential observations.
4. **Multiple Regression:** Recap of matrix algebra; Model fitting by least squares; Statistical properties of least square estimators: expectation, dispersion matrix and linear combination; Inferences:– hypothesis testing and confidence interval, ANOVA, F-test for the overall model; Extra sums squares principles; Interactions; Dummy variables; Simultaneous Confidence Interval.
5. **Model Building Criteria:** R^2, adjusted R^2, S and Mallow's statistic.
6. **Selection:** Stepwise regression, forward and backward selection.
7. **Diagnostics:** Leverage value, Cook's distance measure.
8. **Assumptions Violation Remedies:** Transformation, weighted least squares.
9. **Multi-collinearity:** Correlation coefficient between $X'S$, effects on least squares estimates, variance inflator factor (VIF).

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Problem Papers/Laboratory Assignments 10%
    - Mid-semester Examination 10%
    - Mini-project 20%

<u>STAT3002</u> **<u>TIME SERIES</u>**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
MATH2404 - Introduction to Probability Theory **AND** STAT2001 - Inferential Statistics.

Course Content:

1. **Introduction:** Definition, notation and objectives of time series analysis; types of series; simple models and descriptive techniques:-additive, multiplicative models, trend, seasonality, cycles, noise, fits; test for randomness; *describing serial dependence:*-autocorrelation coefficients, sample correlation function and correlogram; *describing seasonality:*- seasonal adjustment; *describing trend(smoothing):*- filters and moving averages, differencing, Slutzky-Yule effect, exponential smoothing and other methods; Operators.
2. **Stationary Processes:** strict and second-order stationarity (mean, variance, covariance); autocorrelation function, autocovariance and autocorrelation functions, partial autocorrelation function and general linear process.
3. **Models for Time Series:** Definitions and properties of the following:- MA:-correlogram, generating functions, invertibility AR:-linear difference equations, characteristic equation, stationarity, Yule-Walker and Wold equations, correlogram ARMA:-stationarity, invertibility, correlogram, extension to integrated processes.ARIMA:-difference equation, general linear process, inverted form, $E\left(Y \text{ at time } t+k \mid \text{knowledge up to time } t\right)$
4. **Model Building:** Model identification: differencing to produce stationarity, estimating the correlogram:-sampling properties of sample autocorrelation coefficients; partial autocorrelation coefficients, estimating the partial correlation function. Model fitting: estimation of paramters: - method of moments, least squares, maximum likelihood;

fitted values, residuals Model diagnostics: residuals analysis, principle of parsimony, AIC, BIC.

5. **Forecasting:** Forecasting under fitted ARIMA models, Box-Jenkins forecasting.
6. **Financial Time Series:** Features of financial time series, ARCH (1) model.

Evaluation:

- Final Written Examination (2 hours) 60%
- Coursework: 40%
    - Mid-semester Examination 15%
    - Problem Papers/Laboratory Assignments 25%

STAT3003 **DESIGN & ANALYSIS OF EXPERIMENTS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
STAT2001 - Inferential Statistics.

Course Content:

1. **Introduction:** Collecting data by experiment, Principles of experimental design,
2. Simple design ideas, quick look at ANOVA.
3. **Background Theory:** Models, matrix formulation, GLM's, parameter estimation, contrasts inference, subdivision of TSS, Cochran's theorem, and parameterisations.
4. **Completely Randomised Designs:** Fixed and Random effects model, residual analysis, contrasts, quantitative factors by polynomial regression and Tukey's test
5. **Randomised Block Designs:** Fixed, Random and Mixed models, randomised block designs, Efficiency, additivity, interaction, missing values, balanced incomplete block, Latin Squares, Graeco-Latin squares, Youden square, Transformation, analysis of covariance.
6. **Multifactor Experiment:** Factorial treatment structure, nested models, 2^k and 3^k experiments, confounding, partial confounding, fractional replication in 2^k experiments.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• Problem Papers	10%
• Mid-semester Examination	15%
• Written Project	15%

DEPARTMENT
OF
PHYSICS

PROGRAMMES

Majors and B.Scs.

1. Electronics (Major)
2. Electronics and Computer Science (B.Sc.)
3. Energy and Environmental Physics (Major)
4. General Physics (Major)
5. Materials Science (Major)
6. Medical Physics (Major)
7. Physics with Education (B.Sc.)

Minors

1. Electronics
2. Energy and Environmental Physics
3. General Physics
4. Materials Science
5. Medical Physics

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
0	PHYS0411	Introduction to Mechanics	CXC Physics OR CSEC Physics OR GCE O-Level Physics		1	3-P
0	PHYS0412	Introduction to Oscillations & Heat			1	3-P
0	PHYS0421	Introduction to Electricity & Magnetism			2	3-P
0	PHYS0422	Introduction to Nuclear Physics & Optics			2	3-P
1	ELET1400	Introduction to Electronics	CAPE Physics (Units I & II) OR GCE A-Level Physics OR PHYS0411, PHYS0412, PHYS0421, PHYS0422 OR CXC Physics/CSEC Physics/GCE O-Level Physics and CAPE Mathematics (Units I & II)/GCE A-Level Mathematics/MATH0100, MATH0110		2	3
1	ELET1405	Practices in Basic Electronics		ELET1400	2	3
1	PHYS1411	Mechanics			1	3
1	PHYS1412	Waves, Optics & Thermodynamics			1	3
1	PHYS1421	Electricity & Magnetism			2	3
1	PHYS1422	Modern Physics			2	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
2	ELET2405	Practices in Electronics Design I	ELET1400, ELET1405	Level 2 Electronics or Electronics Engineering course	1	3
2	ELET2410	Analysis and Design of Analog Circuits	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE Mathematics (Units I & II) OR MATH0100, MATH0110		2	3
2	ELET2415	Practices in Electronics Design II	ELET1400, ELET1405	Level 2 Electronics or Electronics Engineering course	2	3
2	ELET2420	Semiconductor Devices	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE		2	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
			Mathematics (Units I & II) OR MATH0100, MATH0110			
2	ELET2430	Digital Circuits & Microprocessors	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE Mathematics (Units I & II) OR MATH0100, MATH0110		1	3
2	ELET2450	Embedded Systems	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE Mathematics (Units I & II) OR MATH0100, MATH0110		1	3
2	ELET2460	Signals & Systems	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE Mathematics (Units I & II) OR MATH0100, MATH0110		1	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
2	ELET2470	Electric Circuit Analysis	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE Mathematics (Units I & II) OR MATH0100, MATH0110		1	3
2	ELET2480	Communication Systems	ELET1400, PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Mathematics OR CAPE Mathematics (Units I & II) OR MATH0100, MATH0110		2	3
2	PHYS2200	Practices in Medical Physics 1	PHYS1411, PHYS1412, PHYS1421, PHYS1422	PHYS2296	2	3
2	PHYS2296	Physics of the Human Body	PHYS1411, PHYS1412, PHYS1421, PHYS1422		2	3
2	PHYS2300	General Physics Lab I	PHYS1411, PHYS1412, PHYS1421, PHYS1422	PHYS2351, PHYS2386	1	3
2	PHYS2351	Quantum Mechanics and Nuclear Physics	PHYS1411, PHYS1412, PHYS1421, PHYS1422	MATH1185	1	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
2	PHYS2386	Electromagnetism & Optics	PHYS1411, PHYS1412, PHYS1421, PHYS1422		1	3
2	PHYS2396	Computer Applications in Physics	PHYS1411, PHYS1412, PHYS1421, PHYS1422		1 and 2	3
2	PHYS2500	Materials Science Lab I	PHYS1411, PHYS1412, PHYS1421, PHYS1422	PHYS2561	2	3
2	PHYS2561	Fundamentals of Materials Science	PHYS1411, PHYS1412, PHYS1421, PHYS1422, GCE A-Level Chemistry/CAPE Chemistry (Units I & II)/CHEM0901, CHEM0902		2	3
2	PHYS2600	Fluid Dynamics and Environmental Physics Lab	PHYS1411, PHYS1412, PHYS1421, PHYS1422	PHYS2671	2	3
2	PHYS2671	Fluid Dynamics	PHYS1411, PHYS1412, PHYS1421, PHYS1422		1 and 2	3
2	PHYS2701	Essentials of Renewable Energy	None		1	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
		Technologies and Solutions				
3	ELET3405	Practical Analysis of Advanced Electronic Circuits and Systems	ELET2405, ELET2415		1	3
3	ELET3430	Instrumentation and Measurements	ELET2410, ELET2430		1	3
3	ELET3440	Introduction to Robotics	ELET2430, ELET2450		2	3
3	ELET3450	Satellite Communication & Global Navigation Satellite Systems	ELET2480		2	3
3	ELET3460	Digital Signal and Image Processing	ELET2460		2	3
3	ELET3470	Wave Transmission & Fibre Optics	ELET2480		1	3
3	ELET3480	Wireless Communication Systems	ELET2480		1	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
3	ELET3490	Electronics Research Project	ELET2410 OR ELET2450		1 and 2	4
3	ELET3600	Energy Systems Laboratory	PHYS3671, PHYS3681	ELET3611	1	3
3	ELET3611	Integrating Alternative Energy	ELET2420	PHYS3671, PHYS3681	2	3
3	PHYS3200	Advanced General Physics Lab	PHYS2300	PHYS3351, PHYS3386	2	3
3	PHYS3300	Advanced Practices in Medical Physics	PHYS2200		1	3
3	PHYS3341	Biomedical Optics and Biomechanics	PHYS2296		1	3
3	PHYS3351	Modern Physics 2	PHYS2351		2	3
3	PHYS3386	Electromagnetism	ELET2480 OR PHYS2386		1 and 2	3
3	PHYS3389	Medical Radiation Physics & Imaging	PHYS2296		2	3
3	PHYS3395	Astronomy & Cosmology	PHYS1411, PHYS1412, PHYS1421, PHYS1422		2	3
3	PHYS3399	Research Project (Non-Electronics)	Head of Department’s Approval		1 and 2	4

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
3	PHYS3400	Physics in Practice Internship	At least a ‘B’ grade in PHYS2386 or ELET2470; One of the Department’s majors declared; Head of Department’s Approval		Summer	3
3	PHYS3500	Advanced Materials Science Laboratory	PHYS2500		1	3
3	PHYS3561	The Physics of Crystalline Materials	PHYS2561		2	3
3	PHYS3562	The Physics of Non-Crystalline and Amorphous Materials	PHYS2561		1	3
3	PHYS3565	Thermodynamics and Kinetics of Materials	PHYS2561		2	3
3	PHYS3661	Physics of the Atmosphere & Climate	PHYS1411, PHYS1412, PHYS1421, PHYS1422		2	3
3	PHYS3671	Solar Power	PHYS3661		1	3
3	PHYS3681	Wind & Hydro Power	PHYS2671, PHYS3661		2	3

UNDERGRADAUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS						
LEVEL	**CODES**	**TITLES**	**PRE-REQUISITES**	**CO-REQUISITES***	**SEMESTER**	**CREDITS**
3	PHYS3701	Advanced Renewable Energy Technologies and Solutions	PHYS2701		2	3
***can be done prior to the course**						

Students pursuing a major in the Physics Department are required to complete ***MATH1185 - Calculus for Scientists & Engineers and MATH1141 - Intro to Linear Algebra and Analytic Geometry*** *before their final year.*

To qualify for Level 2 Physics, students must have: PHYS1411 - Mechanics; PHYS1412 - Waves, Optics & Thermodynamics; PHYS1421- Electricity & Magnetism; PHYS1422 - Modern Physics; ELET1400 (except Material Science major); Electronics major needs ELET1405.

A double major in the Physics Department must have Electronics as one of the majors.

REQUIREMENTS FOR MAJORS AND MINORS				
	Major		**Minor**	
	requires 36 Level 2 Credits as outlined below		*requires 18 Level 2 Credits as outlined below*	
	Core	**Electives**	**Core**	**Electives**
General Physics	PHYS2300 PHYS2351 PHYS2386 PHYS2396 ELET2420 MATH2230 PHYS3200 PHYS3351 PHYS3386 PHYS3395	**Any two of the following:** PHYS3399 Any other Level 2/3 PHYS course Any level 2/3 Electronics	PHYS2351 PHYS2386 PHYS2396 PHYS3351 PHYS3386	
Energy and Environmental Physics	ELET2420 PHYS2300 PHYS2351 PHYS2386 PHYS2396 PHYS2600 PHYS2671 ELET3600 ELET3611		PHYS2351 PHYS2386 PHYS2396 PHYS2600 PHYS3661 PHYS3671	-

	PHYS3661 PHYS3671 PHYS3681			
Medical Physics	ELET2460 PHYS2200 PHYS2296 PHYS2300 PHYS2351 PHYS2386 PHYS2396 PHYS3300 PHYS3341 PHYS3399	**Any two of the following:** MATH2230 PHYS3399 Any other Level 2/3 PHYS Course Any Level 2/3 Electronics	PHYS2200 PHYS2300 PHYS2351 PHYS2386 PHYS2396 PHYS2296 PHYS3389	-
Materials Science	PHYS2300 PHYS2351 PHYS2386 PHYS2396 PHYS2500 PHYS2561 PHYS2671 PHYS3500	**Any two of the following** MATH2230, PHYS3399 Any other Level 2/3 PHYS Course Any Level 2/3 Electronics	PHYS2351 PHYS2386 PHYS2500 PHYS2561 PHYS3561 PHYS3562	-

	PHYS3561 PHYS3562 PHYS3565			
Electronics	ELET2405 ELET2410 ELET2415 ELET2430 ELET2470 ELET3405 ELET3490	Any five of the following - at least two must be from Level 3 ELET2460 ELET2480 ELET2450 ELET3450 ELET3480 ELET3470 ELET3460 ELET3412 ELET3485	ELET2405 ELET2415 ELET2470 ELET2430 ELET2410	Any other Level 2/3 ELET course

Requirements for a Major in the Physics Department

The table below outlines the courses required for a major in the Department of Physics. Please note that in some cases additional credits must be obtained from other Physics Department courses to satisfy the thirty-six (36) credits needed for the major. Other department and/or Faculty and/or out of Faculty courses (including Foundation courses) must be done to satisfy the ninety-three (93) credits necessary for award of your degree.

A double major within the department is possible only if the Electronics major is a part of the double major. E.g. A major in Electronics and a major in General Physics. Also a major and a minor within the department is possible only if Electronics satisfies the major or the minor. E.g. A major in Medical Physics with a minor in Electronics. Alternatively double majors may be done with any Physics Department major and a major from another Department e.g. A major in Material Science with a major in Chemistry.

