UWI
MONA CAMPUS
JAMAICA, WEST INDIES

FACULTY OF SCIENCE AND TECHNOLOGY

UNDERGRADUATE STUDENT HANDBOOK

ACADEMIC YEAR
2023/24

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THE UNIVERSITY OF THE WEST INDIES
MONA CAMPUS

FACULTY OF
SCIENCE AND TECHNOLOGY

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On the cover:

Catching Zzzs

by Mr. Jonathan Morris

Captured here is a Stripefoot Anole (*Anolis lineatopus*) sleeping on the leaf of a ZZ Plant.

Winner of the FST Science in the Tropics STEAM Photo Competition 2023

CONTENTS

DISCLAIMER

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 2023-2024 academic year; 2) Students who transferred into the Faculty for the 2023-2024 academic year; and 3) Students who changed their major/minor for the 2023-2024 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 BACHELOR'S DEGREES IN FST

LEVEL	MINIMUM CREDIT REQUIREMENT	NOTES
1	24	Eighteen (18) must be from FST courses
2 and 3 (Advanced)	60	All courses relating to the declared major(s) and or minor(s) must be completed
Foundation Courses *	9	Three (3) FOUN courses required for FST Students: 1. **Either** FOUN1014: Critical Reading and Writing in Science and Technology & Medical Science **or** FOUN1019: Critical Reading and Writing in the Disciplines 2. FOUN1101: Caribbean Civilization* 3. FOUN1301: Law, Governance, Economy and Society* Students registered in FST should NOT register for FOUN1201- Science, Medicine and Technology in Society
TOTAL	**93**	**Minimum credits required for BSc**

* Students may now substitute one (1) Foundation course (except for English Language/Writing courses) with a foreign language at the level of their competence. They may choose from any modern language, Caribbean sign language or Caribbean vernacular language course. Exemptions may also be granted from time to time by the Board for Undergraduate Studies.

BIOCHEMISTRY SECTION

PROGRAMMES

MAJORS

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

UNDERGRADUATE COURSES OFFERED BY THE BIOCHEMISTRY SECTION				
CODES	**TITLES**	**CREDIT**	**SEMESTER**	**PRE-REQUISITES**
		LEVEL 1		
BIOC1016	Anti-Doping in Sports	3	2	Cross faculty course, World Anti-doping Agency (WADA) facilitated. No special pre-requisite, open to all registered UWI students from any faculty.
BIOC1020	Cellular Biochemistry	3	1 or 2	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents
BIOC1021	Practical Biochemistry I	2	1 or 2	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents. Co-requisite: BIOC1020
MICR1010	Introductory Microbiology & Molecular Biology	3	1 or 2	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents
MICR1011	Practical Microbiology and Molecular Biology I	2	1 or 2	CAPE Chemistry (1 & 2) and CSEC Biology, or equivalents. Co-requisite: MICR1010
		LEVEL 2		
BIOC2014	Bioenergetics and Cell Metabolism	8	1	BIOC1020, BIOC1021, MICR1010, MICR1011, CHEM1810, CHEM1811, CHEM1820, CHEM1910, CHEM1911 & CHEM1920
BIOL2312	Molecular Biology I	4	2	BIOC1020, BIOC1021, MICR1010, MICR1011, CHEM1810, CHEM1811, CHEM1820, CHEM1910, CHEM1911 & CHEM1920 Co-requisite: BIOC2014
MICR2211	Microbiology	4	2	BIOC1020, BIOC1021, MICR1010, MICR1011, CHEM1810, CHEM1811, CHEM1820, CHEM1910, CHEM1911 & CHEM1920. Co-requisite: BIOC2014

UNDERGRADUATE COURSES OFFERED BY THE BIOCHEMISTRY SECTION				
CODES	**TITLES**	**CREDIT**	**SEMESTER**	**PRE-REQUISITES**
		LEVEL 3		
BIOC3011	Advanced Biochemistry	4	2	BIOC2014, MICR221, BIOL2312
BIOC3013	Biochemical Physiology	4	1	BIOC2014, BIOL2312, MICR2211
BIOC3014	Plant Biochemistry	4	2	BIOC2014, MICR2211, BIOL2312
BIOC3413	Project	4	1 or 2	BIOC2014, BIOL2312, MICR2211 Co-requisites: BIOC3013, BIOC3014, BIOC3311, BIOL3312, BIOL3313, BIOT3113, BIOT3114, BIOT3116, MICR3213 or MICR3214
BIOL3312	Molecular Biology II	4	1	BIOC2014, BIOL2312, MICR2211
BIOL3313	Human Molecular Biology	4	2	BIOC2014, BIOL2312, MICR2211 Pre/Co-requisite: BIOL3312
BIOT3113	Biotechnology I	4	1	BIOC2014, BIOL2312, MICR2211
BIOT3114	Biotechnology II	4	2	BIOC2014, BIOL2312, MICR2211 Pre/Co-requisite: BIOT3113
BIOT3116	The Biotechnology of Industrial Ethanol Production	4	2	BIOC2014, MICR2211, BIOL2312
MICR3213	Applied and Environmental Microbiology	4	1	MICR2211, BIOC2014, BIOL2312
MICR3214	Molecular Microbiology	4	1	BIOL2312, MICR2211, BIOC2014
MICR3215	Food Microbiology and Biotechnology	4	2	BIOC2014, MICR2211
MICR3216	Medical Microbiology	3	2	MICR2211

PROGRAMME DETAILS

BIOCHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in Biochemistry requires a total of twenty-two (22) Level 1 credits from:**	
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	CHEM1810	Introductory Chemistry I
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1911	Introductory Chemistry Laboratory II
	CHEM1920	Introductory Chemistry IV
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
Advanced Courses (Levels 2 and 3)	**A major in Biochemistry requires a total of thirty-two (32) credits from Levels 2 and 3 and must include:**	
	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)		
Introductory Courses (Level 1)	**A major in Biotechnology requires a total of twenty-two (22) Level 1 credits from:**	
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	CHEM1810	Introductory Chemistry I
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1911	Introductory Chemistry Laboratory II
	CHEM1920	Introductory Chemistry IV
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
Advanced Courses (Levels 2 and 3)	**A major in Biotechnology requires a total of thirty-two (32) credits from Levels 2 and 3 and must include:**	
	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)		
Introductory Courses (Level 1)	**A major in Microbiology requires a total of twenty-two (22) Level 1 credits from:**	
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	CHEM1810	Introductory Chemistry I
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1911	Introductory Chemistry Laboratory II
	CHEM1920	Introductory Chemistry IV
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
Advanced Courses (Levels 2 and 3)	**A major in Microbiology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:**	
	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 **
	NB: A course in Statistics is required for this major *Strongly recommended:* *BIOL3404 - Virology AND ZOOL3406 – Immunology* ***Prerequisites for Levels 2 and 3 courses from Life Sciences can be satisfied by courses from Biochemistry Section***	

MOLECULAR BIOLOGY (MAJOR)		
Introductory Courses (Level 1)	**A major in Molecular Biology requires a total of twenty-two (22) Level 1 credits from:**	
	BIOC1020	Cellular Biochemistry
	BIOC1021	Practical Biochemistry
	CHEM1810	Introductory Chemistry I
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1911	Introductory Chemistry Laboratory II
	CHEM1920	Introductory Chemistry IV
	MICR1010	Introductory Microbiology and Molecular Biology 1
	MICR1011	Practical Microbiology and Molecular Biology 1
Advanced Courses (Levels 2 and 3)	**A major in Molecular Biology requires a total of thirty-two (32) credits from Levels 2 and 3 and must include:**	
	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** BIOL3404	Biotechnology II or Virology
	BIOL3313	Human Molecular Biology

COURSE DESCRIPTIONS

BIOC1016
ANTI-DOPING IN SPORTS
(3 Credits) (Level 1) Semester 2)

Pre-requisites:
None

Course Content:

Doping in sports
- Definition of doping
- History of doping and anti-doping
- Creation of the World Anti-Doping Agency (WADA)

The fight against doping in sports
- Agencies involved in anti-doping
- World anti-doping code
- Copenhagen Declaration & UNESCO Convention
- International standards (testing, laboratories, prohibited list, protection of privacy and personal information)
- How is doping fought (doping control process, athlete biological passport, investigations)

Science & Medicine
- Therapeutic Use Exemptions (TUE)
- Gene doping
- Performance enhancement without doping (use of supplements)

Consequences of doping
- Ethical consideration
- Economic consideration
- Health consequences of doping
- Sports consequences (sanctions)

Vulnerability and Signs and Symptoms
- Vulnerability
- Signs and symptoms of doping
- Preventing doping

Evaluation:
- **In-course Test 1 (MCQ)** **45%**
- **In-course Test 2 (MCQ)** **45%**
- **Coursework** **10%**

(Case report examples include topical issues in doping or case study of alleged doping in an athlete)

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

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

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 Examination (2 hours) 60%
- Course Work: 40%
    - 2 In-course Tests 2x20%

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

<u>MICR1010</u>
<u>INTRODUCTORY MICROBIOLOGY AND MOLECULAR BIOLOGY</u>
(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 eukaryotes 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 Examination (2 hours) 60%
- Course Work: 40%
  - 2 In-course Tests (2 x 20%)

<u>MICR1011</u>
<u>PRACTICAL MICROBIOLOGY AND MOLECULAR BIOLOGY I</u>
(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 Examination (2 hours) 40%
- Course Work: 60%
    - 10 Laboratory Reports (10 x 6%)

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

Pre-requisites:
BIOC1020 - Cellular Biochemistry,
BIOC1021 - Practical Biochemistry 1,
MICR1010 - Introductory Microbiology & Molecular Biology,
MICR1011 - Practical Microbiology and Molecular Biology,
CHEM1810 - Introductory Chemistry I
CHEM1811 - Introductory Chemistry Laboratory I
CHEM1820 - Introductory Chemistry II
CHEM1910 - Introductory Chemistry III
CHEM1911 - Introductory Chemistry Laboratory II **AND**
CHEM1920 - Introductory Chemistry IV.

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

BIOL2312
MOLECULAR BIOLOGY 1
(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,
CHEM1810 - Introductory Chemistry I
CHEM1811- Introductory Chemistry Laboratory I
CHEM1820- Introductory Chemistry II
CHEM1910- Introductory Chemistry III
CHEM1911- Introductory Chemistry Laboratory II **AND**
CHEM1920 - Introductory Chemistry IV.

Co-requisite: BIOC2014 - Bioenergetics and Cell Metabolism.

Course Content:
Nucleic acid structure and function; Genome organization in Eukaryotes, Bacteria, Yeast and Viruses. Methods of studying nucleic acids: DNA sequencing, DNA hybridization, cloning and analysis, restriction mapping, PCR. Recombinant DNA technology. Replication of DNA. Biology and genetics of bacteriophage lambda. RNA and protein synthesis. Protein trafficking.

Evaluation:

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

MICR2211
MICROBIOLOGY
(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
CHEM1810 - Introductory Chemistry I
CHEM1811 - Introductory Chemistry Laboratory I
CHEM1820 - Introductory Chemistry II
CHEM1910 - Introductory Chemistry III
CHEM1911 - Introductory Chemistry Laboratory II **AND**
CHEM1920 - Introductory Chemistry IV.

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 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.
MICR2211 - Microbiology
BIOL2312 - Molecular Biology I

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

<u>BIOC3013</u>
<u>BIOCHEMICAL PHYSIOLOGY</u>
(4 Credits) (Level 3) (Semester 1)

Pre-requisites:
BIOC2014 - Bioenergetics and Cell Metabolism **AND**
BIOL2312 - Molecular Biology I
MICR2211 - Microbiology

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

<u>BIOC3014</u>
<u>PLANT BIOCHEMISTRY</u>
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOC2014 - Bioenergetics and Cell Metabolism **AND**
MICR2211 - Microbiology
BIOL2312 - Molecular Biology I

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

<u>BIOC3413</u>
<u>PROJECT</u>
(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.