MAJORS	YEAR 1		YEAR 2		YEAR 3		ELECTIVES
	SEMESTER 1	SEMESTER 2	SEMESTER 1	SEMESTER 2	SEMESTER 1	SEMESTER 2	
GENERAL PHYSICS	**MATH1141**	**ELET 1400**	**PHYS2300**	ELET2420	MATH2230	**PHYS2396**	Any 2 of the following
	MATH1185	**PHYS1421**	**PHYS2351**		**PHYS3386**	PHYS3100	PHYS3399
	PHYS1411	**PHYS1422**	**PHYS2386**			**PHYS3351**	PHYS3565 (highly recommended)
	PHYS1412					**PHYS3395**	Level 2 or 3 PHYS or ELET course
ENERGY AND ENVIRONMENTAL PHYSICS	**MATH1141**	**ELET 1400**	**PHYS2300**	ELET2420	ELET3600	ELET3611	
	MATH1185	**PHYS1421**	**PHYS2351**	**PHYS2600**	**PHYS2386**	**PHYS2396**	
	PHYS1411	**PHYS1422**	PHYS2671	**PHYS3661**	**PHYS3671**	PHYS3681	
	PHYS1412						
MEDICAL PHYSICS	**MATH1141**	**ELET 1400**	ELET2460	**PHYS2200**	PHYS3300	**PHYS3389**	Any 2 of the following
	MATH1185	**PHYS1421**	**PHYS2300**	**PHYS2296**	PHYS3341		MATH2230
	PHYS1411	**PHYS1422**	**PHYS2351**	PHYS2396			PHYS3399

	PHYS1412		**PHYS2386**				Level 2 or 3 PHYS or ELET course
MATERIALS SCIENCE	**MATH1141**	**PHYS1421**	**PHYS2300**	**PHYS2500**	PHYS3500	PHYS2396	Any 1 of the following
	MATH1185	**PHYS1422**	**PHYS2351**	**PHYS2561**	**PHYS3562**	**PHYS3561**	MATH2230
	PHYS1411		**PHYS2386**	PHYS2671		PHYS3565	PHYS3399
	PHYS1412						Level 2 or 3 PHYS or ELET course
ELECTRONICS	**MATH1141**	**ELET 1400**	**ELET2405**	**ELET2410**	ELET3405	ELET3490	Any 5 of the following
	MATH1185	**ELET1405**	**ELET2430**	**ELET2415**			Level 2 or 3 ELET course
	PHYS1411	**PHYS1421**	**ELET2470**				
	PHYS1412	**PHYS1422**					
There are two streams that some electronics students choose to "specialise" in. These are Telecommunications and Robotics & Instrumentation. There are some courses that need to be done in any of these streams and they are listed below. Please note that these are suggestions and are not meant to restrict your choice of courses or course combinations.							
TELECOMMUNICATIONS	**MATH1141**	**ELET 1400**	**ELET2405**	**ELET2410**	**ELET2470**	ELET3450	
	MATH1185	**ELET1405**	**ELET2430**	**ELET2415**	ELET3405	ELET3460	
	PHYS1411	**PHYS1421**	ELET2450	ELET2480	ELET3470	ELET3490	
	PHYS1412	**PHYS1422**	ELET2460		ELET3480		
ROBOTICS AND INSTRUMENTATION	**MATH1141**	**ELET 1400**	**ELET2405**	**ELET2410**	**ELET2470**	ELET3440	
	MATH1185	**ELET1405**	**ELET2430**	**ELET2415**	ELET3405	ELET3490	
	PHYS1411	**PHYS1421**	ELET2450	ELET2480	ELET3430		
	PHYS1412	**PHYS1422**	ELET2460		ELET3480		

- **Courses in bold are required for a minor.**
- **A major in Physics/Electronics requires 36 credits of advanced level (level 2 and level 3) courses.**
- **A minor in Physics/Electronics requires 18 credits of advanced level (level 2 and level 3) courses.**
- **Additional Physics/Electronics courses may be needed to complete a major.**
- ***If pursuing a double major, a single advanced level course CANNOT count towards 2 majors. Therefore, due to overlapping core courses, a double major within the department MUST have Electronics as one of the majors. Note well, ELET2420 is a core course for some non-electronics major, so it cannot be counted towards the Electronics majors as a free elective.***
- **The Mathematics courses listed are those required to complete Physics majors. For more information on Mathematics courses, please contact the Department on Mathematics. Students pursuing both MATH1142 and MATH1151 otherwise do not need to do MATH1185.**

Notes:

- *Other credits are required to complete majors. See previous page. Electives can be selected in any semester of Level 2 and Level 3 as offered.*
- *MATH1141 and MATH1185 are compulsory and recommended for completion in Level 1, but may be done in Level 2.*
- *Preliminary Chemistry courses or their equivalent are needed for Materials Science Major.*

PHYSICS WITH EDUCATION (B.Sc.)

LEVEL 1

Twenty-four (24) credits from two subject areas in the Faculty of Science and technology, divided equally between the two so as to provide the Pre-requisites for Level 2 courses (Note that MATH1141 & MATH1185 must be completed prior to pursing Level 3 Physics Department courses). One of the subject areas must be Physics (required courses are PHYS1411, PHYS1412, PHYS1421, PHYS1422 and ELET1400). Foundations of Education courses (see A below) may also be taken with Level 1 courses from the Faculty of Science and Technology.

Trained Teachers with the New Double Option (since 2004) with Physics as one of their majors and who have a GPA of at least 2.9 may be granted exemption from Level 1 requirements.

Trained Teachers with Single Option science are required to do Preliminary Physics.

LEVEL 2

Thirty-six (36) credits are required from Levels 2 and 3 Physics courses such that constitute the General Physics major.

EDUCATION COURSES

Please consult the Faculty of Humanities & Education regarding the selection of Education Courses.

ELECTRONICS AND COMPUTER SCIENCE (B.Sc.)

At least 99 credits are required for this programme. The courses are outlined below.

(E = Examination, C = Coursework, and the numeral after E or C = Number of Credits)

YEAR 1 Semester I		Credits	YEAR 1 Semester II		Credits
COMP1126	Introduction to Computing I	E 3	COMP1161	Object-Oriented Programming	E 3
COMP1127	Introduction to Computing II	E 3	COMP1220	Computing and Society	E 3
MATH1185	Calculus for Scientists and Engineers	E3	ELET1400	Introduction to Electronics	E 3
ELNG1101	Physics for Engineers+	E3	ELET1405	Practices in Basics Electronics	C 3
MATH 1141	Introductory Liner Algebra and Geometry	E3			
	Total Credits	**15**		**Total Credits**	**12**
YEAR 2 Semester I		**Credits**	**YEAR 2 Semester II**		**Credits**
COMP2140	Software Engineering	E3	COMP2211	Analysis of Algorithms	E3
COMP2190	Net-Centric Computing	E3	COMP2201	Discrete Mathematics for Computer Science	E3
ELET 2405	Practices in Electronics Designs I	C3	ELET 2410	Analog Circuits	E3

ELET2450	Embedded Systems	E3	ELET2415	Practices in Electronics Designs II	E3
ELET2460	Signals and Systems	E3	ELET2480	Communication Systems	E3
	Total Credits	**15**		**Total Credits**	**15**
YEAR 3 Semester I		**Credits**	**YEAR 3 Semester II**		**Credits**
ELET2430	Digital Circuits and Microprocessors	E3	COMP2170	Object Technology	E3
ELET2470	Electric Circuit Analysis	E3	COMP3161	Database Management Systems	E3
COMP3101	Operating Systems	E3	COMP3901	Capstone Project	C3
COMP3220	Principles of Artificial Intelligence	E3	**ELECTIVES (Any 2*)** COMP3652 COMP3702 COMP3911 ELET3440 ELET3450 ELET3460 INFO2180 INFO3110 INFO3155	 Language Processors Theory of Computation Internship in Computing I Introduction to Robotics Satellite Communication and Navigational Systems Digital Signal and Image Processing Web Design and Programming I Information Systems in Organisations Computer and Network Security	 E3 E3 C3 E3 E3 E3 E3 E3 E3
ELET3405	Practical Analysis of Advanced Electronic Circuits	C3			

			INFO3180 Web Design and Programming II	E3 E3
ELECTIVES (Any 1*) COMP3170 User Interface Design COMP3191 Principles of Computer Networks COMP3801 Real-Time Embedded Systems COMP3911 Internship in Computing I ELET3430 Instrumentation and Measurements ELET3470 Wireless transmission and Fibre Optics ELET3480 Wireless Communication Systems ELET2420 Solid State Electronic Devices				
Total Credits		**18**	**Total Credits**	**15**
3 Foundation Courses				**9**
TOTAL PROGRAMME CREDITS				**99**

+ Persons pursuing PHYS1411, PHYS1412, PHYS1421 and PHYS1422 could use these to replace ELNG 1101 as the content of the latter is covered in parts of each of the four courses.

**** At least two of the three electives must be level.***

COURSE DESCRIPTIONS

PHYS0411 **INTRODUCTION TO MECHANICS**
(3 P-Credits) (Level 0) (Semester 1)

Pre-requisite:
CXC/CSEC Physics, GCE "O" Level Physics **OR** the equivalents.

Course Content:

1. **Physical Quantities and Units:** Physical quantities and their units with mass, length, time and temperature as fundamental (base) quantities. The nature of the physical quantities: scalars and vectors, components of a vector, addition and subtraction of vectors by means of components.
2. **Kinematics in One Dimension:** Definitions in displacement, speed (average and instantaneous), velocity (average and instantaneous), acceleration (average and instantaneous). Displacement-time and velocity-time graphs. Graphical interpretation of velocity and acceleration. Distance travelled as area under the velocity-time graph. Derivation of kinematic equations for constant acceleration and their application to solving problems.
3. **Projectile Motion:** Introduction to projectile motion as a combination of two one-dimensional motions. Derivative of range, maximum height and time of flight. Derivation of the equation for a parabolic path. Application of the equations for projectile motion. Forces & Newton's Laws of Motions; Concepts of force, mass and inertia. Statement of Newton's Laws. Vector nature of Newton's Second Law of Motion ($\Sigma F_x = ma_x$,$\Sigma F_y = ma_y$).
4. **Types of Forces:** Static and kinetic frictional forces. Tension. Gravitational forces. Newton's laws of gravitation. Moment of a force. Equilibrium and conditions for equilibrium. Forces on an object immersed in a fluid. Pressure and upthrust. Archimedes' principle and its derivation using a cubical object. Simple battery hydrometer. Viscosity. Statement of Stokes' law and the concept of terminal velocity.
5. **Dynamics of Uniform Circular Motion:** Introduction to the concept of centripetal acceleration and force. Centripetal force and motion around a curve. Satellites in circular orbits.
6. **Work and Energy:** Concepts of work and power. Kinetic and potential energies. Work-Energy Theorem. Definition of conservation of force. The principle of conservation of mechanical energy. Concepts of energy

conversion and applications with special references to renewable energy sources such as solar, wind, geothermal and wave.

7. **Impulse and Momentum:** Definition of impulse and linear momentum. Impulse-Momentum theorem. The principle of conservation of linear momentum including the derivation using the impulse-momentum theorem. Application to collisions.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• Laboratory Work	10%
• In-course Tests	15%
• Tutorial Tests	15%

PHYS0412 **INTRODUCTION TO OSCILLATIONS AND HEAT**
(3 P-Credits) (Level 0) (Semester 1)

Pre-requisite:
CXC/CSEC Physics, GCE "O" Level Physics **OR** the equivalents.

Course Content:

1. **Simple Harmonic Motion:** Introduction to Hooke's Law and definition of simple harmonic motion. Treatment of light spring-mass system as simple harmonic oscillator. The displacement-time graph for SHM and the application of $x = A \cos(w\ t)$ or $x = A \sin(w\ t)$ to interpret the results. Expressions for velocity, acceleration and period for SHM. Energy considerations and conservation for SHM. The Simple Pendulum.
2. **Temperature and Thermometers:** Thermal equilibrium and the Zeroth law of thermodynamics. Thermal expansion. The Gas laws and absolute temperature. The ideal gas law. The ideal gas law in terms of molecules. Avogadro's number. Kinetic theory. Real gases and change of phase. Vapour pressure and humidity.
3. **Heat and Internal energy.** Specific heat capacity. Latent heat. Calorimetry. Heat transfer: Conductio**n, convection and radiation. F**irst law of thermodynamics. First law applied to simple processes including isobaric and isothermal processes.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - Laboratory Work 10%
  - In-course Tests 15%
  - Tutorial Tests 15%

PHYS0421 **INTRODUCTION TO ELECTRICITY AND MAGNETISM**
(3 P-Credits) (Level 0) (Semester 2)

Pre-requisite:
CXC/CSEC Physics, GCE "O" Level Physics **OR** the equivalents.

Course Content:

1. **Electric field and potential:** Definition of point charge. Coulomb's law; The electric field E; Force on a charge q in electric field E; Electric potential; Charge q traversing electric potential ΔV; Definition of the electron volt; Electric potential energy; Charge q in a conducting sphere; Resulting E and V; Capacitors: Q = CV; Capacitance of the parallel plate capacitor and the electric field between charged plates; Dielectrics; Energy stored in a charged capacitor and energy density in terms of E; Capacitors in series and parallel.
2. **Ohm's Law:** Resistors in series and parallel; Emf, internal resistance and terminal potential difference of a battery; Kirchhoff's laws and applications; Electric power for DC and AC voltages.
3. **Magnetism:** Force on current-carrying wire in a magnetic field; Definition of magnetic field B; Force due to B on charge q moving with velocity v; B due to a long straight current-carrying wire and a solenoid; Force between current-carrying conductors; Definition of the Coulomb and Ampere.
4. **Electromagnetic Induction:** Faraday's law of electromagnetic induction; Lenz's law; Motional emf; The inductance L; Energy stored in an inductor and energy density in terms of B; Electric generators.
5. **Logic Gates and their truth tables.** P-type and n-type semiconductors; Diodes.

Evaluation:

• Final Written Examination (2 hours)	60%
Course Work:	40%
• Laboratory Work	10%
• In-course Tests	15%
• Tutorial Tests	15%

PHYS0422 INTRODUCTION TO NUCLEAR PHYSICS AND OPTICS

(3 P-Credits) (Level 0) (Semester 2)

Pre-requisite:

CXC/CSEC Physics, GCE "O" Level Physics **OR** the equivalents.

Course Content:

Optics

1. **Light as Electromagnetic Wave:** The electromagnetic spectrum; The speed of light; Wavefronts and rays; Laws of reflection; Image formation by Concave and convex mirrors; Refraction of light; Index of refraction; Snell's law; Total internal reflection and the critical angle; Examples of application of TIR.
2. **Lenses:** Thin converging and diverging lenses; Image formation by lenses using ray diagrams; Linear magnification; Derivation of the lens equation and sign convention; Lenses in combination.
3. **Human Eye:** Anatomy of the human eye; Image formation by the eye of objects at varying distances; Defects of vision (near-sightedness and farsightedness) and their correction by lenses.
4. **Telescopes and Microscopes:** Angular magnification; Simple and compound microscopes and their angular magnification; Astronomical and Galilean telescopes and angular magnification.

Nuclear Physics

5. **Nuclear Model of the Atom:** Geiger-Marsden experiment; Nuclear structure; The fundamental forces; Binding energy and mass defect; Atomic mass unit; Nuclear stability and natural radioactivity; Fission and fusion;
6. **Radioactivity:** Radioactive decay and its equation; Activity; Radioactive dating; Medical and other applications of radioactivity; X-ray production and spectrum; Simple radioactive detectors;

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Laboratory Work 10%
    - In-course Tests 15%
    - Tutorial Tests 15%

PHYS1411 **MECHANICS**

(3 Credits) (Level 1) (Semester 1)

Pre-requisites:

CAPE/A-Level Physics or (PHYS0411, PHYS0412, PHYS0421 and PHYS0422) **OR** (CSEC Physics with CAPE/A-Level Maths or MATH0100 and MATH0110).

Course Content:

1. **Scalars and Vectors:** Scalar and Vector products; Vectors and their components; Unit vectors; Vector algebra in terms of their components.
2. **Vector Treatment of Motion:** Position vector and particle trajectory; Average and instantaneous acceleration; Application to uniform circular motion; Derivation of $a = -w^2r$; Relative velocity.
3. **Work and Kinetic Energy:** General definition of work; Work done by a variable force; One-dimensional analysis; Interpretation of work as area under graph of F vs x; Proof of Work-Kinetic Theorem.
4. **Conservation of Energy:** Conservative Forces; General definition of potential energy and examples of its calculation; Mechanical Energy; Proof of conservation of Mechanical Energy; Non-conservative forces; Conservation of total energy.
5. **System of Particles:** Centre of mass for systems of particles and extended objects; Newton's Second Law for systems of particles and extended objects and consequences; Proof of conservation of linear momentum.
6. **Rotation:** Description of rotation using θ, w and α; Kinematic equations; Kinematic energy of rotation; Rotational inertia and its calculation for some symmetrical objects; Parallel and Perpendicular Axes Theorem; Torque $\tau = r \times F$ and $\tau = Iw$; Work and Torque.
7. **Rolling:** Definition of Rolling; Rolling as a combination of rotation and translation; Rolling as pure rotation about an instantaneous axis; Role of friction in rolling; Kinetics and dynamics of rolling; Definition of Angular Momentum; Newton's Second Law in angular form; Angular

momentum for a system of particles; Conservation of angular momentum and its application.

8. **Simple Harmonic Motion:** Equation of Linear SHM in differential form and solution as $x = A \sin(\omega t + \theta)$; Definition of angular SHM in terms of torque and angular displacement; Differential equation of motion and its solution; Examples such as physical pendulum (and limiting case of simple pendulum) and suspended oscillating disc.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Laboratory Work 10%
    - In-course Tests 15%
    - Tutorial Tests 15%

PHYS1412 WAVES, OPTICS AND THERMODYNAMICS
(3 Credits) (Level 1) (Semester 1)

Pre-requisites:
CAPE/A-Level Physics **or** (PHYS 0411 - Introduction to Mechanics, PHYS 0412 - Introduction to Oscillations and Heat, PHYS 0421 - Introduction to Electricity and Magnetism, PHYS0422 - Introduction to Nuclear Physics and Optics) **OR** (CSEC Physics with CAPE/A-Level Maths or MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Waves on a String:** Transverse and longitudinal waves; The wave equation; Phase velocity; The sine wave; Power transmission; Superposition principle; Interference; Standing waves and Resonance.
2. **Sound Waves:** Wave speed (without derivation); Displacement and pressure waves; Beats; Doppler effect for sound waves.
3. **Optics:** Huygen's Principle (eg; in Refraction); The electromagnetic wave.
4. **Coherence:** Young's experiment; Intensity in double slit interference; Thin film interference (including wedge films and Newton's rings).
5. **The Phasor Method:** Single slit diffraction; The diffraction grating;
6. **Heat and Thermodynamics: Temperature; Heat and the First Law**: Measuring temperature; Constant volume gas thermometer; Ideal gas temperature; Measurement of thermodynamic temperature; Absorption of heat by solids and liquids; Molar specific heat; Heat and

Work; Calculation of work done by an ideal gas at constant temperature; Differential form of First Law of Thermodynamics and application to selected cases.

7. **Kinetic Theory of Gases:** RMS speed, pressure, translational kinetic energy and pressure; Adiabatic equation of an ideal gas.
8. **Entropy and the Second Law:** Entropy and the second law of Thermodynamics; Heat engines and refrigerators.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - Laboratory Work 10%
    - In-course Tests 15%
    - Tutorial Tests 15%

PHYS1421 **ELECTRICITY AND MAGNETISM**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:

CAPE/A-Level Physics **or** (PHYS 0411 - Introduction to Mechanics, PHYS 0412 - Introduction to Oscillations and Heat, PHYS 0421 - Introduction to Electricity and Magnetism, PHYS0422 - Introduction to Nuclear Physics and Optics) **OR** (CSEC Physics with CAPE/A-Level Maths or MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Electric field and potential:** The electric field E due to extended charge distributions; Integral and differential expressions relating the electric potential V to the E field; Potential due to a dipole and other extended charge distributions;
2. **Gauss' Law:** Application to problems with spherical, cylindrical and rectangular symmetry.
3. **Capacitance:** Calculation of the capacitance of various capacitors; Energy stored in a capacitor; RC circuits; Time constant.
4. **Magnetism:** Magnetic force on current-carrying wire and its application to cases needing calculus treatment; Magnetic torque on a current loop; Magnetic moment of a current loop; The Hall-Effect; Biot-Savart Law and Ampere's Law, and their application to long current-carrying wire, loop, and solenoid.

5. **Electromagnetic Induction:** Faraday's Law and Lenz's Law; Electromagnetic induction and its applications; Self Induction; Inductance; RL circuits.
6. **Electromagnetic Oscillations and Alternating Currents:** LC Oscillation; Damped oscillation in an RLC circuit; Alternating current; Forced oscillation; RLC circuits; Power in AC circuits; the Transformer; Introduction to the Electromagnetic wave.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• Laboratory Work	10%
• In-course Tests	15%
• Tutorial Tests	15%

PHYS1422 **MODERN PHYSICS**
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
CAPE/A-Level Physics **or** (PHYS 0411 - Introduction to Mechanics, PHYS 0412 - Introduction to Oscillations and Heat, PHYS0421 - Introduction to Electricity and Magnetism, PHYS0422 - Introduction to Nuclear Physics and Optics) **OR** (CSEC Physics with CAPE/A-Level Maths or MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:
1. **Bohr Atom:** Spectral series for hydrogen, Bohr's postulates, derivation of energy levels, blackbody radiation and quantized energy levels (qualitative).
2. **Waves and Corpuscles:** Wave-particle duality; photo-electric effect; Compton-effect; energy, momentum and wavelength of a photon, deBroglie's equation, wave function, particle in a box.
3. **Special Relativity:** Galilean relativity; Einstein postulates; Lorentz transformation; simultaneity; time dilation; length contraction; derivation of velocity transformations, the equation $E^2 = p^2c^2 + m_o^2c^4$ and its applications.
4. **Particle Physics and the Big Bang:** Elementary particles; Three groups; Conservation Laws; Eightfold way; Quarks; Fundamental interactions and their unification; The standard model; The history of the universe.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - Laboratory Work 10%
  - In-course Test 15%
  - Tutorial Test 15%

ELET1400 **PRACTICES IN BASIC ELECTRONICS I**
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
CAPE/A-Level Physics **or** (PHYS 0411 - Introduction to Mechanics, PHYS 0412 - Introduction to Oscillations and Heat, PHYS0421 - Introduction to Electricity and Magnetism, PHYS0422 - Introduction to Nuclear Physics and Optics) **OR** (CSEC Physics with CAPE/A-Level Maths or MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

1. **Introduction to Semiconductor Theory and the P-N Junction:** Review of the atomic structure and bonding, Conductor, insulator, and semiconductor; Semiconductor materials; Covalent bonded structures in semiconductor; Charge carriers and Energy levels; Energy level diagrams; Intrinsic and Extrinsic semiconductors; Doping; n-type and p-type semiconductors; Drift and Diffusion currents; Resistivity and conductivity; the Fermi Dirac Distribution function; The P-N Junction; P-N junction at Thermal Equilibrium; Junction capacitance; P-N junction diode; Characteristic curve of the p-n junction diode; Forward and reverse biasing; Diode circuits; Zener diodes; Diode data sheets; voltage doubler; Rectification: half wave and full wave; Light emitting diodes (LED); The Bipolar Junction Transistor (BJT); the Field Effect transistor; Biasing the transistor circuit; Transistor as a switch; Relay drivers; Logic gate design with transistors.
2. **Introduction to Digital Electronics:** Analog and digital concepts; binary digits and logic levels; digital waveforms; logic gates and truth tables; physical realization of logic gates; Boolean algebra and logic simplification; DeMorgan’s theorem; Circuit minimization using Karnaugh maps; Terminologies used in logic designs: Fan in, Fan out, rise time, fall time, propagation delay; debounced switching; Combinational logic circuits:- Decoders, encoders, multiplexers, demultiplexers, parity generators, adders; Number systems, operations

and codes; Binary coded Decimal, ASCII, Gray code; Code converters; Lathes, Flip Flops.

3. **Introduction to Analog Electronics:** Introduction to alternating current (AC); Frequency dependent resistive (R), capacitive (C) and inductive (L) circuits; Resonance in RLC circuits; Determination of bandwidth and half-power points. First order response in RLC circuits; The Operational Amplifier; Op amp characteristics; Feedback in op amp circuits; The inverting, summing and non-inverting amplifiers; The differentiator and the integrator; RC filters; First order active filters; Fundamentals of Communication Systems; Amplitude modulation (AM) and demodulation, Frequency modulation (FM) and demodulation, and Digital Communications basic, Basic building block of Transmitters and Receivers.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

ELET1405 **PRACTICES IN BASIC ELECTRONICS II**

(3 Credits) (Level 1) (Semester 2)

Pre-requisites:

CAPE/A-Level Physics **or** (PHYS 0411 - Introduction to Mechanics, PHYS 0412 - Introduction to Oscillations and Heat, PHYS0421 - Introduction to Electricity and Magnetism, PHYS0422 - Introduction to Nuclear Physics and Optics) **OR** (CSEC Physics with CAPE/A-Level Maths or MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

Course Content:

Week 1: Measuring electronic circuit parameters using oscilloscopes and multimeters; **Week 2:** Determining the characteristics curve of a p-n junction diode and the half wave rectifier; **Week 3:** Evaluating the operation of Full Wave rectifiers and Zener diodes on Voltage regulation; **Week 4:** Investigating Transistor circuits: Logic operation; LED drivers; **Week 5:** Semiconductor circuit design project (In-class); **Week 6:** Verifying truth tables of logic gates and combinational circuits; **Week 7:** Designing combinational circuit for special applications; **Week 8:** Digital circuit design project (in-class); **Week 9:** Investigating circuit theorems; **Week 10:** Investigating Op Amp Circuits; **Week 11:** Investigating AM and FM communication circuits/systems: **Week 12:** Analog Circuit Design Project (in-class).

Evaluation:

- Final Written Examination (2 hours) 40%
- Course Work: 60%
    - 9 Laboratory Reports 15%
    - 3 Design Projects 45%

PHYS2200 **PRACTICES IN MEDICAL PHYSICS 1**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Co-requisite:

PHYS2296 - Physics of the Human Body.

Course Content:

The course will consist of six laboratory exercises and a research project. The laboratory exercises are:

Determination of Young's modulus in bone phantoms; Determination of the centre of gravity of a human body; Electrocardiogram (ECG) techniques to examine the heart; Electromyography (EMG) techniques to examine nerve condition; Audiometric analysis of human hearing; Optical analysis of human sight.

A research project related to the Level 2 medical physics courses will be assigned. The project content will involve the use of techniques in physics to investigate the effects of a variety of phenomena on the human body (for example, the medical implications of radiation of mobile phones and cell towers).

Evaluation:

- Practical Examination (2 hours) 30%
- Course Work: 70%
    - 6 Laboratory Reports 30%
    - 1 Written Project Report and Individual Oral Presentation 40%

PHYS2296 **PHYSICS OF THE HUMAN BODY**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Course Content:
Basic anatomy of the human body; Terminology, modeling, and measurement; Energy, heat, work, and power of the body; Muscle and forces; Physics of the skeleton; Pressure in the body; Physics of the lungs and breathing; Physics of the cardiovascular system; Electrical signals from the body; Sound and speech; Physics of the ear and hearing; Physics of the eyes and vision; Human body in space and microgravity.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 20%
    - 4 Graded Assignments 20%

PHYS2300 **GENERAL PHYSICS LAB 1**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Co-requisites:
PHYS2351 - Quantum Mechanics and Nuclear Physics, PHYS2386 - Electromagnetism and Optics.

Course Content:
Radioactive decay: Decay and counting statistics for dice; Geiger counter and the absorption of gamma rays by matter; Wave behaviour of electrons; Energy levels in a quantum well; Classical and quantum probability; Electromagnetism and capacitors; Magnetic susceptibility; Fresnel diffraction; Resolution of spectral lines; Fraunhofer diffraction.

Evaluation:

- Practical Examination (4 hours) 50%
- Course Work: 50%
    - In-course Practical Examination 30%
    - 10 Laboratory Reports 20%

PHYS2351 **QUANTUM MECHANICS AND NUCLEAR PHYSICS**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Co-requisite:
MATH1185 - Calculus for Engineers and Scientists.
Course Content:

1. **Nuclear Physics:** Basic properties of the nucleus; liquid drop model of the nucleus; α decay & quantum mechanical tunneling; interactions of particles with matter; radiation detectors and magnetic resonance imaging (MRI).
2. **Quantum Mechanics:** Limitations of classical physics, operators and eigenfunctions; Schouroedinger's equation and the wave function (ψ); solutions of Schouroedinger's equation for infinite and finite potential wells, step potential barrier & tunneling, and finite square well.