<u>BIOL3312</u>
<u>MOLECULAR BIOLOGY II</u>

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

Pre-requisites:
BIOC2014 - Bioenergetics and Cell Metabolism **AND**
BIOL2312 - Molecular Biology I
MICR2211 - Microbiology

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 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
MICR2211 - Microbiology

Pre/Co-requisite:
BIOL3312 - Molecular Biology 11

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 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
MICR2211 - Microbiology

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 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
MICR2211 - Microbiology

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 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
MICR2211 - Microbiology

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 and continuous fermentation systems; fermentor design, instrumentation and 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 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-requisites:
BIOC2014 - Bioenergetics and Cell Metabolism,
BIOL2312 - Molecular Biology I **AND**
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 is related to their role in these processes; A practical section of 36 hours.

Evaluation:

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

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

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

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

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

Pre-requisites:
MICR2211 - Microbiology

Course Content:
This provides the fundamental principles of medical microbiology including the sub-disciplines of bacteriology, virology, and mycology; 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 Examination (2 hours) 50%
- Course Work: 50%
    - 2 In-course Tests 20%
    - Laboratory Practical and Reports 20%
    - Problem-oriented learning activity 10%

DEPARTMENT OF CHEMISTRY

PROGRAMMES

B.Sc.

1. **Chemistry with Education**
2. **Chemistry and Management**
3. **Occupational and Environmental Safety and Health**
4. **Special Chemistry**

MAJORS

1. **Applied Chemistry**
2. **Environmental Chemistry**
3. **Food Chemistry**
4. **General Chemistry**

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		
CHEM1810	Introductory Chemistry I	2	1	CHEM0901 and CHEM0902, or CAPE Chemistry I & II, or GCE A-level Chemistry
CHEM1811	Introductory Chemistry Laboratory I	2	1	CHEM0901 and CHEM0902, or CAPE Chemistry I & II or GCE A-level Chemistry, (CHEM1810)
CHEM1820	Introductory Chemistry II	2	1	CHEM0901 and CHEM0902, or CAPE Chemistry I & II or GCE A-level Chemistry
CHEM1910	Introductory Chemistry III	2	2	CHEM0901 and CHEM0902, or CAPE Chemistry I & II or GCE A-level Chemistry
CHEM1911	Introductory Chemistry Laboratory II	2	2	CHEM1810, CHEM1820 and CHEM1811 (CHEM1910, CHEM1920)
CHEM1920	Introductory Chemistry IV	2	2	CHEM0901 and CHEM0902, or CAPE Chemistry I & II or GCE A-level Chemistry

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
		LEVEL 2		
CHEM2010	Chemical Analysis A	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, CHEM1911 or CHEM1901 and CHEM1902
CHEM2011	Chemical Analysis Laboratory I	2	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902; FOUN1014 or FOUN1019; (CHEM2010)
CHEM2110	Inorganic Chemistry A	3	2	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902
CHEM2111	Inorganic Chemistry Laboratory I	2	2	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902 (CHEM2110)
CHEM2210	Organic Chemistry A	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, and CHEM1911, or CHEM1901 and CHEM1902
CHEM2211	Organic Chemistry Laboratory I	2	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902 (CHEM2210)
CHEM2310	Physical Chemistry A	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
CHEM2311	Physical Chemistry Laboratory I	2	2	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902 (CHEM2310)
CHEM2402	Chemistry in our Daily Lives	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920 and CHEM1911, or CHEM1901 and CHEM1902 and Permission of HOD
CHEM2420	Water Treatment and Analysis	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, CHEM1911, or CHEM1901 and CHEM1902 and Permission of HOD (CHEM2010)
CHEM2421	Water Treatment and Analysis Laboratory	2	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, CHEM1911, or CHEM1901 and CHEM1902 and Permission of HOD (CHEM2420 and CHEM2011)
CHEM2510	Food Processing Principles I	3	2	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, CHEM1911, or CHEM1901 and CHEM1902 and Permission of HOD
CHEM2511	Food Processing Laboratory	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, CHEM1911, or CHEM1901 and CHEM1902 and Permission of HOD (CHEM2512)

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
CHEM2512	Food Processing Principles II	3	1	CHEM1810, CHEM1820, CHEM1811, CHEM1910, CHEM1920, CHEM1911, or CHEM1901 and CHEM1902 and Permission of HOD
		LEVEL 3		
CHEM3010	Chemical Analysis B	3	2	CHEM2010, Pass or Fail, but not Fail Absent
CHEM3011	Chemical Analysis Laboratory II	2	2	CHEM2010 Pass or Fail, but not Fail Absent; CHEM2011 (CHEM3010)
CHEM3110	Inorganic Chemistry B	3	1	CHEM2110 Pass or Fail, but not Fail Absent
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

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
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
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 the course. CHEM2510 or CHEM2512 and CHEM2511 OR CHEM3402 and Permission of HOD
CHEM3402	The Chemical Industries	4	2	CHEM2010 + CHEM2011 and ANY of: CHEM2110 + CHEM2111 or CHEM2210 + CHEM2211 or CHEM2310 + CHEM2311 and Permission of HOD
CHEM3403	Chemical Process Principles	8	2	CHEM2310 and CHEM2311 and Permission of HOD

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
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
CHEM3513	Food Safety and Quality Assurance	3	2	CHEM2510 OR CHEM2512 and CHEM2511 (preferred) and Permission of HOD
CHEM3610	Marine and Freshwater Chemistry	3	1	CHEM2010, CHEM2011 and any two of the following: CHEM2110, CHEM2210, CHEM2310, CHEM2420 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 CHEM2420, CHEM3010 and CHEM2310; Permission of HOD **(course will not be offered in 2023/24)**
CHEM3621	Marine and Freshwater Chemistry Field Course	2	3	CHEM3610 or CHEM3612; Permission of HOD **(course will not be offered in 2023/24)**
CHEM3711	Chemistry Undergraduate Research Project	6	1 & 2 or 2 & 3	Majoring in Chemistry; Completion of all compulsory Level 2 Chemistry courses and at least 6 credits from Level 3 Chemistry and Permission of HOD

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF CHEMISTRY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES (COREQUISITES)**
		OESH COURSES		
OESH1000	Introduction to Occupational and Environmental Safety and Health	6	2	CSEC (CXC) Chemistry and Biology, Grade 3 or better or other approved equivalents and Permission of the HOD
OESH2000	Environmental Contaminants	8	1	The course requirements are met by doing CHEM2420 & CHEM2421 (CHEM2010 + CHEM2011 and afterwards, CHEM3610)
OESH3010	Occupational and Environmental Health Disorders	4	2	OESH1000
OESH3020	Occupational and Environmental Safety and Health Measurement Methods	4	2	OESH3220
OESH3030	Workplace Survey and Evaluation	4	1	OESH3200
OESH3040	Disaster and Emergency Management	4	2	GEOG1231 and GEOG1232 and Permission of HOD
OESH3100	Environment Hazard Evaluation and Risk Management and Control	4	1	OESH1000
OESH3200	Occupational Safety Evaluation and Measurement	4	1	OESH1000
OESH3210	Ergonomics	4	2	OESH1000
OESH3220	Occupational Hygiene	4	1	OESH1000
OESH3430	Practicum	4	Summer	Permission of HOD

PROGRAMME DETAILS

CHEMISTRY WITH EDUCATION (B.Sc.) (FOR TRAINED AND PRE-TRAINED TEACHERS)		
	The B.Sc. Chemistry with Education requires a minimum of: • Thirty (30) credits of Level 2/3 Education courses AND • Thirty-two (32) credits of Level 2/3 Chemistry courses. **Please consult the School of Education, starting in year one, about selection of the required Education Courses.**	
	A B.Sc. in Chemistry with Education requires:	
	12 credits of Level 1 Chemistry Courses	
Introductory Courses (Level 1)	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
	(or CHEM1901 + CHEM1902)	
	6 credits from Level 1 Mathematics (Any 2 of the Math courses below)	
	STAT1001	Statistics for Scientists
	MATH1185	Calculus for Scientists and Engineers
	MATH1141	Introduction to Linear Algebra and Analytical Geometry
	MATH1142	Calculus 1
	MATH1151	Calculus 2
	MATH1152	Introduction to Formal Mathematics
	ALONG WITH	**Required Level 1 Education Courses**
	AND	9 credits of Foundation Courses which must include FOUN1014 or FOUN1019.
	A B.Sc. in Chemistry with Education requires a total of thirty-two (32) credits of Levels 2 and 3 Chemistry Courses and must include:	
	20 credits of Level 2 General Chemistry (compulsory)	
Advanced Courses (Levels 2 & 3)	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
	8 credits of Level 2/3 General Chemistry (compulsory)	
	CHEM2510	Food Processing Principles I
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
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.***	**At least FOUR (4) additional credits from Level 2 or 3 Chemistry Courses:**	
	CHEM2402	Chemistry in our Daily Lives
	CHEM2420	Water Treatment and Analysis (Formerly CHEM2410)
	CHEM2421	Water Treatment and Analysis Laboratory
	CHEM2511	Food Processing Laboratory
	CHEM2512	Food Processing Principles II
	CHEM3110	Inorganic Chemistry B
	CHEM3210	Organic Chemistry B
	CHEM3310	Physical Chemistry B
	CHEM3111	Inorganic Chemistry Laboratory II
	CHEM3211	Organic Chemistry Laboratory II
	CHEM3311	Physical Chemistry Laboratory 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
	CHEM3511	Food Chemistry Laboratory
	CHEM3512	Food Chemistry II
	CHEM3610	Marine & Freshwater Chemistry
	CHEM3711	Chemistry Undergraduate Research Project

N.B. Contact the School of Education for advice on selection of the required Levels 1, 2 and 3 Education courses

Pre-Trained Teachers:
An important feature of this programme is the field-work component that is carried out in local secondary schools. The field-work enables pre-trained teachers to get initial teaching experience by first working in pairs in their second year for 6

weeks, and then individually, during their final year, for 10 weeks. For the field-work components, teachers in training are required to plan and deliver aspects of the secondary school science curricula under joint supervision of UWI personnel and the cooperating teachers in the schools assigned. During the two years in the advanced part of the programme, effort is made to expose students to teaching at both the lower and upper levels in more than one type of secondary schools. In final year, students are required to plan, implement and evaluate a specific lesson that they have taught while on field-work.

Trained Teachers:
Trained teachers take the same advanced chemistry courses pursued by the pre-trained teachers. The trained teachers get an opportunity to revisit teaching through their field-work experience. They are required to use action research as a means of planning, implementing and evaluating specific interventions that are used to teach topics from the CSEC curriculum. Strong emphasis is also placed on reflective practice and on identifying areas of their teaching that need to be strengthened. The field-work places strong focus on professional development and is carried out over a 6-week period in selected secondary schools.

N.B. Candidates who have completed the New Double Option Science diploma programmes from The MICO University College or Church Teachers College (with a GPA ≥ 2.5) may be exempt from Level 1 Chemistry courses.

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:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
	(or CHEM1901 + CHEM1902)	
	STAT1001	Statistics for Scientists
	ACCT1003*	Introduction to Cost Management and Accounting
	ACCT1005*	Introduction to Financial Accounting
	ECON1000*	Principles of Economics
	ECON1012*	Principles of Economics II
	PSYC1002*	Introduction to Industrial and Organizational Psychology
	SOCI1002*	Sociology for the Caribbean
	AND	
	MATH	3 credits from any Level I Mathematics course (taken in Semester 1 or Semester 2)
	AND	9 credits of Foundation Courses which must include FOUN1014 or FOUN1019.
Advanced Courses (Levels 2 and 3)	**A B.Sc. in Chemistry and Management requires a total of sixty-two (62) credits from Levels 2 and 3 and must include:**	
	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
	MKTG2001*	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: twenty-one (21) 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
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.***	**Three (3) additional credits from Level 2 or 3 Management Studies Courses AND**	
	Three (3) additional credits from Level 2 or 3 Chemistry Courses from:	
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	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
	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

Courses are offered by the Faculty of Social Sciences

OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH (B.Sc.)		
	A B.Sc. in Occupational and Environmental Safety and Health requires a total of thirty-six (36) Level 1 credits from:	
Introductory Courses (Level 1)	BIOL1017	Cell Biology
	BIOL1262	Living Organisms I
	BIOL1263	Living Organisms II
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
		(or CHEM1901 + CHEM1902)
	GEOG1231	Earth Environments I: Geomorphology and Soil
	GEOG1232	Earth Environments II: Climate and the Biosphere
	OESH1000	Introduction to OESH
	PSYC1002	Introduction to Industrial and Organizational Psychology
	PLUS	*Foundation Course* (FOUN1014 or FOUN1019)
	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 (31) compulsory credits	
Advanced Courses (Levels 2 & 3)	BIOL2403	Principles of Ecology
	BIOL2406	Eukaryotic Microorganisms
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	LANG3101*	Business Communication: Principles and Practices
	OESH3200	Occupational Safety Evaluation and Measurement
	OESH3220	Occupational Hygiene
	PHAL3306**	Toxicology
	PLUS Foundation Course	

Year 2: Summer: three (3) credits	
MDSC3200**	Understanding Research
Year 3: thirty-five (35) 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
PLUS 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.***
@ OESH2000 is satisfied by doing CHEM2420 and CHEM2421 during year 2 and CHEM3610 in year 3.

SPECIAL CHEMISTRY (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Special Chemistry requires a total of twenty-four (24) Level 1 credits, which must include:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
	(or CHEM1901 + CHEM1902)	
	MATH	6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2)
	AND	9 credits of Foundation Courses which must include FOUN1014 or FOUN1019
	PHYS	CAPE Physics or equivalent is required
	A B.Sc. in Special Chemistry requires a total of fifty-four (54) credits from Levels 2 and 3 chemistry courses and six (6) credits (Level 2 or 3) in another subject area in science or Mathematics. The chemistry courses must include:	
Advanced Courses (Levels 2 and 3) **Students must satisfy the prerequisites and corequisites required to enter advanced chemistry courses**	**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:

CHEM2420	Water Treatment and Analysis
CHEM2421	Water Treatment and Analysis Laboratory
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

And six (6) Level 2 or 3 credits from a science discipline other than chemistry.

APPLIED CHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in Applied Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
		(or CHEM1901 + CHEM1902)
	AND	
	MATH - 6 credits from any Level I Mathematics courses (taken in Semester 1 and/or Semester 2)	
Advanced Courses (Levels 2 and 3) ***CHEM2010, CHEM2011, CHEM2310 and CHEM2311 may be counted as elective credits.***	**A major in Applied Chemistry requires 10 credits of prerequisite courses (*CHEM2010, CHEM2011, CHEM2310 and CHEM2311*) and thirty-four (34) credits of required Levels 2 and 3 chemistry courses.** **The courses required include:**	
	Level 2: fifteen (15) compulsory credits	
	CHEM2010	Chemical Analysis A (prerequisite)
	CHEM2011	Chemical Analysis Laboratory I (prerequisite)
	CHEM2310	Physical Chemistry A (prerequisite)
	CHEM2311	Physical Chemistry Laboratory I (prerequisite)
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	Level 3: Twenty-six (26) compulsory credits	
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3402	The Chemical Industries
	CHEM3401	Project Evaluation & Management for Science-based Industries
	CHEM3403	Chemical Process Principles
	CHEM3610	Marine & Freshwater Chemistry
	CHEM3611	Environmental Chemistry Laboratory
Electives ***Students must ensure that they satisfy the prerequisite courses required for entry to the electives of***	**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

interest. In most instances, 12 Level 1 credits in the subject of interest are required. One or more advanced courses may also be needed.	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 (31) 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. These prerequisite credits can contribute towards a minor in Chemistry.

ENVIRONMENTAL CHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in Environmental Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory I
	(or CHEM1901 + CHEM1902)	
	AND	
	MATH - 6 credits from any Level 1 Mathematics courses (taken in Semester 1 and/or Semester 2)	
Advanced Courses (Levels 2 and 3)	**A major in Environmental Chemistry requires fourteen (14) credits of prerequisite courses (***CHEM2010, CHEM2011, CHEM2110, CHEM2210 and CHEM2310***) and thirty-five (35) credits of required Levels 2 and 3 chemistry courses.**	
	Level 2: nineteen (19) compulsory credits	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2110	Inorganic Chemistry A
	CHEM2210	Organic Chemistry A
	CHEM2310	Physical Chemistry A
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	Plus four (4) credits from:	
	CHEM2111	Inorganic Chemistry Laboratory
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2311	Physical Chemistry Laboratory I
	Level 3: twenty (20) compulsory credits	
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	CHEM3402	The Chemical Industries
	CHEM3610	Marine and Freshwater
	CHEM3611	Chemistry Laboratory
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycle

Electives	**And six (6) additional credits from Level 2 or 3 taken from environmental courses including but not limited to:**	
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	CHEM3621	Marine and Freshwater Chemistry Field Course ***(not offered in 2023/24)***
	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	Environmental Change
	GEOG3132	Tourism Planning & Development
	GGEO2233	Water Resources
	GGEO3232	Climate Change in the Tropics
	GGEO3233	Hydrology and Hydrological Geology
	PHYS2701	Essentials of Renewable Energy Technologies and Solutions
	PHYS3701	Advanced Renewable Energy Technologies and Solutions
	PHYS3661	Physics of the Atmosphere and Climate
	PHYS3671	Solar Power
	PHYS3681	Wind and Hydro Power

The major requires 25 credits of specified Environmental courses along with 6 credits from Level 2 or 3 approved environment-related electives; an additional 4 credits from Level 2 laboratory electives are also required. There are 14 credits of defined prerequisite courses (CHEM2010, CHEM2011, CHEM2110, CHEM2210, and CHEM2310).

FOOD CHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in Food Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
		(or CHEM1901 + CHEM1902)
	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 10 credits of prerequisite courses** (*CHEM2010, CHEM2011, CHEM2210 and CHEM2211)* **and thirty-five (35) credits of required Levels 2 and 3 Food chemistry courses.**	
	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
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	Level 3: twenty-one (21) compulsory credits	
	CHEM3010	Chemical Analysis B
	CHEM3011	Chemical Analysis Laboratory II
	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-five (35) credits of specialized Food Chemistry courses supported by 10 prerequisite credits of General Chemistry (CHEM2010, CHEM2011, CHEM2210, and CHEM2211). These prerequisite courses can contribute towards a minor in General Chemistry.		

GENERAL CHEMISTRY (MAJOR)		
Introductory Courses (Level 1)	**A major in General Chemistry requires a total of eighteen (18) Level 1 credits from:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
		(or CHEM1901 + CHEM1902)
	AND	
	MATH - 6 credits from any Level 1 Mathematics courses (taken in Semester 1 and/or Semester 2)	
Advanced Courses (Levels 2 and 3)	**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	
	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 courses may also be needed.*	**And six (6) additional Level 2 or 3 credits from:**	
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	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 **(not offered in 2023/24)**
	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. An additional 9 credits in chemistry electives are required.

ENVIRONMENTAL CHEMISTRY (MINOR)		
Introductory Courses (Level 1)	**A minor in Environmental Chemistry requires a total of twelve (12) Level 1 credits from:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
	(or CHEM1901 + CHEM1902)	
Advanced Courses (Levels 2 and 3)	**A minor in Environmental Chemistry requires a total of sixteen (16) credits from Levels 2 and 3 and must include:**	
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	CHEM3610	Marine and Freshwater Chemistry
	CHEM3611	Environmental Chemistry Laboratory
	CHEM3612	Atmospheric Chemistry & Biogeochemical Cycles. **(Not offered in AY 2023/24**)

<table>
<tr><th colspan="3">FOOD CHEMISTRY (MINOR)</th></tr>
<tr><td rowspan="7">Introductory Courses (Level 1)</td><td colspan="2">A minor in Food Chemistry requires a total of twelve (12) Level 1 credits from:</td></tr>
<tr><td>CHEM1810</td><td>Introductory Chemistry I</td></tr>
<tr><td>CHEM1820</td><td>Introductory Chemistry II</td></tr>
<tr><td>CHEM1910</td><td>Introductory Chemistry III</td></tr>
<tr><td>CHEM1920</td><td>Introductory Chemistry VI</td></tr>
<tr><td>CHEM1811</td><td>Introductory Chemistry Laboratory I</td></tr>
<tr><td>CHEM1911</td><td>Introductory Chemistry Laboratory II</td></tr>
<tr><td></td><td colspan="2">(or CHEM1901 + CHEM1902)</td></tr>
<tr><td rowspan="17">Advanced Courses (Levels 2 and 3)</td><td colspan="2">A minor in Food Chemistry requires a total of at least sixteen (16) credits from Levels 2 and 3 and must include:</td></tr>
<tr><td>CHEM3510</td><td>Food Chemistry I</td></tr>
<tr><td>CHEM3511</td><td>Food Chemistry Laboratory</td></tr>
<tr><td>CHEM3512</td><td>Food Chemistry II</td></tr>
<tr><td colspan="2">AND at least (7) credits from:</td></tr>
<tr><td>CHEM2010</td><td>Chemical Analysis A</td></tr>
<tr><td>CHEM2011</td><td>Chemical Analysis Laboratory I</td></tr>
<tr><td>CHEM2210</td><td>Organic Chemistry A</td></tr>
<tr><td>CHEM2211</td><td>Organic Chemistry Laboratory I</td></tr>
<tr><td>CHEM2310</td><td>Physical Chemistry A</td></tr>
<tr><td>CHEM2311</td><td>Physical Chemistry Laboratory I</td></tr>
<tr><td>CHEM2420</td><td>Water Treatment and Analysis</td></tr>
<tr><td>CHEM2421</td><td>Water Treatment and Analysis Laboratory</td></tr>
<tr><td>CHEM3010</td><td>Chemical Analysis B</td></tr>
<tr><td>CHEM3011</td><td>Chemical Analysis Laboratory II</td></tr>
<tr><td>CHEM3210</td><td>Organic Chemistry B</td></tr>
<tr><td>CHEM3513</td><td>Food Safety & Quality Assurance</td></tr>
<tr><td colspan="3">CHEM2010, CHEM2011, CHEM2210 and CHEM2211 are prerequisites for CHEM3510 and CHEM3512.</td></tr>
<tr><td colspan="3">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.</td></tr>
</table>

FOOD PROCESSING (MINOR)		
Introductory Courses (Level 1)	**A minor in Food Processing requires a total of twelve (12) Level 1 credits from:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
		(or CHEM1901 + CHEM1902)
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
	CHEM2420	Water Treatment and Analysis
	CHEM2421	Water Treatment and Analysis Laboratory
	CHEM3401	Project Evaluation & Management for Science-based Industries
	CHEM3402	The Chemical Industries
	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:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
	(or CHEM1901 + CHEM1902)	
Advanced Courses (Levels 2)	**A minor in General Chemistry requires a total of at least sixteen (16) credits from Level 2 and must include:**	
	CHEM2010	Chemical Analysis A
	CHEM2011	Chemical Analysis Laboratory I
	CHEM2110	Inorganic Chemistry A
	CHEM2210	Organic Chemistry A
	CHEM2310	Physical Chemistry A
	AND at least two (2) credits from:	
	CHEM2111	Inorganic Chemistry Laboratory I
	CHEM2211	Organic Chemistry Laboratory I
	CHEM2311	Physical Chemistry Laboratory I

The General Chemistry minor gives students a foundation in analytical chemistry and the other traditional chemistry sub-disciplines (inorganic, organic and physical chemistry). The minor comprises 12 credits of theory and 4 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:**	
	CHEM1810	Introductory Chemistry I
	CHEM1820	Introductory Chemistry II
	CHEM1910	Introductory Chemistry III
	CHEM1920	Introductory Chemistry IV
	CHEM1811	Introductory Chemistry Laboratory I
	CHEM1911	Introductory Chemistry Laboratory II
		(or CHEM1901 + CHEM1902)
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.		
Minor consists of 16 compulsory advanced credits. CHEM3402 examines the operations of selected chemical industries and includes an internship within an approved chemical industry. CHEM3401 deals with project management while CHEM3403 covers the unit operations of chemical industries.		