Evaluation:

- Final Written Examination (2 hours) 40%
- Course Work: 60%
    - 5 Tutorial Assignments1 10%
    - 5 Pop Quizzes 20%
    - 2 In-course Practical Examinations 30%

PHYS2386 **ELECTROMAGNETISM AND OPTICS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Course Content:

1. **Electricity and Magnetism:** Electric fields and magnetism in matter; Displacement current and charge conservation; The electromagnetic waves and Maxwell's equations; the plane wave equation; Poynting vector.
2. **Optics:** Polarization of electromagnetic waves; Temporal and spatial coherence; Visibility of fringes; Diffraction grating; Fresnel diffraction and the zone plate.

Evaluation:

- Final Written Examination (4 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

PHYS2396 **COMPUTER APPLICATIONS IN PHYSICS**

(3 Credits) (Level 2) (Semesters 1 & 2)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Course Content:

1. **Introductory Material:** Introduction to software package (e.g. MATLAB/SciLAB, MathCAD) and programming language (e.g. V-Python); limitations, errors and tolerances.
2. **Data organization for manipulation**: 2-D and 3-D plots, matrices and vectors, "Least Squares" method.
3. **Functions and Equations**: Systems of equations and approximation of functions (e.g., Taylor series, Fourier series); differential and state-space equations.
4. **Programming:** Writing/algorithms/programmes (e.g., Bisection method, Newton-Rhapson method); numerical integration.
5. **Applications**: Mandatory: Projectile motion with air resistance; Forced-Damped oscillations; Double-Spring oscillations; the wave equation, the

heat equation, Poisson's Equation. Optional Driven damped pendulum; Radioactive Decay; Potentials and Fields; Navier-Stokes Equation; Two- and Three-body problem; Planetary motion; Fourier Analysis; Transients in circuits; Chaos; Molecular dynamics; Electrostatics; Diffusion; Phonons; Random systems; Statistical mechanics; Quantum mechanics.

Evaluation:

- Final Practical Examination (4 hours) 50%
- Course Work: 50%
  - 2 Practical Tests 20%
  - 3 Graded Assignments 30%

PHYS2500 **MATERIALS SCIENCE LABORATORY I**

(3 Credits) (Level 2) (Semester 2)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Co-requisite:

PHYS2561 - Fundamental of Material Science.

Course Content:

1. **Determination of the mechanical properties of materials:** Stress, strain and shear measurements; sound propagation through various materials (acoustic properties); deformation and hardness measurements and comparison to standards; identifying fractures, fatigues and creeps; measuring toughness and impact strength.
2. **Investigation of crystalline structures:** Constructing lattice structures; lattice measurements and Miller indices; examining Bragg's law of diffractions and Fick's law of diffusion.
3. **Measurement of thermal and electrical properties:** Investigating conduction of electricity and heat; electron-phonon interactions; properties of insulators.

Evaluation:

- Final Practical Examination (3 hours) 40%
- Course Work: 60%
  - 9 Laboratory Reports 36%
  - Paper Review and Oral Presentation 24%

PHYS2561 **FUNDAMENTALS OF MATERIALS SCIENCE**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, CHEM0901 - Preliminary Chemistry A **AND** CHEM0902 - Preliminary Chemistry.

Course Content:

1. **Atomic Structure and Bonding**: Electrons in atoms; types of bonding, melting point.
2. **Crystalline and Non-Crystalline (Amorphous) Structures:** Lattice, sub-lattices and lattice parameters; structures: metal, ceramic and covalent; defects and dislocations.
3. **Diffusion:** Diffusion mechanisms; Steady-state diffusion (Fick's 1st law); Transient/non-steady state diffusion (Fick's 2nd law), Arrhenius behaviour.
4. **Electrical Properties: Conductivity** and mobility; electronic and ionic conduction; electron-phonon interaction in metals; superconductivity, semiconductivity; band theory.
5. **Thermal Properties:** Phonons, heat capacity and the Einstein solid; thermal expansion and thermal conductivity.
6. **Mechanical Properties:** Stresses, strain, and shear; elastic properties; sound propagation; deformation and hardness; fracture, fatigue, and creep.

Evaluation:

• Final Written Examination (2 hours)	50%
• Course Work:	50%
• 5 Graded Tutorials	15%
• 1 Graded Assignment	15%
• 1 In-course Test	20%

PHYS2600 **FLUID DYNAMICS & ENVIRONMENTAL PHYSICS LABORATORY**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Co-requisites:
PHYS2671 - Fluid Dynamics.

Course Content:
Measurement of fluid drag on spheres and disks; Investigation of Bernoulli and Poiseulle equations with applications to fluid flow; Energy Losses in fluid flow; Computer simulations of fluid flow in circular and rectangular pipes; Estimation of evaporation from wet surfaces; Investigation of heat flux and latent heat flux; Measurement of meteorological parameters; Computer aided environmental data analysis; Investigation of cloud droplet formation via super cooling of water; Simulation of the effects of environmental parameters on climate change.

Evaluation:
- Final Practical Examination (4 hours) 40%
- Course Work: 60%
    - 1 Paper Review 10%
    - 1 Oral Presentation 14%
    - 9 Laboratory Reports 36%

PHYS2671 **FLUID DYNAMICS**
(3 Credits) (Level 2) (Semesters 1 & 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Course Content:
1. **Introduction to Mathematical Concepts in Fluid Dynamics:** Vector analysis and basic mathematical tools; physical characteristics of the fluid state and description of flow types; viscosity coefficients as they relate to laminar and turbulent flows; the Poiseuille equation.
2. **Kinematics and Dynamics of Fluid Motion:** In-compressible and compressible fluids; Euler's equations of motion; Bernoulli's equation

and its application; continuity equation; analyses of steady fluid flow, propeller, wind turbine, and wind velocity profile; Navier-Stokes equation and descriptions of boundary layer and turbulence; vertical transport of kinetic energy, mass, heat, moisture and pollutants.

3. **Introduction to Atmospheric Flows:** Apparent forces (Coriolis and centrifugal) in rotating coordinate systems and their effects; geostrophic flows; qualitative introduction to Ekman layer; basic treatment of Rossby waves and Kelvin waves.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

PHYS2701 **ESSENTIALS OF RENEWABLE ENERGY TECHNOLOGIES AND SOLUTIONS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
None

Course Content:

1. Background and Introduction to RESs:
    - Force, energy, and power as key concepts.
    - Units of power and energy
    - Introduction to the governing laws of thermodynamic - the main forms of heat transfer
    - Forms of energy, energy conversion, and efficiency.
    - Energy use globally and in Caribbean region.
    - Climate change and the shift to RESs.
    - Overview of the sources of renewable energy.
    - Introduction to forms of energy storage.
    - Introductory concepts in hybridized RES
2. The history/evolution and technologies of the main sustainable energy sources: Solar Energy (Thermal and Photovoltaics); Bioenergy; Hydro energy; Tidal and Wave Energy; Wind Energy, Geothermal Energy and Waste to Energy. Variations, innovations, current markets, and limitations in the Caribbean; Active and passive measures (LEED certification etc.) for energy conservation in buildings and households.

3. Energy Efficiency. Active and passive measures (CFL and LED Lighting, HVAC upgrades, LEED certification etc.) for energy conservation in buildings and households.
4. Economics and policies of Caribbean islands to encourage the positive shift towards RESs including applications, resource assessments, social and environmental impacts, and energy storage; the importance of RESs in the context of climate change mitigation and carbon emissions.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 1 In-course Test 25%
    - Research paper (Word limit: approximately 1500) 15%
    - Oral presentation 10%

ELET2405 **PRACTICES IN ELECTRONICS DESIGNS I**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
ELET1400 - Practices in Basic Electronics I **AND** ELET1405 - Practices in Basic Electronics I.

Co-Requisite:
Any Level 2 Semester 1 Electronics or Electronics Engineering course.

Course Content:
Design and synthesis of digital circuits and microprocessor systems using a hardware descriptive language such as VHDL; Verification of circuit network theorems and their applications to circuit designs for maximum power transfer and impedance matching; Application of circuit simulation tools (PSPICE, Workbench, Multisim) to the design and analysis of electronic circuits; Exploration of interface circuit designs for microcontrollers and their application to embedded system; Exploration of the behaviour of various signals and systems using MATLAB software tool.

Evaluation:

- 1 Design Project 70%
- 6 Laboratory Reports 30%

<u>ELET2410</u> **<u>ANALYSIS AND DESIGN OF ANALOG CIRCUITS</u>**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:
Basic Concepts of Analog Circuits and Signals; Diodes and Applications; Transistor circuits**:** AC analysis of transistor amplifiers, Feedback, multistage, RF, and Audio amplifiers; Differential amplifiers; Voltage regulation and regulator circuits; Optoelectronics circuits: Light emitting diodes, phototransistor, Optoisolators; Operational Amplifiers: Op-Amp Responses, Basic Op-Amp Circuits, Active Filters; Linear integrated circuits: The phase lock loop, the 555 timer IC, Other linear ICs; Oscillators: Principles of oscillation, types of oscillators; Special-Purpose Amplifiers; Data conversion circuits.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 1 In-course Tests 20%
  - Assignments 20%

<u>ELET2415</u> **<u>PRACTICES IN ELECTRONICS DESIGNS II</u>**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
ELET1400 - Practices in Basic Electronics I **AND** ELET1405 - Practices in Basic Electronics I.

Co-Requisite:
Any level 2 Semester 2 Electronics or Electronics Engineering course.

Course Content:
Design and analysis of analogue circuits via hardware designs and software Simulations; An interactive web-based design and analysis of a motor controller to perform a specific task; Application of mathematical modeling to the design of control circuits; Design and analyses of digital communication circuits and systems; The use of spectrum analyzers and oscilloscopes to analyze electrical

communication signals;Development and verification of electrical models for semiconductor devices; Performance analyses of semiconductor devices and circuits via simulation software (PSPICE) and hardware designs.

Evaluation:

- Final Written Examination (1 hour) 20%
- Course Work: 80%
    - 6 Laboratory Reports 30%
    - 1 Major Design Project 50%

ELET2420 **INTRODUCTION TO SEMICONDUCTOR DEVICES**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:

1. **Semiconductor Fundamentals:** General introduction to semiconductor, Carrier modelling, energy quantization and probability concepts; energy bands structure, density of states, statistical mechanics; Semiconductor in equilibrium; Carrier transport and excess carrier phenomenon; Carrier Modeling; Carrier Action; Basics of device fabrications.
2. **PN Junctions:** PN Junction electrostatics; PN Junction Diode, I-V Characteristics, small signal admittance, Transient response; Optoelectronic Devices; microwave diodes – tunnel, IMPATT, Gunn.
3. **Bipolar Junction Transistors (BJT):** BJT fundamentals, static characteristics, dynamic response modelling- equivalent circuits, transient response; PNPN Devices: Silicon controlled rectifiers (SCRs); TRIACS, DIACS; Metal Semiconductor contacts and the Schottky Diode; Circuit application examples for PN junction devices.
4. **Field Effect Devices:** The JFET and the MESFET; The Metal Oxide Semiconductor Field Effect Transistor (MOSFET)-theory of operation, ID-VD relationships, Threshold considerations; Non Ideal MOSFETs, Modern FET structures Circuit application examples for Field Effect Devices.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 1 In-course Test 20%
  - Assignments 20%

ELET2430 **DIGITAL CIRCUITS AND MICROPROCESSORS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:

1. **Digital Logic Design:** Brief review of Combinational logic; Flip-Flops and Latches: Synchronous, Asynchronous, Single bit; Memory elements, Counters & Shift Registers and Timing; System specification using State Diagrams; System design using state diagrams and flip-flops; The design of multidimensional memory arrays using flip-flops.
2. **Computer Arithmetic:** Unsigned and Signed Integer Representation; Signed Magnitude Representation; One's Complement Representation; Two's Complement Representation; Floating-Point Representation; Fractions Floating-Point Addition, Multiplication and Division.
3. **Processor Organization:** Overview – RISC, CISC, Data Path, Control Unit; Operand Types; Addressing Modes; Instruction Types; Instruction Format: zero, one, two and three address machines; Micro-program Control: Hardware and Software implementation, Data Path manipulation.
4. **Cache Memory:** Cache Design Basics; Mapping Function - Direct Mapping, Associative Mapping and Set-Associative Mapping; Replacement Policies; Write Policies; Cache management - Locating a Block and Replacement Policies.
5. **Parallelism:** Pipeline - Basic Concepts; Handling Resource Conflicts; Data Hazards; Register Forwarding; Register Interlocking; Handling Branches: Delayed Branch; Execution, Branch Prediction and Performance Enhancements; Superscalar Processors; Superpipelined Processors;Very Long Instruction Word; Architectures; Example Implementations - Pentium and SPARC Processors; Vector processors.
6. **Interrupts:** A Taxonomy of Pentium Interrupts; Hardware and Software Interrupts; Example implementations – Pentium and SPARC Processors.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - Assignments 20%

ELET2450 **EMBEDDED SYSTEMS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:

1. **Embedded Systems Overview:** Introduction and Background; An Embedded System; Processor in the Embedded System; Other Hardware Units; Exemplary Embedded Systems; Embedded System-On-Chip (SOC) and in VLSI Circuits.
2. **Microcontroller Overview:** Basic Layout; Components; Memory and Register; Instruction Set; The AVR 8-Bits Microcontrollers.
3. **Assembly Programming & Simulation:** Assembly Language Structure; Branch, Call and time delay loops; AVR Studio: Editor, Assembler, Simulator, Debugger and Hex Programmer; Simulation of Written Code; STK500 Hardware: Description and Operation; Actual Microcontroller Programming.
4. **Digital & Analog Capabilities:** Digital Input/Output Capabilities, Configuration and Operation of I/O Ports; Digital I/O Port Programming; Analog Input/Output Capabilities; Configuration and Operation of I/O Pins/Ports; Analog-to-Digital Conversion; Analog Peripheral Programming.
5. **Interrupt Subsystem:** Introduction to concept of Interrupts; Configuration and Operation of Interrupts Sources; External and Internal Interrupts Capabilities; Interrupts Control Flow; Interrupt Vectors and Vector Table; Interrupt Programming.
6. **Timing Subsystem:** Introduction to timer/counters 8/16-Bits Timers; Configuration and Operation of Timers; Timers Modes of Operation: Counter, Input Capture, Output Compare and Pulse Width Modulation; Watch Dog Timer; Timer Programming.
7. **Serial Communication Subsystem:** Parallel vs. Serial Communication; UART and USART; Operation and Configuration; Serial Communication

Protocol: Framing, Parity, etc; RS232 Serial Ports Layout (DB25 and DB9); RS232 Standard Line Drivers; Serial Programming.