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 48 hours.

Evaluation:

- Final 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 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 48 hours.

Evaluation:

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

Practical work is assessed throughout 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.

CHEM1810
INTRODUCTORY CHEMISTRY I

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

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

Course Content:
Introductory Chemistry I discusses the structure and properties of atomic species and examines the fundamental principles that govern bonding in matter. It explains how these concepts give information about the shapes of molecules and helps to influence their characteristics and reactions. The Schrödinger wave equation is used to explore the concept of electron density in atoms and to rationalize the types of bonding that occur between atoms. Fundamental concepts such as periodicity, molecular orbital theory and intermolecular forces are used to help explain the chemical and physical properties of substances and to predict the reactions that they undergo.

Evaluation:

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

CHEM1820
INTRODUCTORY CHEMISTRY II

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

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

Course Content:
Introductory Chemistry II is an introductory level course which explores the fundamental laws, theories and models that govern stability and reactivity in chemical reactions. The course covers Acid-Base theories and explores the principles of Thermodynamics, Electrochemistry and Kinetics. The course includes both descriptive and mathematical components and effectively connects theories with industrial applications. The various topics are logically organized and readily facilitate meaningful understanding of the course material.

Evaluation:

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

CHEM1811
INTRODUCTORY CHEMISTRY LABORATORY I
(2 Credits) (Level 1) (Semester 1)

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

Co-requisites: CHEM1810

Course Content:
This course will expose students to concepts and laboratory skills associated with Analytical and Inorganic Chemistry through exercises and experiments designed to improve experimental skills. These exercises will focus on volumetric analysis and inorganic synthesis and will support and reinforce the content covered in the Introductory Chemistry I and Introductory Chemistry II theory courses through practice and application. The course will be offered over one semester and will include 48 hours of experimental work.

Evaluation:

- Final Examination (2 hours) 20%
- Course Work: 80%
  - Pre-laboratory Tests 10%
  - Laboratory Reports 70%

Practical work is assessed throughout the duration of the course. Students must provide the ORIGINAL worksheets of their laboratory work which must be certified by the laboratory course Supervisor or Demonstrator.

CHEM1910
INTRODUCTORY CHEMISTRY III
(2 Credits) (Level 1) (Semester 2)

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

Course Content:
Introductory Chemistry III is an introductory level course with a blend of Physical and Inorganic Chemistry. The course covers the fundamentals of atomic and molecular spectroscopy from a quantum mechanical view point, and also examines the inorganic chemistry of main group and first row transition elements.

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

CHEM1920
INTRODUCTORY CHEMISTRY IV
(2 Credits) (Level 1) (Semester 2)

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

Course Content:
This course is a mechanistic, principles-based approach to the structures, properties and synthesis of hydrocarbons and compounds functionalized with halogen, hydroxyl, carbonyl, carboxyl, and amino groups. It builds on the material introduced in CAPE Chemistry and aims to encourage students to take an imaginative and creative approach to organic chemistry.

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

<u>CHEM1911</u>
<u>INTRODUCTORY CHEMISTRY LABORATORY II</u>
(2 Credits) (Level 1) (Semester 2)

Pre-requisites:
CHEM1810, CHEM1820 and CHEM1811

Co-requisites: CHEM1910 and CHEM1920

Course Content:
This course combines an integrated science approach which focuses on organic, inorganic, and physical chemistry approaches to chemical experimentation. Appropriate laboratory experiments will enable development of students' practical skills in these sub-disciplines. The experimental bases of many of the concepts introduced in the co-requisite Introductory Chemistry courses, III and IV will be demonstrated and these concepts clarified and reinforced.

Evaluation:
- Final Examination (2 hours) 20%
- Course Work: 80%
    - Pre-laboratory Tests 10%
    - Laboratory Reports 70%

Practical work is assessed throughout the duration of the course. Students must provide the ORIGINAL worksheets of their laboratory work which must be certified by the laboratory course Supervisor or Demonstrator.

<u>CHEM2010</u>
<u>CHEMICAL ANALYSIS A</u>
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)

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, high performance liquid chromatography and gas

chromatography. Instrumental components and techniques for qualitative and quantitative chromatographic analysis; Introduction to analytical molecular absorption spectroscopy: Beer-Lambert's law, instrumentation, and applications.

Evaluation:

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

CHEM2011
CHEMICAL ANALYSIS LABORATORY I
(2 Credits) (Level 2) (Semester 1)

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)
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:
EITHER CHEM1810 - Introductory Chemistry I,

CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II

OR (CHEM1901 AND CHEM1902)

Course Content:

1. **Symmetry elements and operations**. Introduction to group theory; Point groups. Applications of group theory in bonding (e.g., to derive molecular orbitals for polyatomic species) and in spectroscopy (e.g., vibrational analysis).
2. **Transition metals bonding and spectroscopy:** various bonding models for transition metal complexes; interpretation, and prediction of the electronic spectra of first row transition metal complexes.
3. **Solution chemistry**: Review of Acid-base theories; Periodic trends in acid-base properties; reactions in aqueous and non-aqueous media; aqua-metal complexes, solubility of salts.
4. **Oxidation and Reduction Reactions;** standard reduction potentials, redox potentials and stability constants, disproportionation reactions, Potential Diagrams.

Evaluation:

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

CHEM2111
INORGANIC CHEMISTRY LABORATORY I

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

Pre-requisites:

EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II

OR (CHEM1901 AND CHEM1902)

Co-requisite:

CHEM2110 - Inorganic Chemistry A.

Course Content:

This lecture/laboratory-based course is designed to develop practical skills in inorganic chemistry. The course introduces synthetic reaction procedures, product isolation, and the use of spectroscopic techniques to identify target compounds. It provides the hands-on training necessary to develop skills in problem-solving, equipment manipulation, experimental design and data collection. Students analyse their results and communicate their experimental findings through oral presentations and written laboratory reports. The course emphasizes team work, critical thinking and time management skills. In addition, students are exposed to international laboratory safety standards. The lectures cover aspects of UV/Vis spectroscopy of transition metal complexes and their magnetic properties.

Evaluation:

- In-course Tests 30%
- Laboratory Reports 70%

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

Pre-requisites:

EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)

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

CHEM2211
ORGANIC CHEMISTRY LABORATORY I
(2 Credits) (Level 2) (Semester 1)

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)

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:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)

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

CHEM2311
PHYSICAL CHEMISTRY LABORATORY I
(2 Credits) (Level 2) (Semester 2)

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)
AND 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:
EITHER CHEM1810 - Introductory Chemistry I,

CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II

OR (CHEM1901 AND CHEM1902)

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 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 (CHEM1810, CHEM1811, CHEM1820, CHEM1910, CHEM1911 and CHEM1920 OR [CHEM1901 + CHEM1902]) Chemistry courses. This course cannot be counted towards a major or minor in Chemistry, with the exception of Chemistry with Education. The course can, however, be counted as advanced credits within these degrees.

CHEM2420
WATER TREATMENT AND ANALYSIS

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

Pre-requisites:

EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II

OR (CHEM1901 AND CHEM1902)

AND Permission of Head of Department.

Co-requisite:

CHEM2010 - Chemical Analysis A

This is a blended course and includes both face-to-face and online lectures. About 40% of lectures are delivered online.

Course Content:
Water Resources; The nature, properties and use of water for domestic, industrial and agricultural purposes; Water quality monitoring; Local and international water quality standards (NEPA, USEPA, WHO); Regulations for industrial effluents, potable water, sewage effluents and their receiving bodies (river, wells and coastal waters). Water distribution and environmental contamination. Potable and waste-water treatment processes; Water re-use and recycling; Management of domestic sewage and industrial wastes.

Evaluation:
- Final Examination (2 hours) 50%
- Course Work: 50%
  - Online quizzes 20%
  - In-course Tests 30%

CHEM2421
WATER TREATMENT AND ANALYSIS LABORATORY
(2 Credits) (Level 2) (Semester 1)

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)
AND Permission of Head of Department.

Co-requisites:
CHEM2011 – Chemical Analysis A and
CHEM2410 – Water Treatment and Analysis

Course Content:
Water Analysis Principles, Analyte Concentration and Figures of Merit; Water Sample Collection and Preservation; Water Quality Monitoring; Determination of Water Quality Parameters: pH and alkalinity; Conductivity, Hardness, Biological Oxygen Demand, Chemical Oxygen Demand and Coliforms. Evaluation of Water Quality in relation to its end use.

Evaluation:
- Laboratory Notes and Reports 50%
- Field Trip Reports 25%
- Technical Report and Oral Presentation 25%

CHEM2510
FOOD PROCESSING PRINCIPLES I
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)
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 Examination (2 hours) 60%
- Course Work: 40%
  - In-course Tests 40%
    (*an assignment may be given*)

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

Pre-requisites:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)
AND Permission of HOD.
Preference will be given to students majoring in Food Chemistry. A valid food handler's permit is required for participation in the processing laboratory.

Co-requisite:
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:
EITHER CHEM1810 - Introductory Chemistry I,
CHEM1820 - Introductory Chemistry II,
CHEM1910 - Introductory Chemistry III,
CHEM1920 - Introductory Chemistry IV,
CHEM1811 - Introductory Chemistry Laboratory I and
CHEM1911 - Introductory Chemistry Laboratory II
OR (CHEM1901 AND CHEM1902)
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 Examination (2 hours) — 60%
- Course Work: — 40%
    - In-course Tests — 40%
      (*an assignment may be given*)

<u>CHEM3010</u>
<u>CHEMICAL ANALYSIS B</u>
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
CHEM2010 - Chemical Analysis A *(Pass or Fail but not Fail Absent)*.

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

<u>CHEM3011</u>
<u>CHEMICAL ANALYSIS LABORATORY II</u>
(2 Credits) (Level 3) (Semester 2)

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

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-requisite:
CHEM2110 - Inorganic Chemistry A *(Pass or Fail but not Fail Absent)*.

Course Content:

1. **Solid State Chemistry:** Bonding in solids, electronic conductivity, semiconductors, bands in d-block compounds, photoconductivity, doping, p-n junction, superconductivity, defects, Crystal Systems and X-ray Diffraction, Ionic lattices.
2. **Properties of d- and f- blocks Transition Metals**
3. **Inorganic Reaction Mechanisms:** Classification of inorganic reaction mechanisms. Square planar and octahedral substitution; the *trans*-effect, inner and outer-sphere electron transfer reactions.
4. **Transition metal organometallics**: Transition metal complexes with ligands such as cyclopentadienyl and carbon monoxide. Structure, bonding, reactivity, fundamental mechanisms, and homogeneous catalysis.

Evaluation:

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

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

Pre-requisites:
CHEM2111 - Inorganic Chemistry Laboratory I
AND permission of Head of Department.

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

Course Content:
Synthesis and characterization of inorganic and organometallic compounds. Application of Infra-red, X-ray diffraction and NMR spectroscopies to analysis of inorganic materials.

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 Examination (2 hours) 60%
- Course Work: 40%

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

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

Pre-requisites:
CHEM2210 - Organic Chemistry A
CHEM2211 - Organic Chemistry Laboratory I
CHEM3210 - Organic Chemistry B **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 B
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 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 B
AND permission of Head of Department.

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

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

<u>CHEM3402</u>
<u>THE CHEMICAL INDUSTRIES</u>
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
Any two combinations:
CHEM2010 - Chemical Analysis A **AND**
CHEM2011 - Chemical Analysis Laboratory I
AND EITHER
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 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
CHEM2311 - Physical Chemistry Laboratory I
AND Permission of Head of Department.

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

Evaluation:

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

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

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 (including course test) — 30%
- Laboratory Reports — 50%

CHEM3512
FOOD CHEMISTRY II
(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 Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests 40%
      (*an assignment may be given*)

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 CHEM2511 - Food Processing Laboratory (preferred)
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 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 two of the following:
CHEM2110 - Inorganic Chemistry A, CHEM2210 - Organic Chemistry A, CHEM2310 - Physical Chemistry A, CHEM2420 - Water Treatment and Analysis **or** CHEM3010 - Chemical Analysis B.

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 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 pursuing a major 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 40%

CHEM3612
ATMOSPHERIC CHEMISTRY AND BIOGEOCHEMICAL CYCLES
(6 credits) (Level 3) (Semester 2)
This course will NOT be offered during the 2023/24 academic year.

Pre-requisites:
CHEM3610 - Marine and Freshwater Chemistry or a combination of:
CHEM2420 - Water Treatment and Analysis, CHEM3010 - Chemical Analysis B and CHEM2310 - Physical Chemistry A
AND Permission of Head of Department.
Preference will be given to students pursuing a major in Environmental Chemistry.

Course Content:

1. **Atmospheric Chemistry:** Atmospheric composition and structure; Atmospheric pollution: Global warming; Acid rain; Photochemical smog; 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.
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 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) (Level 3) (Semester 2)
This course will NOT be offered during the 2023/24 academic year.

Pre-requisites:
CHEM3610 - Marine and Freshwater Chemistry or
CHEM3612 - Atmospheric Chemistry and Biogeochemical Cycles **AND**
Permission of Head of Department.
Preference will be given to students pursuing a major 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 Chemistry courses and at least 6 credits from Level 3 Chemistry **AND** Permission of 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%

OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH PROGRAMME

OESH1000
INTRODUCTION TO OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH

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

Pre-requisites:
CSEC (CXC) Chemistry and Biology, Grade 3 or better
OR other approved equivalents
AND Permission of the Head of Department.
Preference will be given to students pursuing a major in Occupational and Environmental Safety and Health.

Course content:

1. Occupational Health: Introduction to basic human anatomy and physiology – respiratory, gastrointestinal and excretory systems, skin etc.; review of documented occupational and environmental diseases and illnesses.
2. Occupational Safety: Evaluation of exposure to occupational hazards and risks; introductory ergonomics and workplace design for safety; evaluation and control of workplace hazards.
3. Environment Health: Mutual dependence of life forms on the natural environment; human and other impacts on the environment; costs and effects of environmental degradation and benefits of environmental protection; environmental hazards and exposure risks; health hazards and exposure risks from air, water, soils, their health effects and their impacts on specific organs;
4. Health Promotion: Analysis of the role of individuals, employers, OESH professionals, civic societies, and the public in practicing and promoting occupational and environmental health;
5. Workplaces and the Environment: their diversities and relationships.
6. OESH Legislation: Regulatory and control frameworks for hazardous materials, wastes, workplaces; Regulatory frameworks for protecting the environment; Sustainable use of natural resources.

Evaluation:

- Final Examination (2 hours) 50%
- Course Work: 50%
    - In-course Tests 25%
    - Two (2) assignments 25%

<u>OESH2000</u>

<u>ENVIRONMENTAL CONTAMINANTS AND THEIR CONTROL</u>

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

The requirements for this course are met by doing CHEM2420, CHEM2421 and CHEM3610. See descriptions of these courses above.

CHEM2420 WATER TREATMENT and ANALYSIS

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

CHEM2421 WATER TREATMENT and ANALYSIS LABORATORY

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

These courses should be completed in YEAR 2 of the OESH Programme.

Pre-requisites:

CHEM1810 - Introductory Chemistry I, CHEM1820 - Introductory Chemistry II, CHEM1910 - Introductory Chemistry III, CHEM1920 - Introductory Chemistry IV, CHEM1811 - Introductory Chemistry Laboratory I and CHEM1911 - Introductory Chemistry Laboratory II or CHEM1901 + CHEM1902 AND Permission of Head of Department.

Co-requisites:

CHEM2010 - Chemical Analysis A AND CHEM2011 - Chemical Analysis Laboratory I.

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.

<u>OESH3010</u>

<u>OCCUPATIONAL AND ENVIRONMENTAL HEALTH DISORDERS</u>

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

Pre-requisite:

OESH1000 - Introduction to Occupational and Environmental Safety and Health.

Course Content:

Respiratory disorders- pneumoconiosis (silicosis, asbestosis, CWP etc.), chronic obstructive pulmonary disease e.g. emphysema, bronchitis, reactive airways disorders, hypersensitivity pneumonitis, asthma; Skin disorders – chronic and acute irritant dermatitis, pigment disorders, allergic contact dermatitis; Eye disorders – Irritant conjunctivitis; Renal and Urinary Tract disorders; Hearing Loss; Infectious Diseases.

Evaluation:

- Final Examination (2 hours): 50%
- Course Work: 50%
    - In-course Tests: 25%
    - Projects/Reports: 25%

OESH3020
OESH MEASUREMENT METHODS
(4 Credits) (Level 3) (Semester 2)

Pre-requisite:
OESH3220 – Occupational Hygiene.

Course Content:
Instruments/equipment used in OESH, including outdoor (air, soil, water, waste), indoor (air, dust), workplace (air, skin), source emission (both stationary and mobile services) and noise pollution measuring techniques, in both real-time and with time-integration; Calibration, service and preventive maintenance; Analytical laboratory management standards and practices; Certification of analysis (biological, chemical and physical measurements); Information-communication-technology in OESH including surveys and mapping.

Evaluation:

- Final written examination (2 hours): 50%
- Coursework: 50%
    - o In-course Tests: 25%
    - o Projects/Reports: 25%

OESH3030
WORKPLACE SURVEY AND EVALUATION
(4 Credits) (Level 3) (Semester 1)

Pre-requisites:
OESH3200 – Occupational Safety Evaluation and Measurement.

Course Content:
Assessment strategies, models and techniques including hazard ranking and resource allocation; Design of data collection instruments; Background survey to establish demographics, practices, plant operations, raw materials; Walkthrough survey (including familiarity with various industrial processes); In-depth/Detailed surveys including sampling for air, water, soil; biological samples (taken from

workers: blood, urine, stool, hair etc.); bulk samples; use of sampling equipment; Inspection of operation of installed equipment; Report writing and ethical issues in risk communication.

Evaluation:

- Final Examination (2 hours): 50%
- Coursework: 50%
  - In-course Tests: 25%
  - Projects/Reports: 25%

OESH3040
DISASTER AND EMERGENCY MANAGEMENT
(4 Credits) (Level 3) (Semester 2)

Pre-requisites:
GEOG1231- Earth Environments 1: Geomorphology & Soils
GEOG1232 - Earth Environments 2: Climate and the Biosphere **AND**
Permission of Head of Department.

Course Content:
Introduction to the basic principles and techniques in disaster management; Study of theories, hazards, vulnerability, response capability, risk assessment; Disaster scenarios, disaster management, preparedness, prevention, emergency response and simulation; Disasters, emergencies and occupational and environmental health-spills, contamination, fires, epidemics, flooding; Accidents (technological disasters and emergencies): causation theories, investigation, reporting, prevention; Acts of sabotage and terrorism (social emergencies and disasters); Relevant laws, standards and practices (Caribbean and Global).

Evaluation:

- Final Examination (2 hours): 50%
- Coursework: 50%
  - In-course Tests: 25%
  - Projects/Field trip Report: 25%

OESH3100
ENVIRONMENTAL HAZARD EVALUATION AND RISK MANAGEMENT AND CONTROL
(4 Credits) (Level 3) (Semester 1)

Pre-requisite:
OESH1000 – Introduction to OESH

Course Content:
Environmental hazards – chemical, biological, physical, psychological; The concept of risk in relation to environmental hazards; Quantitative methods of risk assessment; Environmental hazards in air (indoor and outdoor), water and soils; Air, water and soil quality – chemical and biological content with respect to environmental hazards and exposure risks; Ecotoxicological and genotoxicological methods of assessing environmental hazards and risk, their limitations and effectiveness; Bioavailability and mobility of hazardous materials; biomarkers; Environmental hazards and exposure risks in sectors such as agricultural, tourism and financial services; Abatement methods and technologies- asbestos, lead, heavy metals, pesticides, POPs, ozone depleting substances, etc.; Waste handling and disposal; Risk communication; Preparation of environmental impact assessments.

Evaluation:
- Final Examination (2 hours): 50%
- Coursework: 50%
  - In-course Tests: 25%
  - Projects/Field trip Report: 25%

OESH3200
OCCUPATIONAL SAFETY EVALUATION AND MEASUREMENT
(4 Credits) (Level 2) (Semester 1)

Pre-requisite:
OESH1000 – Introduction to occupational and environmental safety and health

Course Content:
Introduction to fire safety and confined space entry equipment; Job safety analysis; Psychology of accidents – personality type, risky behaviours, risk tolerance, outlook; Safe handling, transport and disposal of hazardous materials; Personal protective gear for physical hazards; Design and operation of safety equipment; Laboratory and industrial (in key operations) safety procedures; Workplace injuries including burns; Slips, trips and falls; Workplace violence; Lock out/Tag out procedures; Radiation Safety; Accident Investigation and Reporting.

Evaluation:
- Final Examination (2 hours): 50%
- Coursework: 50%
  - In-course Tests: 25%
  - Projects/Field trip Report: 25%

OESH3210
ERGONOMICS
(4 Credits) (Level 3) (Semester 2)

Pre-requisite:
OESH1000 – Introduction to OESH

Course Content:
Principles of Ergonomics/Human factors – application of science, design and other disciplines in workstation design; Environments for optimal human use (i.e. comfortable, safe and efficient working environments}; Health problems associated with poor ergonomics in diverse work settings; Musculoskeletal disorders- physiology, anthropometry; Psychosocial stressors, neurological and psychotic disorders, neuromuscular fatigues etc. of ergonomic relevance; Other ergonomic risk factors- vibration, temperature, material handling, repetition and lifting and transfers, in health care; Ergonomics in selected sectors: tourism, agriculture and service sectors; Instrumentation for assessing, evaluating and managing ergonomic risks; Ergonomic engineering- analysis and design of work stations and equipment for optimal human use.

Evaluation:
- Final Examination (2 hours): 50%
- Coursework: 50%
    - In-course Tests: 25%
    - Projects/Field trip Report: 25%

OESH3220
OCCUPATIONAL HYGIENE
(4 Credits) (Level 2) (Semester 1)

Pre-requisite:
OESH1000 – Introduction to OESH

Course Content:
Overview of occupational hazards – physical, chemical and biological; Principles of hazard evaluation; Occupational risk assessment databases; Exposure limit values, standards and guidelines for worker exposure; Administrative controls – materials substitution, process changes, work scheduling: Personal protective equipment – respirators and gloves; Engineering controls – HVAC systems, enclosures, , dilution and local exhaust ventilation, fume hoods; Occupational hygiene programme management, including worker involvement in hygiene; Ethics of occupational hygiene; Health promotion.

Evaluation:
- Final Examination (2 hours): 50%
- Coursework: 50%
    - In-course Tests: 25%
    - Projects/Field trip Report: 25%

OESH3430
PRACTICUM
(4 Credits) (Level 3) (Semester 3)

Pre-requisites:
Successful completion of Year 2 courses
AND have sat examinations for Year 3 courses
AND permission of the Head of Department.

Course Content:
Students will be exposed to real life situations requiring application of OESH concepts to solve workplace problems based on the OESH principles learnt in the classroom. Students will be afforded opportunities to demonstrate their understanding of how the concepts learnt can be applied to specific (and general) OESH challenges in the workplace.

Evaluation:

• Assessment by the Supervisor assigned in the workplace which will be documented at the end of the study	40%
• Assessment of an oral presentation by the student on his/her return from internship	10%
• Submission of a formal report on the internship by the student for evaluation	50%

Students are required to work for at least 6 weeks in an approved OESH setting during the summer.

DEPARTMENT OF COMPUTING

PROGRAMMES

B.Sc.