8. **C Language for Embedded Systems:** Introduction to Embedded C; C Language vs. Assembly Language; Introduction to the WinAVR C Compiler; C Structure.
9. Pre-processor Commands; C Types, Operators and Expression; C Control Flow (For, While, If/Else, Switch, etc. Control Structure.); Function and Program Structure.
10. **Operating Parameters & Interfacing:** Operating Parameters; Interfacing Input Devices, Switches including de-bounce circuit, Keypad and Keypad Drivers, etc. Keypad Programming; Interfacing Output Devices, LCD, LED, etc; LCD Interface Programming; Motor Control, DC Motors, Stepper Motors and Their Drivers, Servo Motors and Their Drivers; Motor Control Programming; Isolators, Optical and Other Isolators; Power Supply and Regulation, Oscillators and Clocks; Interfacing GPS Receivers; GPS NEMA Standard; Interface GSM Modems; Modems' AT Commands.
11. **Design & Development:** Design Plans (Project Specifications, etc.); Sourcing and Selection of Controllers and Components; Designing Circuits; Flowcharts and Programs; Implementation and Packaging; Documentation.
12. **Communication Technology:** Introduction to IrDA; Introduction to USB; USB Packets; USB Physical Interface; Implementing USB Interface.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - Assignments 20%

ELET2460 **SIGNALS AND SYSTEMS**

(3 Credits) (Level 2) (Semester 1)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:

1. **Continuous-Time Elementary Signals:** The Unit Step, the Unit Impulse,

the Unit Ramp, Sinusoidal Signal.

2. **Signal Transformations:** Continuity, Piece-wise continuity; Time shifting, time scaling, time reversal; Convolution; Convolution and Impulse Response.
3. **Introduction to Systems:** Is a system? Modelling of Physical Systems, Linear Differential Equations, I/O State Space; Properties of Systems (I/O, Linearity, TI, Causality); Testing for System Properties.
4. **Frequency Domain Representation of Signals and Systems:** The Fourier Series; Trigonometric Form; Complex Exponential Form; Representation of Periodic Signals; Transform.
5. **Transform Domain Representation of Systems:** Laplace Transfer; System Transfer Function; Block Diagrams; Signal Flow Graphs.
6. **Time Domain Analysis of Systems:** System Response; Zero Input Response; Zero State Response; Input-Output Relationships for LTI Systems; and the Impulse Response; The Routh-Hurwitz Criterion; Step Response Analysis**;** Frequency Response; Space Analysis.
7. **Mathematical Representation of Discrete-Time Signals:** Difference Equations; z-Transform; Inverse Transform; Division Z-Transform Inversion; Fraction Expansion; Equations.
8. **Frequency Domain Representation of Discrete-Time Signals:** Discrete-Time Fourier Transforms; Discrete-Time Fourier Series; Discrete Fourier Transforms; Comparison of Fourier Transforms.
9. **Time Domain Representation of Discrete-Time Systems:** System Classification; Discrete Time Systems; Discrete Time Convolution; of Discrete-Time Convolution of Discrete-time Systems.
10. **Transform Domain Representation of Discrete-Time Systems:** Discrete-Time Systems; Stability of Discrete-Time Systems; Time Steady State Response.
11. **Filter Design:** Analog Filters; Digital Filters (FIR and IIR Filters).

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - Assignments 20%

Six take-home problem solving assignment of equal weighting (10%); one paper on a survey of the state-of-the-art in the analogue circuit designs (10%). The report will take the form of that required for an IEEE paper publication.

ELET2470 **ELECTRICAL CIRCUIT ANALYSIS**
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:
Basic concepts: electronic charge, current, voltage, power, energy; Introduction to circuit theory; Simple circuits Kirchhoff's voltage and current laws; Series and parallel circuit networks; Structured Circuit Theory; Network theorems: Superposition, Thevenin's, Norton's; Solution using structured approach; Network analysis: branch, loop, node; Source types; Maximum power transfer theorem; Capacitive and inductive circuits; Laplace models; Steady state and dynamic responses of simple networks; AC steady state analysis; Circuit Theory in Laplace domain; Transient and steady state solutions Complex number models; Complex power; Power factor correction.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - Assignments 20%

ELET2480 **INTRODUCTION TO MODERN COMMUNICATIONS SYSTEMS**
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism, PHYS1422 - Modern Physics, ELET1400 - Practices in Basic Electronics I **AND** CAPE Mathematics (or equivalent).

Course Content:
1. **Amplitude Modulation Techniques:** Amplitude Modulation and Demodulation; Quadrature Amplitude Modulation; Single sideband systems; Vestigial sideband Modulation; Suppressed Carrier Amplitude Modulation.
2. **Angle Modulation Techniques:** Properties of Angle Modulation; Relationship between PM and FM waves; Wide-band and narrow-band

Frequency Modulation; Generation of Angle Modulated waves; Demodulation of Angle Modulated signals.

3. **Sampling & Digital Modulation Techniques:** Sampling and Sampling Theorem; Quantization and Bit rates; Pulse Amplitude Modulation (PAM); Pulse Code modulation (PCM); Pulse Width Modulation (PWM); Delta Modulation (DM).
4. **Baseband Data Transmission:** Baseband transmission of digital data; Intersymbol Interference (ISI); The Nyquist Channel; Baseband transmission of M-ary Data; The Eye Pattern; Bandpass modulation techniques; Binary Amplitude-Shift Keying; Phase-Shift Keying; Frequency-Shift Keying; M-ary digital modulation schemes.
5. **Random Signals and Noise:** Probability and random variables; Gaussian random variables; Random processes; Gaussian processes; White noise; Narrowband noise.
6. **Noise in Analog Communications:** Noise in communication systems; Signal-to-noise ratio; Noise factor and Noise figure; Noise in linear systems using Coherent Detection; Noise in AM Receivers using Envelope Detection; Noise in SSB Receivers.
7. **Noise in Digital Communications:** Bit Error Rate; Single pulse detection in Noise; Optimum detection of PAM in Noise; Optimum detection of BPSK; Detection of QPSK and QAM in Noise; Differential Detection in Noise.
8. **Wireless Communication:** Propagation loss in a simple wireless Link; Principles of Radio and Television; Facsimile; Cellular technology and Global; Positioning Systems (GPS); Brief Introduction to GSM technology.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 1 In-course Test 20%
  - Assignments 20%

PHYS3200 **GENERAL PHYSICS LAB 2**

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:

PHYS2300 - General Physics Lab I.

Co-requisites:

PHYS3351 - Modern Physics 2 **AND** PHYS3386 - Electromagnetism.

Course Content:
The Skin Effect; Electromagnetic Reflection and Refraction - Fresnel's Equations Microwave Propagation; Measurement of the Speed of Light; The Milikan Oil Drop Experiment; Numerical Solution of Laplace's Equation on a Grid with Dirichlet or Neumann Boundary Conditions; Variation of the Wave Function (ψ) with Potential Energy (V); Energy Levels of the Deuteron; Relativity (Kinematics); Calculation of the Mass of A^0 Particle Relativity (Dynamics).

In a particular semester experiments may also be added from other topics in electromagnetism and modern physics

Evaluation:

- Final Practical Examination (4 hours) 50%
- Course Work: 50%
    - 10 Laboratory Reports 20%
    - 1 In-course Test 30%

PHYS3300 **ADVANCED PRACTICES IN MEDICAL PHYSICS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
PHYS2200 - Practices in Medical Physics I.

Course Content:
Biomechanics: Gait Analysis using a modern mobile phone; Optics of the eye; Dual Energy X-Ray Absorptiometry; Physics of Gamma Spectroscopy in Nuclear Medicine; Image analysis and processing using ImageJ and Matlab; Research project; Inverse Square Law in medical diagnostics.

Evaluation:

- 1 Oral Presentation 25%
- 1 Written Project Report 35%
- 6 Laboratory Reports 40%

PHYS3341 **BIOMEDICAL OPTICS AND BIOMECHANICS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
PHYS2296 - Physics of the Human Body.

Course Content:

1. **Optics in Medical Physics:** Image formation and interferometry; theory of optics; tissue optics and optical microscopy; optical coherence topography and acousto-optics microscopy; lasers application in medicine; applications of microscopy and spectroscopy in medicine; tissue-light transport modeling using e.g. MatLab and image analysis.
2. **Biomechanics in Orthopaedics:** Analysis of forces of bones and tissues with heavy focus on the spine; mechanical aspects of fractures; joint replacement and Gait analysis; biomechanics and orthopaedic disorders.
3. **Biomaterials:** Types of biomaterials and their use; properties of biomaterials; preparation of biomaterials for implantation.
4. **Ethical/legal aspects**: Current and future ethical and legal implications associated with the use of biomaterials and nanoparticles in the treatment of diseases and similar dilemmas will be explored.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - 4 In-class Quizzes 5%
  - 1 Term Paper 10%
  - 3 Assignments 15%
  - 1 In-course Test 20%

PHYS3351 **MODERN PHYSICS 2**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
PHYS2351 - Quantum Mechanics and Nuclear Physics.

Course Content:

1. **Quantum Mechanics:** Simple Harmonic Oscillator; Hydrogen-like Atom; Quantum Numbers; Non-degenerate Pertubation Theory; Varioational Principle.

2. **Relativity:** Lorentz Transformation Equations; Simultaneity; Time Dilation; Length Contraction; Velocity Addition; Minkowski's Spacetime Diagrams Spacetime Interval; Twin Paradox; Four Vector Formalism; Doppler Effect Relativistic Mass; Momentum and Kinetic Energy; Relativistic Collisions.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - 4 Surprise Quizzes 4%
    - 6 Tutorials 6%
    - 1 In-course Test 10%
    - Projects 10%

P33K/PHYS3386 **ELECTROMAGNETISM**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ELET2480 - Introduction to Modern Communication Systems **OR** PHYS2386 - Electromagnetisms and Optics.

Course Content:
Review of Vector Analysis and Vector Calculus
Derivation of Maxwell's equations in differential form; Equation of continuity; Poisson's equation; Derivation of the electro-magnetic wave equation; Solution for plane waves in dielectrics; Electro-magnetic nature of light; Energy flow and the Poynting vector; Boundary conditions; Reflection and refraction of electro-magnetic waves at dielectric boundaries; Derivation of Snell's law; Fresnel's equations; Total reflection; Brewster's angle; Transmission and reflection co-efficients; Propagation of electro-magnetic waves in conducting media; Skin depth; Energy flow in conductors; Reflection of Electro-magnetic waves by a conductor; Dispersion of electro-magnetic waves in various media; Sources of electro-magnetic waves.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Practical Work 10%
    - 1 In-course Test or equivalent 20%

PHYS3389 **MEDICAL RADIATION PHYSICS AND IMAGING**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:

PHYS2296 - Physics of the Human Body.

Course Content:

1. **Physics of X-ray Diagnostic Radiology:** X-ray Production and interaction with matter, Operation and diagnostic of X-ray tubes, Instrumentation for X-ray imaging, X-ray Computed Tomography.
2. **Radioactivity and Nuclear Medicine:** Physics of Nuclear medicine, Radioactivity and radionuclides, Single Photon Emission Computed Tomography, Position Emission Tomography.
3. **Physics and Instrumentation of Diagnostic Medical Ultrasonography:** Principles of ultrasonic imaging; Instrumentation for diagnostic ultrasonography; Image characteristics; Medical applications of ultrasound.
4. **Physics of Magnetic Resonance Imaging:** Quantum mechanics and nuclear magnetism; Instrumentation, Magnetic Resonance Imaging; Magnetic resonance angiography, Medical applications.
5. **Radiation Dosimetry and Protection:** Principles of radiation protection, Units of exposure and dose, Radiation detection and measurement.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Theory Course Work 10%
  - Practical Work 40%

PHYS3395 **ASTRONOMY & COSMOLOGY**

(4 Credits) (Level 3) (Semester 2)

Pre-requisites:

PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Course Content:

The celestial sphere, Celestial mechanics, Co-ordinate systems, Sidereal Time; Telescopes and their capabilities; The Solar System, Stellar Radiation, Magnitudes, Classification; Stellar Structure, Binary Stars; Distance measurements and the distance ladder; hour diagram; Stellar Evolution and

Endpoints; The Milky Way; Other galaxies; Cosmological Distance methods; The structure of the Universe; Introductory Cosmology; Simple Cosmological Models; Observational Cosmology; The Age of the Universe; The Big Bang.

Evaluation:

- Final Written Examination (2 hours) 70%
- Course Work: 30%
    - Practical Work 10%
    - 1 In-course Test or equivalent 20%

PHYS3399 **RESEARCH PROJECT (NON ELECTRONICS)**
(4 Credits) (Level 3) (Semester 1 or 2)

Pre-requisites:
Students must (i) qualify for one of the Physics Majors offered by the department;
(ii) get permission from the Head, and (iii) satisfy any additional criteria deemed necessary by the department.

Course Content:
Students will consult staff members with whom they wish to work about possible topics. If pre-requisites are met and permission granted, the staff member will be assigned to supervise the student. Staff member will assign reading list and meet weekly with the student. Staff members may assign research tasks to teach particular skills. Written report and oral presentation as a seminar on the approved topic are required at end of course.

Evaluation:

- Oral Presentation 10%
- Course Work (Assignments) 30%
- Written Report 60%

PHYS3400 **PHYSICS IN PRACTICE INTERNSHIP**
(3 Credits) (Level 3) (Summer)

Pre-requisites:
Student must have declared a major offered by the Department of Physics and has, at a minimum, a ‘B’ Grade in PHYS2386 Electromagnetism and Optics, or a ‘B’ Grade in ELET2470 Electrical Circuit Analysis, with Head of Department Approval.

Course Content:

1. **Module 1: Orientation**: Contractual Issues, Occupational Health and Safety, Workplace Ethics and Confidentiality Issues, Project Management, Resource and Time Management, Introduction to Psychometric Assessment Tools.
2. **Module 2: Company Assignment:** Perform on-the-job Activities Assigned by Supervisor, Maintain Log of Activities**,** Write technical reports.