1. **Computer Studies**
2. **Computer Systems Engineering** ***Not being offered 2023/2024***
3. **Information Technology**
4. **Software Engineering [Mobile Application Technologies]** ***Not being offered 2023/2024***

MAJORS

1. **Computer Science**
2. **Software Engineering**

MINORS

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

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDITS**	**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 OR Teacher's College Diploma OR Associate 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 OR Teacher's College Diploma OR Associate 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
SWEN1007	Software Engineering Essentials	3	2	None
		LEVEL 2		
COMP2130	Systems Programming	3	1	COMP1126, COMP1127 and COMP1161
COMP2140	Software Engineering	3	1	COMP1126, COMP1127 and COMP1161
COMP2171	Object Oriented Design and Implementation	3	2	COMP2140

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
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
INFO2101	Probability and Statistics for Computing	3	2	COMP1210
INFO2111	Data Structures	3	1	COMP1126, COMP1127 and COMP1161
INFO2180	Dynamic Web Development 1	3	1	COMP1126, COMP1127 and COMP1161
SWEN2165	Requirements Engineering	3	2	COMP2140 or SWEN1007
LEVEL 3				
COMP3092	An Introduction to Quantum Computing	3	1	COMP2211, INFO2111 or PHYS2351
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 INFO2101) AND (COMP2211 OR INFO2111)

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
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	2	COMP2340 and COMP2140
COMP3802	Speech and Language Technology	3	1	COMP2802 or ELET2210
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
INFO3106	Computer Systems Administration	3	1	COMP2340 and COMP2190
INFO3110	Information Systems	3	2	COMP2140 and COMP2190

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	TITLES	CREDITS	SEMESTER OFFERED	PREREQUISITES
INFO3155	Information Assurance and Security	3	2	COMP2190 and (COMP2201 or INFO2101)
INFO3165	Security Analysis and Digital Forensics	3	2	COMP2190 and (COMP2201 or INFO2101)
INFO3171	User Interface Design	3	1	COMP2140 or INFO2180
INFO3180	Dynamic Web Development II	3	2	INFO2180
INFO3435	Ecommerce	3	2	COMP2140 and INFO2180
SWEN3000	Application Development for iOS Devices	3	2	COMP2171
SWEN3001	Android Application Development I	3	1	COMP2171 and COMP3161
SWEN3002	Android Application Development II	3	2	SWEN3001
SWEN3003	Web &Mobile Application Development I	3	1	SWEN1005, COMP2171 and COMP3161
SWEN3004	Web & Mobile Application Development II	3	2	SWEN3003
SWEN3120	Software Architecture	3	1	COMP2140 and COMP2171
SWEN3130	Software Project Management	3	1	COMP2140
SWEN3145	Software Modelling	3	1	COMP2140 and COMP2171
SWEN3165	Software Testing	3	2	COMP2140 and COMP2171

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF COMPUTING				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
SWEN3185	Formal Methods and Software Reliability	3	2	COMP2201
SWEN3920	Capstone Project (Software Engineering)	6	1, 2 or 3	COMP2140, SWEN3130, and SWEN3145
LEVEL 4				
SWEN4001	Advanced Database Systems	3	2	COMP3161 or SWEN2005
SWEN4002	IT Certification I (Course Shell)	3	1	None

PROGRAMME DETAILS

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	Financial Accounting & Introduction to Cost and Management Accounting
	OR	
	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 Computing courses at 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
	COMP2340	Computer Organization
	COMP3101	Operating Systems
	COMP3161	Database Management Systems
	COMP3220	Principles of Artificial Intelligence
	COMP3901	Capstone Project
	INFO3110	Information Systems
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 2023/2024*		
Introductory Courses (Level 1)	**A B.Sc. in Computer Systems Engineering requires a total of thirty-four (34) Level 1 credits from:**	
	Semester 1	
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1220	Computing and Society
	ECNG1000	Mathematics for Computing
	ENGR1000	Introduction to Engineering
	MATH1180	Engineering Mathematics I
	Semester 2	
	COMP1161	Object-Oriented Programming
	ECNG1012	Electrical Circuits
	ELET1400	Introduction to Electronics
	ELET1405	Practices in Basic Electronics
	ELNG1101	Physics for Engineers
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	
	COMP2140	Software Engineering
	COMP2190	Net-Centric Computing
	COMP2201	Discrete Mathematics for Computer Science
	ELET2405	Practices in Electronics Design I
	ELET2430	Digital Circuits and Microprocessors
	ELET2450	Embedded Systems
	Level 2: Semester 2	
	COMP2130	System Programming
	COMP2211	Analysis of Algorithms
	INFO2180	Dynamic Web Development I
	INFO3106	Computer Systems Administration
	MATH2201	Probability and Statistics for Engineers
	Summer Term	
	COMP3911	Internship in Computing I
	Level 3: Semester 1	
	COMP3101	Operating Systems
	COMP3191	Principle of Computer Networking
	ECNG3021	Introduction to Engineering Management and Accounting Systems

	ELET2460	Signal and Systems
	INFO3180	Dynamic Web Development II
	Electives	
	ELET3485	Introduction to Robotics
	INFO3155	Information Assurance and Security
	Level 3: Semester 2	
	COMP3801	Real Time Embedded Systems
	COMP3901	Capstone Project
	MGMT3136	New Venture Creation and Entrepreneurship
	Electives	
	ECNG3016	Advanced Digital Electronics
	MATH2230	Engineering Mathematics

INFORMATION TECHNOLOGY (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. in Information Technology requires a total of fifteen (15) Level 1 credits from:**	
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	COMP1210	Mathematics for Computing
	Elective	
	COMP1220	Computing and Society
Advanced Courses (Levels 2 and 3)	**A B.Sc. in Information Technology requires a minimum of forty-two (42) credits from Computing Courses at Levels 2 and 3 and must include:**	
	COMP2140	Software Engineering
	COMP2190	Net-Centric Computing
	COMP2340	Computer Systems Organization
	COMP3161	Database Management Systems
	COMP3901	Capstone Project
	INFO2101	Probability and Statistics for Computing
	INFO2111	Data Structures
	INFO2180	Web Design and Programming I
	INFO3106	Computer Systems Administration
	INFO3110	Information Systems
	INFO3155	Information Assurance and Security
	INFO3171	User Interface Design
	INFO3180	Dynamic Web Development II
	AND three (3) credits from Levels 2 or 3 courses offered by the Department of Computing, **PLUS eighteen (18) credits from any discipline including Computing.**	

SOFTWARE ENGINEERING[Mobile Application Technologies] (B.Sc.) [Non-UGC Funded] *Not being Offered 2023/2024*		
	A B.Sc. in Software Engineering [Mobile Application Technologies] requires a total of forty-two (42) Level 1 credits from:	
	Semester 1	
Introductory Courses (Level 1)	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1220	Computing and Society
	COMP1210	Mathematics for Computing
	COMP1161	Object-Oriented Programming
	SWEN1003	Current and Future Trends in Computing for Software Engineers
	SWEN1005	Mobile Web Programming
	SWEN1006	Research Methods for Software Engineers
	SWEN1007	Software Engineering Essentials
	SWEN1008	Technical Writing for Software Engineers
	CHIN1001	Chinese (Mandarin) 1A
	CHIN1002	Chinese (Mandarin) 1B
	FOUN1001	English for Academic Purposes
	FOUN1101	Caribbean Civilization
	A B.Sc. in Software Engineering [Mobile Application Technologies]requires all of the following courses from Levels 2, 3 and 4:	
	CHIN2001	Elementary Chinese Culture and Language
	CHIN2002	Intermediate Chinese Culture and Language
	COMP2140	Software Engineering
	COMP2171	Object Oriented Design and Implementation
Advanced Courses (Levels 2, 3 and 4)	COMP2190	Net-Centric Computing
	COMP2201	Discrete Mathematics for Computer Science
	COMP2211	Analysis of Algorithms
	COMP2340	Computer Systems Organization
	COMP3161	Introduction to Database Management Systems
	COMP3912	Internship in Computing II
	SWEN2165	Requirements Engineering
	SWEN3000	Application Development for iOS Devices
	SWEN3001	Android Application Development I
	SWEN3002	Android Application Development II

	SWEN3003	Web & Mobile Application Development I
	SWEN3004	Web & Mobile Application Development II
	SWEN3120	Software Architecture
	SWEN3130	Software Project Management
	SWEN3145	Software Modeling
	SWEN3165	Software Testing
	SWEN3185	Formal Methods and Software Reliability
	SWEN3920	Capstone Project (Software Engineering)
	SWEN4001	Advanced Database Systems
	SWEN4002	IT Certification I

COMPUTER SCIENCE (MAJOR)		
Introductory Courses (Level 1)	**A major in Software Computer Science 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 Computer Science requires a minimum of thirty-nine (39) credits from Computing courses at 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
	COMP2340	Computer Systems Organization
	COMP3101	Operating Systems
	COMP3161	Introduction to Database Management Systems
	COMP3220	Principles of Artificial Intelligence
	COMP3901	Capstone Project
	AND nine (9) credits from Level 2 or 3 courses offered by the Department of Computing.	

SOFTWARE ENGINEERING (MAJOR)		
Introductory Courses (Level 1)	**A major in Software Engineering requires a total of fifteen (15) Level 1 credits from:**	
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	COMP1210	Mathematics for Computing
	COMP1220	Computing and Society
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
	COMP3911	Internship in Computing
	SWEN3130	Software Project Management
	SWEN3145	Software Modelling
	SWEN3165	Software Testing
	SWEN3185	Formal Methods and Software Reliability
	SWEN3920	Capstone Project (Software Engineering)
	AND three (3) credits from Level 2 or 3 courses offered by the Department of Computing.	

COMPUTER SCIENCE (MINOR)		
Introductory Courses (Level 1)	**A minor in Computer Science requires a total of twelve (12) Level 1 credits from:**	
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	COMP1210	Mathematics for Computing
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 (3) 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
	COMP3220	Principles of Artificial Intelligence
	COMP3652	Language Processors
	COMP3702	Theory of Computation
	COMP3801	Real-Time Embedded Systems
	COMP3911	Internship in Computing

INFORMATION TECHNOLOGY (MINOR)		
Introductory Courses (Level 1)	**A minor in Information Technology requires a total of twelve (12) Level 1 credits from:**	
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	COMP1210	Mathematics for Computing
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:**	
	COMP2190	Net-Centric Computing
	INFO2111	Data Structures
	AND any three courses from below:	
	INFO2101	Probability and Statistics for Computing
	INFO2180	Dynamic Web Development I
	INFO3106	Computer Systems Administration
	INFO3155	Information Assurance and Security
	INFO3171	User Interface Design
	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:**	
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	COMP1161	Object-Oriented Programming
	COMP1210	Mathematics for Computing
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 (3) courses from below:	
	COMP2201	Discrete Mathematics for Computer Science
	SWEN3130	Software Project Management
	SWEN3145	Software Modelling
	SWEN3165	Software Testing
	SWEN3185	Formal Methods and Software Reliability

COURSE DESCRIPTIONS

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

Pre-requisites:
A CAPE (Units 1 & 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, Creating new functions at run-time.
5. **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 II
(3 Credits) (Level 1) (Semester 1 or 2)

Pre-requisite:
A CAPE (Units 1 & 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) (Semester 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)

SWEN1007
SOFTWARE ENGINEERING ESSENTIALS
(3 Credits) (Level 1) (Semester 2)

Pre-requisite:
None

Course Content:

- Dynamics of working in teams and groups: Differentiate between team and group; team and group communication; reading, understanding, and summarizing reading; presentation skills (goals, slide composition, audience interaction); dealing with multicultural environments
- Individual cognition

- Accreditation, certification, and licensing: codes of ethics and professional conduct; the nature and role of software engineering standards; employment contracts
- Software engineering basics: life cycle, the four common activities; basic human considerations for code; software product basics
- Software engineering careers (including software entrepreneurs)
- Characteristics of successful/unsuccessful software engineering projects
- Engineering foundations: measurement and metrics; theory of measurement (e.g., criteria for valid measurement); engineering design (e.g., formulation of problem, alternative solutions, and feasibility)
- Software quality: software quality concepts and models; software quality assurance methods; software quality metrics; product quality attributes; software reliability; configuration control