Evaluation:

Assessment procedures used to evaluate the students' attainment of the learning outcomes are outlined as follows:

- **Quiz (Module 1)** 10%
  Quiz will be administered online, and the student must obtain a minimum grade of B.
- **One Report** 50%
  (Module 2 - Appendix to include log of daily activities performed)
  The report will detail the primary activities of the internship, their objectives, and observations regarding how physics concepts are being applied in the work environment. The report may also include recommendations on alternative approaches to any procedure with which the student has interacted, as well as identifying additional inputs that would be necessary to accomplish the same task using alternate approaches.
- **Performance Evaluation** (Graded by supervisor) 20%
  The performance of the student while executing the assigned duties will be assessed by a supervisor approved by the company and the course coordinator**.**
- **One Oral Presentation** (Graded by a panel comprising lecturers in the department and a company representative) 20%
  An oral presentation will be prepared and delivered by the student for assessment by the department and a company representative. The presentation should summarize the submitted report, and should include descriptions of the assigned tasks, their objectives, physics concepts that are required to execute the tasks, lessons learnt and recommendations.

PHYS3500 **ADVANCED MATERIALS SCIENCE LABORATORY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
PHYS2500 - Material Science Laboratory I.

Course Content:
1. Synthesizing and characterizing materials.
2. **Synthesis Techniques:** solid state powder/fibre processing for metal, ceramic and composite samples; calcination, green body formation and sintering; wet chemical processing; simple polymerization.
3. **Characterization Techniques:** Test for porosity/density, electrical conductivity, elastic modulus, fracture toughness, flexural strength, and compressive strength, Fourier Transform Infrared spectroscopy (FTIR), X-ray diffraction (XRD), X-ray fluorescence (XRF).

Evaluation:
- 5 Laboratory Reports 20%
- 2 Written Reports 40%
- 2 Oral Presentations 40%

PHYS3561 **THE PHYSICS OF CRYSTALLINE MATERIALS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
PHYS2561 - Fundamentals of Materials Science.

Course Content:
Consult Department

Evaluation:
Consult Department

PHYS3562 **THE PHYSICS OF NON-CRYSTALLINE AND AMORPHOUS MATERIALS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
PHYS2561 - Fundamentals of Material Science.

Course Content:
Introduction to non-crystalline and amorphous materials (polymers, glasses, etc.); Structure and chemistry of amorphous and non-crystalline materials: molecular structure of polymers; polarization and defects; thermoplastic and thermosetting polymers; crystallinity and elastomers; Glass: formation, structure and transition temperature; Thermodynamics of glass formation; kinetics of glass formation Properties of amorphous and non-crystalline materials: mechanical, electrical, thermal, dielectric, and optical.

Evaluation:
- Final Written Examination (2 hours) 60%
- Course Work: 40%
  - 1 In-course Test or equivalent 20%
  - 2 Graded Tutorials 20%

PHYS3565 **THERMODYNAMICS AND MATERIALS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
PHYS2561 - Fundamentals of Material Science.

Course Content:
Review of Zeroth First, Second and Third laws of thermodynamics; The concept of time dependent processes and implications; examples of kinetic processes Gibb's free energy; enthalpy, entropy, equilibrium, mass action expressions; Phase equilibria; unary and binary phase diagrams; Gibbs Phase Rule; Lever Rule; Development of microstructure; Binary Eutectic Systems; Ceramic systems; Kinetics of phase transformations; the Avrami Equation; Ostwald ripening (coarsening), thermodynamics of curved surfaces (capillarity); The surface state; Energetics of the surface; Bulk versus surface properties; Nanomaterials (surface-dominated materials); Solid-solid interfaces; Solid-liquid interfaces; Solid-gas interfaces and the Nernst Equation; Wetting; Hydrophilic and hydrophobic materials; Composites (interface-dominated materials), e.g., asphalt, concrete, fiberglass.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test or equivalent 20%
    - 2 Graded Tutorials 20%

PHYS3661 **PHYSICS OF THE ATMOSPHERE AND CLIMATE**
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics, PHYS1412 - Wave, Optics and Thermodynamics, PHYS1421 - Electricity and Magnetism **AND** PHYS1422 - Modern Physics.

Course Content:

1. **Survey of the Atmosphere:** Composition of the lower, middle and upper atmosphere; diffusive equilibrium; photo-chemical processes and thermal structure.
2. **Atmospheric Thermodynamics:** Dry air-adiabatic processes, potential temperature, entropy, equation of state; moist air-Clausius-Clapeyron equation, virtual temperature, vapour pressure, relative humidity, and condensation; atmospheric aerosols, clouds-formation and growth.
3. **Radiative Transfer:** Absorption and emission of atmospheric radiation, Greenhouse effect and global warming.
4. **Atmospheric Dynamics (qualitative derivations):** Real and apparent forces in a rotating co-ordinate system, equations of motions and the Geostropic approximation, gradient wind.
5. **General circulation of the Tropics:** Brief overview of general circulation; Hadley and Walker cells; ITCZ; El Nino-Southern Oscillation, trade winds, and climate variability.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

PHYS3671 **SOLAR POWER**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
PHYS3661 - Physics of the Atmosphere and Climate.

Course Content:
The characteristics and measurement of solar radiation; Analysis and design of flat plate collector systems; The operation, design and application of Photovoltaic (PV) cells and systems; Qualitative analysis of the Rankine cycle; Solar thermal power systems; Principles of operation of ocean thermal energy conversion (OTEC); Absorption refrigeration and solar cooling.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - 6 Graded Tutorials 10%
  - 2 In-course Tests 20%
  - 1 Seminar-based Group Presentation 20%

PHYS3681 **WIND AND HYDRO POWER**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
PHYS2671 - Fluid Dynamics **AND** PHYS3661 - Physics of the Atmosphere and Climate.

Course Content:

1. **Wind Power:** Overview of global wind power, wind types and classes, and its physical characteristics; Wind resource assessment: Anemometry and site prospecting; Introduction to basic statistics: Weibull and Rayleigh distributions; Wind energy and power density calculations; Components and basic operation of WEC (Wind Energy Conversion) systems and turbine types; Horizontal and vertical axis turbines; Conversion of wind power to electrical power; Factors affecting turbine performance and efficiency; Wind farms designs and installations; Economic analysis and environmental considerations; Wind hybrid systems (solar, diesel, hydro) and other applications of wind power; Energy storage: batteries, flywheels, compressed gas.
2. **Hydro Power:** Hydrologic (water) cycle, global hydro power, and hydro resource assessment; Analysis of power losses in pipes Moody

diagrams, and the Operating principles and the characteristics of selected turbines; Criteria for selection of a particular turbine; Concepts of gross head, net head, energy line, hydraulic grade line and available head; Conversion of hydro- power to electrical power: Shaft torque and shaft power; Energy storage: pumped storage facilities; Economic analysis and environmental considerations.

Evaluation:

• Final Written Examination (2 hours)	50%
• Course Work:	50%
• 6 Graded Tutorials	10%
• 2 In-course Tests	20%
• 1 Seminar-based Group Presentation	20%

PHYS3701 ADVANCED RENEWABLE ENERGY TECHNOLOGIES AND SOLUTIONS

(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
PHYS2701 – Essentials of Renewable Energy Technologies and Solutions

Course Content:

1. **The integration of RESs including:**
   - Energy capture, efficiency, variability, and installation.
   - Current penetration levels and installed capacity in the Caribbean.
   - Role of RESs in greenhouse gas mitigation.
   - Renewable energy resource assessment.
   - Quantifying renewable energy sources from energy capture to energy use by the consumer.
   - Grid improvement and energy storage, grid integration; load curves (power supply and demand).
2. **Cost-analysis of RESs and energy cost scenarios including:**
   - Overview of the economics of RES including Gross Domestic Product (GDP), and Net Present Value (NPV).
   - Consumer pricing including Tariffs, and Incentives.
   - Payback periods - Comparison of capital upfront costs across renewable types.
   - Investment and inertia to RES globally with focus on the Caribbean.
   - Governance of RES - Targets and National Policy including innovative RES policy in the Caribbean.

- Community-invested programmes - energy auditors, energy practitioners, ESCO Jamaica.
- RES of the future - Innovative strides in renewable energy capture. Major industry players such as Tesla are used to highlight a large issue plaguing RES, energy storage, and transmission. For instance, Tesla's research in the Caribbean (Barbados in particular) which utilizes electric cars as a means of energy storage.

3. **Transitioning to RES across the Caribbean.** The area delves into the ideas and the mainstream processes from the resource to the respective power plant of resource farm.
    - Barriers and Innovations - accessing international sustainable energy finance
    - Environmental impact and government policies targeted on RE development
    - Feed-in tariff system
    - Power purchase aggrements (PPAs) and Tax credits
    - Guaranteeing grid access and priority for renewable capacity
    - Brief discussion on the social issues involved.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 1 In-course Test 15%
    - Research paper (Word limit: approximately 1500) 15%
    - Group project/Laboratory Work 10%
    - Oral presentation 10%

ELET3405 **PRACTICAL ANALYSIS OF ADVANCED ELECTRONIC CIRCUITS AND SYSTEMS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
ELET2405 - Practices in Electronics Designs I **AND** ELET2415 - Practices in Electronics Design II.

Course Content:

1. **Practical Analysis of Advanced Electronic Circuits and Equipment:** This section will run for the first five weeks of the semester. Students will carry out diagnosis and repairs of general purpose electronic circuits and equipment. These include power supplies, battery backup systems (e.g. UPS), inverters, computer mother boards and peripherals,

electronic consumer appliances, light projectors, and electronics test equipment (oscilloscopes, meters, etc.).

2. **Practical Analysis of Telecommunication Circuits, Devices and Systems:** This section will run concurrently with section 3 and targets the students who specialized in telecommunications. Students will perform diagnostics and repairs of telecommunication circuit and systems. These include radio frequency (RF) transmitters and receivers, antennas and antenna placements, software tools, signal strength measurements, bandwidth verification and control, optimization of telecommunication networks, field strength measurements using spectrum analyzers, up-link and down-link communication with satellites via antennas on Physics Dept roof, fiber optic networks and components, and 3G and 4G equipment and implementations. Wherever possible, actual industry diagnostics tasks will be assigned in collaboration with our industry partners.
3. **Practical Analysis of Instrumentation and Control Systems:** This section will run concurrently with section 2 and targets the students who specialized in Instrumentation and control. Students will perform diagnostics and repairs of instrumentation and control systems. These include sensor analysis and calibration, instrument repair and calibrations, industrial motors and their controllers, industrial power supplies and power systems, programmable logic controllers (PLC) and PLC programming, control room operation, fault finding in industrial control system loops, and optimization of automation processes. Wherever possible, actual industry diagnostics tasks will be assigned in collaboration with our industry partner.

Evaluation:

- Final Practical Examination (4 hours) 40%
- Course Work: 60%
    - 5 Laboratory Reports 20%
    - 8 Industry-type Technical Reports 40%

ELET3430 **INSTRUMENTATION AND MEASUREMENTS**

(3 Credits) (Level 3) (Semester 1)

Pre-requisites:

ELET2410 - Analysis and Design of Analog Circuits **AND** ELET2430 - Digital Circuits and Microprocessors.

Course Content:

1. **Measurement Systems and Standards:** Measurement system architecture; Errors in measurements; Standards used in measurements.
2. **Electrical and Electronic Measurements:** Units and standards; Electrical measuring instruments- AC voltages and currents Magnetic fields; phase; resistance, capacitance and inductance measurements; vector impedance meters; power and energy measurements; magnetic measurements; process parameter measurements; displacement, force, torque, dimension, density, viscosity, pH, level measurements, flow, pressure, temperature; DC voltages and currents; static electric field.
3. **Sensors And Transducers Input Mechanisms:** Categories of sensors – resistive, voltage generating, variable magnetic coupling, variable capacitance, fiber optic, photomultiplier tubes, ionizing radiation sensors, electronic noses, electrochemical, mechano-electrochemical, velocity sensors, mass flow meters, industrial sensors; Application of sensors to physical measurements;
4. **Analogue and Digital Signal Conditioning:** Differential amplifiers; operational amplifiers; instrumentation amplifiers; active analogue filters, signal processing, charge amplifiers; digital filters; DSP techniques; Interfacing with digital systems; Sampling techniques; ADC and DAC; digital data transmission.
5. **Noise and Coherent Interference in Measurements:** Noise in circuits; circuit optimization to reduce noise; low noise designs; coherent interference and its minimization; AC and DC Null measurements; AC and DC Wheatstone Bridge; Kelvin bridge; Anderson constant current loop; Equivalent AC circuits for passive components; AC bridges; Null methods of measurements.
6. **Design of Measurement Systems:** Capacitive sensor for the detection of hidden object; electric field sensors; velocity meters; industrial systems.

Evaluation:

- Final Practical Examination (4 hours) 60%
- Coursework: 40%
  - In-course Test 20%
  - Case Study of an Industrials Measurement System 20%

ELET3440 **INTRODUCTION TO ROBOTICS**

(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ELET2430 - Digital Circuits and Microprocessors **AND** ELET2450 - Embedded Systems.

Course Content:
What is Robotics? Brief History of Robotics; The Basics Robot; Examples of Robots; Robots & Embedded Controllers: Design of Robot Platforms; Robots Embedded Controllers; Interfacing Controllers with External Device; Software/Hardware Development Tools: Code Compilers; Code Assemblers; Code Simulation/Debugging Software; Hardware Programmers; Sensors & Sensor Interfacing: Comparison of Analog vs. Digital Sensors; Converting Analog Signals to Digital; Operation and Interfacing of various Sensors; Actuators& Actuator Interfacing; Theory of H-Bridge Operation; Pulse Width Modulation; DC Motors Operation and Interfacing; Servo Motors Operation and Interfacing; Stepper Motors Operation and Interfacing; Robot Related Control: On-Off Control, PID Control, Velocity and Position Control, Multiple Motors Control; Wireless Communication for Robots:Basic layout of Communication System; Design of Simple Wireless Communication System; Remote Control of a Robotic Platform; Mobile Robot Design: Exploring Designs for Driving Robot; Exploring Designs for Walking Robots; Exploring Designs for Autonomous Robots; Robot Applications: Discussions on selected robot based applications, such as Industrial Robots, Maze Exploration Robots; Emerging Topics: Selected topics from new developments in the field of robotics.

Evaluation:

- Final Practical Examination (4 hours) 60%
- Course Work: 40%
  - 1 In-course Test 10%
  - 2 Written Assignments 10%
  - 3 Practical Assignments 20%

ELET3450 **SATELLITE COMMUNICATION & GLOBAL NAVIGATIONAL SATELLITE SYSTEMS**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
ELET2480 - Communication Systems.

Course Content:

1. **Satellites and Telecommunication:** Introduction and Background Satellite Services and Applications Telecommunication User and Applications: Broadcast Mobile and Navigational Services.
2. **Communications Fundamentals:** Basic Definitions and Measurements: Overview of Spectrum, Wave Properties, Modulation and Multiplexing: Analog and Digital Signals Capacity.
3. **The Space Segment:** Space Environment: Orbit Types, Slots, Spacing: Launch Related Information Satellite Systems and Construction.
4. **The Ground Segment:** Earth Stations, Antenna Properties, Space Lost, Electronics, EIRP, etc. Signal Flow.
5. **The Satellite Earth Link:** Atmospheric Effects, Climate Models, Link Budget, Multiple Access, and Demand Assignment, On-Board Multiplexing.
6. **Satellite Communications Systems:** Communication Providers; Competitor and Competitiveness; System and Operators: Issues, Trends and Future.
7. **Fundamental of Satellite Navigation Systems:** Brief History; Longitude and Time; Astronomical Methods: Radio navigation; Inertial Navigation; Satellite Navigational Systems.
8. **The GPS System:** System Architecture; Space Segment; Control Segment; Coordinate Frame and Time Reference; User Segment; Signal Structure; Receiver, Signal Power Measurement and Performance; Signal Acquisition and Tracking; Estimation of Position, Velocity and Time; Error Sources and Correction methods.
9. **Future GNSS:** GPS, Galileo, GLONASS and Compass; Frequency Allocation and Plan; Spreading Code and Ranging Signal; Compatibility and Interoperability.
10. **GPS Coordinate Frames, Time Reference and Orbits:** Global Coordinate Systems; Terrestrial and Inertial Systems; Geodetic Coordinates Time References and GPS Time; GPS Orbits and Satellite Position Determination; GPS Orbital Parameters; GPS Navigational Message; GPS Constellation and Visibility Display.

11. **GPS Measurements and Errors Sources:** Measurement Models, Code Phase Measurement; Carrier Measurements; Error Sources: Clock, Multipath, Atmosphere, Receiver, etc. Error Mitigation.
12. **GNSS Applications:** Navigation; Tracking; Crustal Movements; Farming etc.

Evaluation:

- Final Practical Examination (4 hours) 60%
- Course Work 40%

P34F/ELET3460 **DIGITAL SIGNAL AND IMAGE PROCESSING**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
ELET2460 - Signals and Systems.

Course Content:
Part 1: Digital Signal Processing

1. **Review of areas covered at Level 2 Signal and Systems:** Overview A/D and D/A Conversion, Sampling, Quantizing and Encoding, I/O devices, DSP hardware, Fixed and floating point devices; Frequency Domain analysis; DSP Fundamentals.
2. **Digital Filter Design:** FIR and IIR filters. Linear phase FIR filters; All Pass filters. Implementing FIR Filters; Window approach; Linear phase types 1-4; Optimal fit Algorithms. Implementing IIR filters; Bi-linear and Impulse Invariant Transforms.
3. **DSP Structures:** Direct Form 1 & 2 Structures. Effects of Signal Digitisation; Signal Sampling and Reconstruction; Effects of Finite Number Operations; Use of second order sections; Noise and instability. Structure and use of Adaptive Filters; Least-squares error requirement for adaptive filter design.

Part 2: Digital Image Processing

4. **Introduction to Digital Image Processing:** Image Acquisition; Representing Digital Images; Pixel Relationships.
5. **Basic Image Operations:** Histogram Equalisation; Histogram Matching; Image Subtraction; Image Averaging.
6. **Frequency Domain Image Enhancement:** Use of the Fourier Transform in Image Enhancement; Fourier Transform-based Smoothing; Fourier Transform-based Sharpening.
7. **Image Compression:** Error-free Compression; Lossy Compression; Image Compression Standards.

8. **Image Segmentation:** Point Detection; Line Detection; Edge Detection.

Evaluation:

• Final Written Examination (2 hours)	60%
• Course Work:	40%
• 1 In-course Tests	20%
• 5 Take-home Assignments	20%

ELET3470 **WAVE TRANSMISSION AND FIBER OPTICS**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
PHYS2386 - Electromagnetism and Optics **OR** ELET2480 - Communication Systems.

Course Content:

1. **The Electromagnetic Wave and Field Energetics:** Maxwell's equations in integral and differential forms, the electromagnetic wave, electric power density, Poynting's theorem, field energetics. Complex fields, polarization: linear and circular. Group velocity, dispersion relation, wave velocities, complex Poynting's theorem, complex permittivity, load impedance.
2. **Waves in Conducting Media and Across Interfaces:** Wave equation in conductors; Waves in good insulators, waves in good conductors, transition frequencies; boundary conditions, normal incidence with matched impedances, impedance mismatch, reflection and transmission coefficients, energy transmission and reflection, insulator; conductor interfaces, antireflection coating. Oblique waves as nonuniform transverse waves, Snell's law, TE and TM polarization, Brewster angle, power conservation. Reactive impedances, total internal reflection (TIR), TIR for TE and TM polarizations. Skin effect in coaxial conductors.
3. **Transmission Lines:** Non-uniform waves, electrostatic solutions, coaxial line, voltage and current waves, characteristic impedance, mismatched loads, standing waves ratio, impedance measurements, reflection coefficients, input impedance of a line, the Smith Chart, transmission and reflection coefficients (S_{21} and S_{11}), half-wave and quarter-wave transformers, matching stubs, transmission lines on printed circuit boards: microstrip, co-planar, slot line; EMI from PCBs, impedance matching in high speed circuits.

4. **Waveguides:** Generalized non-uniform wave, Helmholtz solution, TE and TM waves, rectangular waveguides, cut-off frequencies, power flow, group and phase velocities in waveguide, cylindrical waveguides, Bessel function.
5. **Antennas:** The elementary dipole, near and far field, radiated power, radiation resistance, radiation pattern, power gain, effective aperture. The half-wave dipole and other harmonics, effects of ground reflection, directors and reflectors, Yagi antennas. Travelling wave antennas, V-antennas, Loop antennas, patched antennas, phased-array antennas, and trend in modern antenna designs. Matching antenna and transmission line, T-Match, Gamma match and Delta match.
6. **Dielectric Cylinders and Optical Fibers:** Step-index fiber, hybrid modes, Derivation of characteristic equation, HE and EH modes, TE and TM modes, Dominant mode.
7. **Practical Versions of Optical Fibers:** Numerical aperture, LP modes, Single-Method fiber, attenuation, material and multi-Method dispersion, graded-index fibers, wave launching, Method coupling.
8. **Fiber Optic Communication Systems Design:** System components; signal measurements, chromatic dispersion, the eye diagram, optical return loss; optical circuits and components.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 40%

ELET3480 **WIRELESS COMMUNICATION SYSTEMS**

(3 Credits) (Level 3) (Semester 1)

Pre-requisite:

ELET2480 - Communication Systems.

Course Content:

Introduction to wireless communication systems; Modern Wireless communication systems: 2G, 2.5G and 3G technologies. Introduction to 4G technologies; The cellular concept: system design fundamentals; Mobile radio propagation: large scale path loss; small scale fading and multi-path; Modulation techniques for mobile radio Equalization, Diversity and Channel coding; Speech Coding; Multiple access techniques for wireless communications; Wireless networking; Wireless systems and standards.

Evaluation:

- Final Written Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Tests 20%
    - 5 Take-home Assignments 20%

ELET3490 **ELECTRONICS PROJECT**
(4 Credits) (Level 3) (Semester 1&2)

Pre-requisites:
ELET2410 - Analysis and Design of Analog Circuits **OR** ELET2450 - Embedded Systems.

Course Content:
Projects will normally be selected from a list approved by the academic staff; A supervisor is assigned to each project which requires about 100 hour of work done over two semesters; Design, testing and construction of selected electronics hardware and/or software may be included in the work.

Evaluation:

- Oral Presentation 10%
- Written Report 30%
- On-the-job Performance 60%

ELET3600 **ENERGY SYSTEMS LABORATORY**
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
PHYS3671 - Solar Power **AND** PHYS3681- Wind and Hydro Power.

Co-requisites:
ELET3611 - Integrative Alternative Energy.

Course Content:
Programming e.g. the Nomad 2 wind data logger and performing data analysis; Wind mapping using suitable computer software (e.g WindMap); Economics of hybrid energy systems; Field visits to hydro and wind power facilities; Clear sky model for solar insolation on horizontal surfaces; Efficiency analysis of a flat-plate solar collector; I-V characteristics of a solar cell; Design and installation of

a solar energy system; Design and construction of rectifier, inverter and transformer circuits; Build a transmission network; Conduct load (power) flow contingency analysis for base-case load flow and short; Circuit study and fault analysis for various system load and network additions.

Evaluation:

- Final Practical Examination (4 hours) 40%
- Course Work: 60%
    - 1 Group Seminar Presentation 20%
    - 10 Laboratory Reports 40%

ELET3611 **INTEGRATING ALTERNATIVE ENERGY**
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
ELET2420 - Semiconductor Devices.

Pre-requisites:
PHYS3671 - Solar Power **AND** PHYS3681- Wind and Hydro Power.

Course Content:
Electrical energy systems and their connectivity, Generator characteristics and applications, Networking and transmission of electricity, Power control and management, Application of power electronics devices, Regulations, policies, Kyoto and Copenhagen protocols and emission targets, Energy economics and the pricing of electricity.

Evaluation:

- Final Practical Examination (4 hours) 50%
- Course Work: 50%
    - 6 Graded Tutorials 10%
    - 1 Group Seminar Presentation 20%
    - 2 In-course Test 20%

OTHER PROGRAMME AND FOUNDATION COURSE

1. Science and Media and Communication (B.Sc.)

2. Science, Medicine and Technology In Society (FD12A/FOUN1201)

SCIENCE AND MEDIA AND COMMUNICATION (B.Sc.)

This B.Sc. contains a named Science major AND a Media and Communication major (i.e. double major).

The programme will be taught jointly by The Caribbean Institute of Media and Communication and departments in the Faculty of Science and Technology Including the Biochemistry Section (Department of Basic Medical Sciences). It is designed to produce a science graduate with expertise in Media and Communication.

Entry requirements

1. Satisfy the University requirements for normal matriculation and have obtained passes at CXC Secondary Education General Proficiency Level (or equivalent) in Mathematics, and two approved science subjects at GCE Advanced Level (or equivalent);
2. Obtain a pass in the CARIMAC Entry Examination; and
3. Undergo mandatory academic counselling.

LEVEL 1

At least one (1) FST subject must be followed over two semesters

Semester I

JOUR1004 -Principles and Practice of Journalism*/IMMCC1010/IMMCC1268 (3 credits)
COMM1001- Communication, Culture and Caribbean Society (3 credits)
FST course(s)
FST course(s)

Semester 2

JOUR1001 - Writing for Journalism*(3 credits)
COMM1121 - Understanding the Media (3 credits)
FST course(s)
FST course(s)

LEVEL 2

One (1) FST subject should be followed over two semesters

Semester 1

JOUR2001 - Print Journalism Basic*(3 credits)

COMM2201 - Introduction to Communication Research Methods (3 credits)
JOUR2004 - Broadcast Announcing Presentation (3 credits)
FST course(s)
FST course(s)

Semester 2
JOUR2401 - Radio Journalism*(3 credits)
JOUR2801 - Television Journalism*(3 credits)
COMM2110 - Media Ethics and Legal Issues (3 credits)
FST course(s)
FST course(s)

LEVEL 3
One (1) subject chosen at Level 2 should be followed over two semesters, leading to a major

Semester 1
JOUR3801- Television Journalism Advanced* (3 credits)
JOUR3301- Print Journalism II (3 credits)
COMM3399 - Media, Research and Production (6 credits)
FST course(s)
FST course(s)

Semester 2
COMM3399 - Media, Research and Production
JOUR2801-Broadcast Journalism- Television II
Media Specialization Course
FST course(s)
FST course(s)

*Minor-Students can choose two of the following:
JOUR2301/JOUR2401/JOUR2801

Foundation Courses:
FOUN1401 OR FOUN1019- Critical Reading and Writing in Science and Technology and Medical Science OR Critical Reading and Writing in the Disciplines
FOUN1101- Caribbean Civilization
FOUN1301- Law, Governance, Economy & Society

NB: FOUN1101 or FOUN1301 can be substituted with a foreign language course.

SCIENCE, MEDICINE AND TECHNOLOGY IN SOCIETY (FD12A/FOUN1201)

Students within the Faculty of Science and Technology MUST NOT pursue this course.

Aim: To develop the ability of the student to engage in an informed manner in public discourse on matters pertaining to the impact of science, medicine and technology on society.

Objectives:
On completion of this module the students should be able to:

- Describe the characteristics of science that distinguish it from other human pursuits and so distinguish between science and non-science;
- Recognize Science as a natural human endeavor and explore some of the attempts made by mankind over time to make maximum use of the environment for personal and societal benefit (including a Caribbean perspective);
- Explore modern western science as one way of Knowing and as a mode of enquiry;
- Appreciate that in science there are no final answers and that understanding in all areas is constantly being reappraised in the light of new evidence;
- Describe the characteristics of technology, distinguish between science and technology and discuss the relationships between the two;
- Discuss in a scientifically informed manner the pros and cons of issues arising from some current scientific, medical and /or technological controversies.

Course Content:
Module 1

- Unit 1:Issues of Current Interest-Introduction
- Unit 2: Induction and Deduction
- Unit 2: The Hypothetico-Deducative Approach: Scientific Fact and Changing Paradigms
- Unit 2: Observation and Experimentation
- Unit 3: The relationship between Science, Medicine and Technology

Module 2

- Unit 1: Energy: Sources and Usages
- Unit 2: Health and Disease in Society
- Unit 3: Information Technology and Society

- Unit 4: Biotechnology and Society: Genetically Modified Organism
- Unit 5: Ethical and Gender Issues

Evaluation:

Each module will be followed by a 2-hour examination; Fifty (50) Multiple Choice Questions and one (1) essay question.

- Module 1 50%
- Module 2 50%

AWARDS, PRIZES

&

BURSARIES

DEPARTMENT OF CHEMISTRY

- **The L.J. Haynes Award**

Professor Leonard J. Haynes joined the staff of the Chemistry Department, University College of the West Indies in 1956. A Natural Products Chemist by training, he was instrumental in launching the Mona Symposium in 1966 and it remains the longest running Natural Products conference of its kind within the Caribbean.