Evaluation:

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

COMP2130
SYSTEMS PROGRAMMING
(3 Credits) (Level 2) (Semester 1 or 2)

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

Course Content:

1. Basic systems programmer tool set
    - o shells and common commands (Linux and Windows)
    - o editors
    - o GNU C and the GNU C compiler
    - o debugging with the GNU gdb
2. Introduction to the C programming language
3. Low level data representation
    - o bit models – magnitude, signed magnitude, two's complement, fixed and floating point
    - o bit operations – bitwise AND, OR and NOT, bitmasks
    - o ASCII
    - o UNICODE
4. Pointers and structures
    - o low level manipulation and management of memory addresses
    - o passing arguments to and from functions

    - data structures for the creation of user defined data types
5. Input and output
    - streams
    - buffers and pipes
    - files and directories
6. System calls
    - input and output
    - memory management
    - file management
    - process management
    - signal management
    - socket management
7. Client-server architecture programming
8. Dynamic memory management
    - linked lists

Evaluation:

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

<u>COMP2140</u>
<u>SOFTWARE ENGINEERING</u>
(3 Credits) (Level 2) (Semester 1)

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

Course Content:

- Introduction
    - Organization of the Internet
    - Switching techniques
    - Physical pieces of a network, including hosts, routers, switches, ISPs, wireless, LAN, access point, and firewalls.
    - Layering principles (encapsulation, multiplexing)
    - Roles of the different layers (application, transport, network, datalink, physical)
    - Evolution of the Internet
- Applications
    - Distributed applications (client/server, peer-to-peer, cloud, etc.)
    - HTTP as an application layer protocol
    - Naming and addressing schemes (DNS)
    - Socket APIs
- Transport layer
    - Multiplexing with TCP and UDP
    - Flow control
    - Error control
    - TCP reliability
- Network layer
    - Addressing (IP addresses)
    - Network address translation
    - Routing versus forwarding
    - Static routing
    - Scalability issues
- Local Area Networks
    - Multiple access problem
    - Local area networks
    - Ethernet
    - Switching
    - 802.11 networks
- Network security
    - Network attack types

- Confidentiality, Integrity, and Availability
- Basic cryptography terminology, covering notions pertaining to the different communication partners, encryption, decryption, keys and their characteristics, signatures. [ACM]
- Cryptography
  - Symmetric key cryptography
  - Public key cryptography
- Authentication protocols
- Types of malware
- Basic network defence tools and strategies
  - IPSec
  - VPNs
  - Firewalls
  - Intrusion detection

Evaluation:

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

COMP2201
DISCRETE MATHEMATICS FOR COMPUTER SCIENCE

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

Pre-requisite:

COMP1210 - Mathematics for Computing **OR**
MATH1152 - Introduction 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 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 II,
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 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 II,

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

INFO2101
PROBABILITY AND STATISTICS FOR COMPUTING
(3 Credits) (Level 2) (Semester 2)

Pre-requisite:
COMP1210 - Mathematics for Computing.

Course Content:

1. Preliminaries
   - Randomness
   - Summary statistics: mean, median, mode, variance, standard deviation
   - Counting
2. Probability
3. Finite probability space, probability measure, events
4. Conditional probability
5. Bayes' Rule
6. Independent events
7. Random variables, expectation, and variance
8. Selected discrete random distributions (Bernoulli, Binomial, Poisson, Hypergeometric,
9. Uniform, Geometric, Negative Binomial) and the PMF
10. Selected continuous random distributions (Uniform, exponential) and the CDF
11. Gaussian/Normal distribution
12. Central Limit Theorem
13. Sampling
14. Statistics
15. Hypothesis testing
    - One-tailed versus two-tailed tests
    - Parametric tests
      - z-test
    - Non-parametric tests
      - t-test
      - chi-square test
      - Sign-test
    - Confidence int1ervals
    - Correlation coefficients
    - Linear regression with one independent variable
    - Spearman's coefficient of rank correlation

Evaluation:

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

INFO2111
DATA STRUCTURES
(3 Credits) (Level 2) (Semester 1)

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

Anti-requisite:
COMP2211 - Analysis of Algorithms.

Course Content:

1. Integer, floating-point and character Representations
   - Overflow and underflow
2. Abstract data types
   - Lists, Queues, stacks and dictionaries
   - Comparing algorithms using time and space complexity
3. Tree Structures
   - M-ary trees, binary trees
   - Binary heaps, binary search trees, Red black trees
4. Hashing and Tries for efficient access
5. Sorting – a case study in applying techniques of varying time and space complexities to solve a
6. problem
   - Bubble and insertion sorts, merge and quick sorts and the radix sort
7. Graphs
   - Definitions and representations
   - Depth-first and breadth first search, Topological sort and Connected components as DFS applications
   - Minimum spanning trees
   - Shortest path calculations using Dijkstra's and Floyd-Warshall's algorithm
8. Efficiency in String processing
   - String processing techniques
   - Using Regular expressions
   - Implementing regular expressions using Finite State Automata
   - Computational complexity (P vs NP, hardness of problems and the concept of a NP-hard problem

Evaluation:

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

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

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

Course Content:
Basic Networking Concepts, Version Control with Git, HTML and CSS, JavaScript, Server-side programming with PHP, Databases and SQL, Asynchronous JavaScript and AJAX, Client-side and Server-side Validation and Web Security, Web Accessibility.

Evaluation:

• Final Examination (2 hours)		50%
• Coursework:		50%
• 1 quiz	10%	
• 5 Laboratories (3% each)	15%	
• 2 Programming Projects	25%	

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, behavioural specifications, goal-driven.
5. **Security in requirements analysis and specification.**
6. **Requirements engineering tools.**

Evaluation:

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

<u>COMP3029</u>
<u>AN INTRODUCTION TO QUANTUM COMPUTING</u>
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
COMP2211 - Analysis of Algorithms **OR**
INFO2110 - Data Structures for IT **OR**
PHYS2351 - Quantum Mechanics and Nuclear Physics

Course Content:

1. **Foundations of quantum computing:** Why quantum computing - problems not in P; sub-atomic particles and their observables; photon, electron; polarization, spin; the influence of measurement, Heisenberg Uncertainty Principle; qubits, contemporary approaches and future considerations for their creation and manipulation; quantum dot, NV centre, Majorama fermions; logical layers of a quantum computer; quantum chip, quantum to classical interface, error detection, quantum compiler.
2. **The mathematics of quantum computing:** vectors, matrices, Dirac notation; vector addition and scalar multiplication, matrix multiplication, linear combination; inner product and tensor product; basis vectors and Bloch sphere representation; X, Y and Z basis states; Hilbert space; conjugate transpose, Hermitian matrix, Unitary matrix; global and relative phase.
3. **Quantum computing principles:** superposition; entanglement; interference.
4. **Quantum gates and circuits:** Pauli gates; Hadamard gate; Toffoli, CNOT, Rx, Ry, Rz, S, S;
5. **Circuits and code:** drawing quantum circuit diagrams as solutions to small, well-defined problems; use a computer-based tool to create, test and execute circuit-based solutions; use a high-level programming language to write code that can be executed on a quantum simulator or quantum computer.
6. **Quantum algorithms and networks:** BB84 quantum key distribution algorithm; Deutsch's algorithm; Grover's search algorithm; Building a quantum network.

Evaluation:

- Coursework: 100%
    - 4 Assignments 40%
    - 3 In-course tests 40%
    - 2 Labs 20%

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

COMP3161
DATABASE MANAGEMENT SYSTEMS
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
COMP1126 - Introduction to Computing I,
COMP1127 - Introduction to Computing II,
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 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-Discreet Mathematics for Computer Science **OR**
INFO2100- Mathematics and Statistics for IT **AND**
COMP2211-Analysis of Algorithms **OR**
INFO2110- Data Structures for IT

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. **Modelling:** 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.

COMP3191
PRINCIPLES OF COMPUTER NETWORKING
(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.
   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.
3. **Network layer:** Names and addresses: ARP, IPv4, IPv6, and NAT, Routing and flooding, source routing, and spanning trees, Routing algorithms: Bellman-Ford and Dijkstra's, Routing: Intra-AS routing (RIP and OSPF), Inter-AS routing (BGP), and multicast.
4. **Software-defined networking:** Basic architecture, the data plane, the control plane.
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 Examination (2 hours)		50%
• Coursework:		50%
• In-course Examination (1 hour)	10%	
• 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 Examination (2 hours) ` 40%
- Coursework: 60%
    - In-course Examination (1 hour) 10%
    - 13 Quizzes (equally weighted) 15%
    - 13 Laboratory Reports 20%
    - Weekly Participation 15%

COMP3220
PRINCIPLES OF ARTIFICIAL INTELLIGENCE
(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, Philosophical Issues in AI, Ethics
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. **Machine learning:** Supervised learning, Linear Regression, Neural Networks, Knowledge Representation and reasoning, Production rules, Inferencing mechanisms
5. **Current topics in AI:** Reasoning under uncertainty, Generative Adversarial network, Long Short Term Memory, Convolutional neural networks, Natural Language Processing, Recommender Systems, Speech recognition, Reinforcement learning, Unsupervised learning, Expert Systems

Evaluation:

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

COMP3410
INTRODUCTION TO PARALLEL COMPUTING
(3 Credits) (Level 3) (Semester 2) *(*Not being offered 2023/2024*)*

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 (bitonic) sort, 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 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 derivations; 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:** Typing (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:

- Extended homework assignments30%
- Mini/In-class assignments: 40%
- Final project: 30%
-

COMP3702
THEORY OF COMPUTATION
(3 Credits) (Level 3) (Semester 2)

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

Course Content:

1. Regular languages (DFA, NFA, Regular Expressions) and their pumping lemma
2. Context Free languages (CFGs, PDAs) and their pumping lemma
3. Turing-recognisable languages (Turing Machines)
4. Church-Turing thesis (Lambda Calculus)
5. Undecidability: the halting problem
6. Turing reducibility and Mapping reducibility
7. Distinction between time and space complexity
8. Definitions of complexity classes: L, P, NP, PSPACE, EXPTIME
9. Effect of Nondeterminism on Space and Time complexity

10. Polynomial time mapping reducibility
11. Hardness and completeness relative to various complexity classes (e.g. NP-hardness, NP-completeness)
12. Classic NP-complete problems
13. Optional content: Exploratory / Frontier topics (e.g. Quantum Polynomial time, Bounded Probabilistic Polynomial)
14. Applications of complexity theory: public-key cryptography, block chain, cryptocurrency.

Evaluation:

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

COMP3801
REAL TIME EMBEDDED SYSTEMS
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
COMP2140 - Software Engineering **AND**
COMP2340 - Computer Systems Organisation.

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

<u>COMP3901</u>
<u>CAPSTONE PROJECT</u>
(3 Credits) (Level 3) (Semester 2)

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%
• Mid-semester 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.

<u>COMP3911</u>
<u>INTERNSHIP IN COMPUTING I</u>
(3 Credits) (Level 3) (Semester 1, 2 and Summer Term)

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 I50 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).

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

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 communicationskills;
- 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).