He served the Department as Professor, carrying out research and lecturing in Organic Chemistry, and was the second Head of Department, leaving in 1968.The award named in his honour is presented annually to the student with the best academic performance in the Introductory Level Chemistry courses CHEM1901/1902 and who is proceeding to Level 2 courses. Seed funding for the award came from a donation made by his widow Mrs. Mary Haynes, in January 1994 and the award was first handed out in 1998. The awardee should not be in receipt of any other Chemistry Department prize in the year of consideration.

- **The Chemistry Department Prize**

The Chemistry Department Prize is awarded to a student who has the second best academic performance in the Introductory Level Courses CHEM1901/1902 in Chemistry and who is proceeding to Level 2 courses. The awardee should not be in receipt of any other Chemistry Department prize in the year of consideration.

- **The Pavelich/Honkan Prize**

Michael Pavelich, Professor of Chemistry at the Colorado School of Mines, U.S.A., spent a year as a visiting Professor in the Department of Chemistry as a sabbatical replacement for Professor Tara Dasgupta during 1984-85. At the end of his stay he donated funds towards a prize to recognize scholarship and excellence among Level 1 students. Dr. Vidya Honkan completed her PhD degree in Organic Chemistry in 1980 under the supervision of Professor Wilfred Chan and Dr. Basil Burke. While visiting the U.S.A. she died in a tragic automobile accident. Her husband later visited the Department and made a donation to establish an award in commemoration of his wife’s love for chemistry.

The Pavelich/Honkan Prize, named in honour of Prof. Michael Pavelich and Dr. Vidya Honkan, is awarded to a student who has the third best academic performance in the Introductory Level Courses CHEM1901/1902 in Chemistry and who is proceeding to Level 2 courses. The awardee should not be in receipt of any other Chemistry Department prize in the year of consideration.

- **The Wilfred Chan Award**

Wilfred Chan completed the requirements for the BSc degree in 1952 and then went on to pursue research under the direction of Prof. Cedric Hassall. He completed his research in 1956 and was the first West Indian to receive the PhD degree at Mona. In 1959 he was appointed Lecturer and began a vigorous research programme and rose through the ranks to become the first West Indian to be promoted to a personal chair (1971). In 1966 the Chemistry Department hosted the first Mona Symposium (on Natural Products Chemistry) with him as its Organizing Secretary.

Prof. Chan later served as Head of the Chemistry Department at Mona from 1972 to 1975. In 1979 he moved to the St. Augustine Campus to boost research efforts in its young Chemistry Department. He retired from St. Augustine in 1997, having served as Head and Dean during his tenure there. Prof. Chan's contributions over the years to natural products chemistry are internationally recognized.

The Wilfred Chan Award was first made in 2000 and is for a student who has the best academic performance in the advanced organic chemistry core courses (i.e. CHEM2201 and CHEM3201) and who is pursuing a major in Chemistry. The awardee should not simultaneously hold any other Chemistry Department prize.

- **The Bert Fraser-Reid Award**

Bertram Fraser-Reid is a synthetic organic chemist who has been recognized worldwide for his work in carbohydrate chemistry and his effort to develop a carbohydrate-based malaria vaccine.

Prof. Fraser-Reid earned his BSc and MSc degrees at Queen's University in Canada and a PhD at the University of Alberta in 1964 before doing post-doctoral work with Nobel Laureate and Sir Derek Barton from 1964 -1966. In 2007, the Institute of Jamaica awarded the Musgrave Gold Medal to Prof. Fraser-Reid for his outstanding work in Chemistry. Apart from his interests in science, Prof. Fraser-Reid is an accomplished musician who has given piano and organ recitals at several notable venues.

The Bert Fraser-Reid Award is given to a student with the second best academic performance in the CHEM2201 and CHEM3201 courses. The awardee should not simultaneously hold any other Chemistry Department prize.

- **The Cedric Hassall Scholarship**

The Cedric Hassall Prize was awarded in the past to a student in Chemistry who in the opinion of the Examiners has shown the best performance in the Examinations associated with the first year of advanced Chemistry courses. This prize was recently upgraded to a Scholarship to be awarded to a final year student who is currently majoring in Chemistry and satisfies the above criteria. The prize/scholarship is named in honour of Professor Cedric Hassall, the first Professor of Chemistry at the University and is intended to foster and encourage students to achieve standards of excellence which Professor Hassall insisted should be the hallmark of students pursuing courses in Chemistry. The prize/scholarship was established largely through the instrumentality of Professor Gerald Lalor during his tenure as Head of the Department, and was first awarded in 1971.

- **The Garfield Sadler Award**

Garfield Sadler graduated from the Chemistry Department of the University of the West Indies, Mona, with a degree in Special Chemistry in 1980. He then pursued doctoral studies in Inorganic Chemistry under the supervision of Professor Tara Dasgupta and graduated three years later with a PhD having specialized in the study of Reaction Mechanisms.

In 1983, Dr. Sadler joined the staff of the Department as a Lecturer of Inorganic Chemistry. This marked the start of a vibrant career in teaching and research. His contribution, however, to the development of Chemistry was short-lived as he died tragically in 1991.

The Garfield Sadler Award, which is a tribute to the life and work of Garfield Sadler, is presented to the student with the best academic performance in the inorganic chemistry core courses CHEM2101 and CHEM3101 and who is pursuing a major in chemistry. The awardee should not simultaneously hold any other Chemistry Department award.

- **The Willard Pinnock Prize**

Willard Pinnock served the Department of Chemistry for more than 29 years and retired as a Senior Lecturer in Physical Chemistry in 2011. He is known for his outstanding contribution to teaching and to student guidance and welfare and has been recognized several times by the Faculty for his high scores on the student assessment surveys. He was the first recipient of the Guardian Life Premium Teaching Award at Mona in the academic year 2003/4 and later that year he also received the Vice Chancellor’s Award for Excellence in Teaching.

A UWI alumnus, he earned both BSc (Chemistry and Physics) and MSc (Atmospheric Physics) degrees from the University of the West Indies and holds a PhD degree in Medical Bio-Physics from the University of Dundee.

The Willard Pinnock Prize is awarded to a Chemistry Major who has the best academic performance in the physical chemistry core courses CHEM2301 and CHEM3301 and who is pursuing a major in chemistry. The awardee should not simultaneously hold any other Chemistry Department prize.

DEPARTMENT OF COMPUTING

- **The Karl Robinson Award in Computer Science**

The Karl Robinson Award is a tribute to the life and work of the late Karl Robinson who distinguished himself as an invaluable member of the then Department of Mathematics & Computer Science. This award is presented to a final year student with the best academic performance in Computer Science. The winner of this award is the student with the highest average in first year, second year and Semester I of the third year Computer Science courses. In case of a tie, the award will be split equally among the winners.

DEPARTMENT OF GEOGRAPHY AND GEOLOGY

- **The Barry Floyd Prizes**

The Barry Floyd Prizes in Geography were named after the first Head of the Department of Geography at the University of the West Indies, Mona Campus, Dr. Barry Floyd. These prizes are awarded annually to the best First and Second year Geography students

- **The Geological Society of Jamaica Scholarship**

DEPARTMENT OF PHYSICS

- **The Francis Bowen Bursary**

The Francis Bowen Memorial Bursary was established in memory of the late Francis Bowen who was the first Head of the Department of Physics. The award is restricted to students in the Faculty of Science and Technology, Mona Campus, who are committed to the study of Physics on the basis of performance in the P200 Level examinations.

- **Level II - Departmental Prize**

The Department has been awarding prizes for many years to students who do well in the "200" level examinations. The purpose is to reward and encourage, and so only those students who go on to "300" level Physics qualify. It is possible, in any case, that no prize is awarded if no student gains a good enough grade, B+ and better. The *two* (2) students with the highest marks are awarded prizes.

- **The Michael Tharmanahthan Physics Bursary**

Dr. Ponnambalam, a Senior Lecturer in the Department of Physics, made a donation to the Department of Physics in memory of his *late father, Michael Tharmanahthan,* to provide bursaries for students reading Physics at the Mona Campus. The Bursary is intended to ensure that financial need does not stand in the way of academic achievement.

- **The John Lodenquai Prize for Introductory Physics**

The John Lodenquai Prize has been established by the family of the late Prof. John Lodenquai, a former Professor in Astro-Physics and a graduate of the University of the West Indies. It is to be presented to the student with the best performance in Level I

DEPARTMENT OF MATHEMATICS

- **The Caribbean Actuarial Scholarship**

The Caribbean Actuarial Scholarship was established in memory of Basil L. and Monica G. Virtue by their son-in-law, S. Michael McLaughlin, an actuary who graduated from the University of the West Indies (UWI). This scholarship is intended to be an annual award to UWI actuarial student(s) who demonstrate a strong record of accomplishment, leadership qualities and a commitment to becoming an actuary.

- **The Harold Chan Scholarship**

Dr. Harold Chan, a graduate of this Faculty and a member of the Department of Pathology, Faculty of Medical Sciences, has donated funds for the award of an Annual Scholarship to the best second-year student in Pure Mathematics.

- **The Merville Campbell Prize: Level I and II**

The Merville Campbell Prize was established by the Mathematics and Computer Science Department in 1995 in memory of Merville Campbell who had served the Department of Mathematics for several years. It is given to the student with the best performance in *MATH1140 and MATH1150* and the student with the best performance in Level II Mathematics.

- **The University Lodge /Leslie Robinson Prize**

The Euclid King/Lodge Prize was established by the University Lodge of the West Indies, as a book grant to a Level I student in honour of one of our members, the late Euclid King who was a lecturer. It has also been decided to commemorate another of its members, Professor Leslie Robinson and each year award the grant in memory of Messrs King and Robinson alternately. This is given to the best first year student.

DEPARTMENT OF LIFE SCIENCES

- **The Don Skelding's Prize**

Professor Arthur Donald Skelding, D.Sc. was the second Professor of Botany at the University of the West Indies, Mona from 1955 to 1973. When he returned to Jamaica in June 1985 in his capacity as External Examiner for the B.Sc. in Botany, he made a donation to the Botany Department which the then Professor of Botany invested. The interest from that investment is used for an annual prize `to the best student in the **Preliminary Biology.**

- **The L.B. Coke Prize in Plant Physiology**

The late Dr. L.B. Coke, former Senior Lecturer and Head of the Department of Botany, taught Plant Physiology for fifteen years. The Department of Botany has instituted the prize in his honour after his sudden death on 31 December, 1990. This prize is awarded every year to the student who obtains highest mark in **Plant Physiology**. This prize is maintained by contributions from the Consultancy Fund of the Botany Department.

- **The Charlotte Goodbody Prize**

Mrs. Charlotte Goodbody was employed as a Teaching Assistant in the Department of Zoology with responsibility for the first year classes (Cell Biology and Animal Diversity). She conducted laboratory classes and occasionally gave lectures. Her fascination with experimental Biology and Zoology made her an invaluable resource to the first year students, demonstrators and lecturers for many years. She retired in 1989 and now lives in Aberdeen with her husband, retired Professor Ivan Goodbody. The award named in her honour, made for the first time in 2011, is a book grant to be given to the best student in the **First year (first semester) courses**.

- **The Vincent Hugh Wilson McKie Prize in Zoology**

Vincent Hugh Wilson McKie in addition to being a Zoologist was President of the

Guild of Undergraduates, Hall Chairman for Taylor Hall, President of the UWI Drama Club, President of the UWI Camera Club and of the Tennis Club while attending the UWI. He achieved excellence as a science teacher and was awarded the Silver Musgrave Medal for his work in (a) the Sciences (b) Education and (c) the Fine Arts. This Award in his honour is based on the results of the examinations taken at the end of Level 2 of the Degree Programme and is given to a student with high grades in the **Level 2 Zoology courses**. The Award is not based on academic excellence alone but also takes into account participation in extra-curricular activities.

- **The Ivan Goodbody Prize**

Professor Ivan Goodbody arrived at the University College of the West Indies in 1955 and began to immediately investigate the marine organisms found in the Kingston Harbour and Port Royal Cays area using the newly established Port Royal Marine Laboratory (PRML) as his base. He was academic coordinator of the PRML and Lecturer for the Marine Biology courses from 1955 – 1964. Professor Goodbody was Head of Department of Zoology (now Life Sciences) from1964 – 1986 and served as Dean of the Faculty from 1975 - 1977. He retired in 1989 and was appointed Emeritus professor in 1991. The award named in his honour, made for the first time in 2011, is to the best second year student majoring in **Marine Biology**.

GLOSSARY

- **Anti-requisites** - Two mutually exclusive courses of which credit may be granted for only one.

- **Co-requisite** - A course which must be taken along with another specified course, in order to ensure the attainment of complementary and/or interdependent competencies.

- **Course** - A body of knowledge circumscribed by a syllabus to be imparted to students by sundry teaching methods and usually followed by an examination.

- **Credit** - A measure of the workload required of students in a course. 1 Credit Hour = 1 hour lecture/tutorial/problem class per week OR 2 hours laboratory session per week, for a Semester.

- **Discipline** - A body of knowledge encapsulated in a set of courses distinguishable from other such bodies on the basis of criteria such as method of enquiry, axioms, areas of application.

- **Elective** - A course within a programme taken by free choice of the student.

- **Faculty Courses** - All approved courses offered by a Faculty of the University for credit towards a degree, except Foundation and Co-curricular courses.

- **In-Faculty** - All Faculty courses originating in the Science Faculties.

- **Level** - A measure of the standard of a course, designated at UWI by the first digit in the course number.

- **Major** - 32 or more credits from prescribed courses at Levels 2 & 3 (See Departmental course listings).

- **Minor** - 15 - 16 credits from prescribed courses at Levels 2 &/or 3 (See Departmental course listings).

- **Out-of-Faculty** - All Faculty courses originating in Faculties other than the Courses Science Faculties.

- **Part** - A stage of a program:
    - Part I (Introductory Stage) - Level 1 and Preliminary courses
    - Part II (Advanced stage) - Level 2 and 3 courses

- **Pre-requisite** - A course which must be passed before another course for which it is required may be pursued.

- **Programme** - A selection of courses (designed to achieve pedagogical goals) the taking of which is governed by certain regulations and the satisfactory completion of which (determined by such regulations) makes a candidate eligible for the award of a degree/diploma/certificate.

- **Subject** - An area of study traditionally assigned to the purview of a department.