INFO3106
COMPUTER SYSTEMS ADMINISTRATION
(3 Credits) (Level 3) (Semester 1)

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

Course Content:

1. **Introduction to System Administration:** Importance of System Administration (SA), System Administration models, Principles of System Administration, Ethics in System Administration
2. **Hardware, Software and Virtualization:** Hardware: Servers, Network infrastructure, Storage systems, Client devices, Appliances; Identify and explain the purpose of various Software: Operating Systems, Enterprise Systems, End-user systems, Virtualization, Cloud Computing, Services
3. **Security, Business Continuity and Disaster Recovery:** Security in context of Information Systems, Privacy in the context of Information Systems, Risks, Threats, Vulnerabilities and Controls, Business Continuity and Disaster Recovery
4. **Infrastructure Design:** Requirements Planning and Business Alignment, Expansion/Upgrade Planning and Lifecycles, Budgeting, Sourcing/Procurement, Change Management, Licensing
5. **Administration Domains and Activities:** Monitoring and Logging, Scripting, Orchestration, User and Group Management, Content Deployment and Management, Maintenance
6. **Data Centre Design:** Data Centre Architectures, Physical Space Design, Power and Cooling, Physical Security, Networking Architecture, Fault Tolerance
7. **Support:** Service Desk, Service Level Agreements, Tier 3 Support Models, IT Organization Structure, Administrative Domains

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - Project 10%
    - Labs 25%
    - Mid-Semester Exam 15%

INFO3110
INFORMATION SYSTEMS IN ORGANISATIONS
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
COMP2140 - Software Engineering **AND**
COMP2190 - Net-Centric Computing.

Course Content:

1. **Organisations, Management, and the Networked Enterprise:** Information Systems in Global Business Today, Global E-business and Collaboration, Information Systems, Organisations, and Strategy, Ethical and Social Issues in Information Systems
2. **Information Technology Infrastructure:** Infrastructure and Emerging Technologies, Telecommunications, the Internet, and Wireless Technology, Securing Information Systems
3. **Global and Organisational issues:** Internet Governance, Legislative and Regulatory Issues, Data Protection
4. **Key Systems Applications for the Digital Age:** Achieving Operational Excellence and Customer Intimacy, E-Commerce, Managing Knowledge, Enhancing Decision Making
5. **Building and Managing Systems:** Building Information Systems, Managing Projects

Evaluation:

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

INFO3155
INFORMATION ASSURANCE & SECURITY
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
COMP2190 - Net-Centric Computing **AND**
INFO2100 - Mathematics and Statistics for IT **or**
COMP2201 - Discrete Mathematics for Computer Science.

Course Content:

1. **Review and discuss the offences and penalties detailed in the Jamaica Cybersecurity Act**
2. **Fundamental concepts of assurance and security:** Need for Information Assurance, Threats, Attacks, Access control policies, Authentication mechanisms
3. **Risk Management:** What is risk analysis, What is involved in determining risk, Approaches to managing risk

4. **Security Policy and Governance:** Strategies and plans for creating security policies
5. **Cryptography:** Cryptographic primitives, Common protocols, Cryptanalysis
6. **Malware:** Taxonomy of various types based on how they propagate and their level of autonomy, Malware payloads, Signature and behaviour-based detection, Polymorphic and metamorphic malware
7. **Prevention and detection:** Intrusion detection systems, Firewalls, Creating rule sets for use in automated prevention and detection systems

Evaluation:

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

<u>INFO3165</u>
<u>SECURITY ANALYSIS AND DIGITAL FORENSICS</u>
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
COMP2190 - Net-Centric Computing **AND**
INFO2100 - Mathematics and Statistics for IT **or**
COMP2201 - Discrete Mathematics for Computer Science.

Course Content:

1. **Introduction to Cybersecurity analysis:** Penetration testing concepts and terminology, Phases of penetration testing, Ethical practices in cybersecurity, Legal considerations (domestic and international)
2. **Phases of Penetration testing:** Information Gathering, Social engineering, Publicly available sources of information, Scanning networks and their devices
3. **Enumeration:** Identify potential vulnerabilities, Map the potential attack surface
4. **Vulnerability Assessment:** Identify potential exploits, Identify potential attacks, Backdoors and shells
5. **Exploitation:** Investigate the potential effects of an attack (sandboxing), Exfiltration of data, Explore countermeasures for various types of attacks, Maintain access and control of a target system or network, System auditing functions
6. **Reporting and Documentation:** Report and document findings and recommendations, Frameworks and templates, Industry standards
7. **Forensics:** Concepts in digital evidence, Network forensics investigative methodology (OSCAR), Sources of network-based evidence, Evidence acquisition and traffic analysis
8. **Tools:** Virtual Machines e.g., Virtual Box, Operating systems for penetration testing activities e.g. Kali Linux, Network tools e.g. Wireshark, Nmap, Suricata, Multi-perspective Machine Learning (MPML), Web scanning tools e.g. burpsuite

Evaluation:

- Final Examination 30%
- Coursework: 70%
  - Assessed Labs 20%
  - Project 25%
  - Assignments 20%
  - Online Quiz 5%

INFO3171
USER INTERFACE DESIGN
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
COMP2140 - Software Engineer **OR** I
NFO2180 - Dynamic Web Development I.

Course Content:

1. **Overview of human-computer interaction (HCI), User Interface (UI) and User Experience (UX) Design:** The role of user interfaces in computer/technology applications/systems, Interrelationships of HCI, UI, UX and interdisciplinary relationships to other academic disciplines and professional fields.
2. **Human Factors, HCI Models, and UI/UX Design Principles and Paradigms:** Human Factors: Cognition, attention, perception, vision, hearing, touch, memory, problem-solving, learning, motor skills, and their implications for UI/UX., Colour perception and UI/UX design guidelines., UI/UX design guidelines for accessibility for differently abled users, Principles and guidelines for use of motion, animation and blinking in UI/UX, UI/UX design guidelines and Gestalt principles, Mental models and conceptual models, Norman's model, gulfs of execution and evaluation, Evaluation of UI/UX designs in terms of human factors, HCI models, and UI/UX, principles, External representation, external cognition, distributed cognition. HIPS model, Social, cultural, organisational, ethical, economic, environmental aspects/contexts of UI/UX and technology, UI paradigms: command-line interfaces, function key interfaces, graphical user, interfaces (GUI), gestural interfaces, speech/natural language interfaces, augmented reality (AR) interfaces, 3D virtual reality (VR) interfaces, body/postural interfaces, etc., UI/UX design principles and guidelines. UI/UX design and user productivity, safety, satisfaction, aesthetics, product marketing.
3. **UI Hardware and Software Environments:** Overview of graphics hardware, display1 devices, input devices, Ergonomics in UI/UX, GUI system architecture, event-driven interaction model, UI toolkits/libraries/frameworks and prototyping tools, Web-based systems. Mobile systems, Collaborative systems, AR systems. VR systems. Gestural systems. Hardware/software support for accessibility.

4. **UI/UX Development Methods:** UI development phases: inquiry, design, prototyping, evaluation, implementation, UI/UX development methodologies - user-centred, contextual, participatory, and others, Contextual, observational, and usability study methodologies for inquiry and analysis, Design of closed and open survey instruments, questionnaires, Likert scales, Methods for planning, piloting, and conducting interviews, surveys, questionnaires and observational studies, Methods for analysing qualitative and quantitative data collected from interviews, surveys, questionnaires, observational and contextual studies, Developing user profiles, UI/UX goals and requirements, task and workflow models, scenarios, personas, and accessibility guidelines, Brainstorming/visioning.

Evaluation:

- Usability Study 15%
- Mini/in-class assignments 10%
- Design Project 60%
- In-course tests 10%
- Research Report 5%

INFO3180
DYNAMIC WEB DEVELOPMENT II
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
INFO2180 - Dynamic Web Development.

Course Content:
Introduction to web application frameworks, routing and templating, Managing File Uploads, User Authentication, Database Migrations and Object Relational Mappers (ORM), Introduction to other client side Web API's (e.g. History API, Web Storage, WebGL, Drag & Drop, Geolocation, etc.), Introduction to other front-end tools and libraries such as VueJS, Bootstrap, SASS, Gulp, Webpack/ViteJS, Web Services/Restful API's and JSON Web Tokens (JWT), Responsive Web Design (RWD). Wireframing, User Interface Design and Design Systems, Progressive Web Apps (PWA), Deploying a web application to a cloud service.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - 1 Quiz 10%
    - Laboratories 10%
    - 2 Programming Projects 30%

INFO3435
E-COMMERCE
(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 Examination (2 hours)		60%
• Coursework:		40%
• In-course Test	10%	
• 3 Assignments	30%	

SWEN3000
APPLICATION DEVELOPMENT FOR iOS DEVICES
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
COMP2171 - Object Oriented Design and Implementation

Course Content:
1. **Introduction to development on MacOS's Xcode IDE**
2. **Introduction to Swift:** Types, literals and subscripting Initializers, properties, instance methods; Optionals; Loops; String interpolation; Enumerations and raw values; Classes and methods; Inheritance, polymorphism, dynamic typing, dynamic binding; arrays, set, dictionaries; categories and protocols.
3. **Xcode and Interface builder:** Application lifecycle; Xib, Storyboard, and interface builder; creating and building simple applications; UIState preservation; view application sandbox and crash logs.
4. **Cocoa Design Patterns:** Model, View and Controller (MVC) classes; Delegate and data source; Singleton pattern; Observer pattern; Target-action; Cocoa coding standards.
5. **Views and the view hierarchy:** the view hierarchy; creating a new project; views and frames; Labels; The Auto Layout System; Constraints in Interface Builder; Intrinsic content size; Misplaced views.

6. **Memory Management:** alloc, init, retain, release; Auto-release pool.
7. **Text input and delegation:** Text editing; keyboard attributes; responding to text field changes; dismissing the keyboard, number formatters; delegation; conforming to a protocol; using a delegate.
8. **View controllers:** View of view controller; Setting the initial view controller; UITabBarController; Tab bar items; Loaded and appearing views; Accessing subviews; Interacting with view controllers and their views.
9. **Interaction with UIControls:** Button, label, text fields; Switch, slider, progress bar; Alerts, action sheet; Tableviews; Scrollview, Web view; Maps; Searchbar, Popovers; Picker, Date picker, ImageView, ImagePicker Controller; Gestures.
10. **UITableView and UITableViewController**: UITableViewController; subclassing UITableViewController; Item classes; Custom initializers; UITableView's Data Source; Implementing data source methods; Creating and retrieving UITableViewCells; Reusing UITableViewCells; Content insets; Editing UITableView; User Alerts
11. **Orientation and iOS Device sensors:** the accelerometer; Detecting shakes; Determining orientation; Responding to the accelerometer.
12. **Testing and debugging**

Evaluation:

- Coursework: 100%
    - 3 programming assignments (10, 10, 30%) 50%
    - One written supporting report for programming assignments 30%
    - Two quizzes 20%

SWEN3001
ANDROID APPLICATION DEVELOPMENT I
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
COMP2171 - Object Oriented Design and Implementation **AND**
COMP3161 - Introduction to Database Management Systems

Course Content:
1. Android platform and architecture
2. Android user interface, layouts, views and GUI controls
3. Menus, Action Bar Menus, Toasts
4. Adapters, Dialogs, Intents
5. Storing and Retrieving Data: internal and external storage, preferences, SQLite Database
6. File Storage
7. Content Providers
8. Fragments

9. Developing for the Android marketplace
10. Java Programming: The Object class and its methods; Wrapper classes for primitive types; Inner and nested classes; The String, Stringbuffer and String Tokeniser classes, String processing; Handling files, input, output and serialisation, building database applications with JDBC; Localisation and Internationalisation, processing dates and time; Regular expressions; Exception handling and assertions; Multithreading and concurrency; Java collections framework; Graphical User Interface development using Swing; Java 5 features: enumerations, enhanced for loop, formatted output, Scanner autoboxing and unboxing of primitives, generic types, variable-length argument lists; JDK tools and deploying applications.

Evaluation:

- Coursework: 100%
    - A standalone Android application for the Android marketplace that uses the Android user interface, controls and local storage mechanisms 60%
    - A supporting report for the Android application 30%
    - An oral presentation 10%

SWEN3002
ANDROID APPLICATION DEVELOPMENT II
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
SWEN3001 - Android Application Development I

Course Content:

1. Android Application Components: activities, broadcast receivers, services, notification manager
2. Mobile Web Applications: web apps overview, targeting screens from web apps, WebView, debugging web apps, best practices for web apps
3. Best Practices for Android Development: compatibility, supporting multiple screens, optimizing for other Android versions
4. Asynchronous Tasks: main UI thread, using AsyncTask
5. Accessing Remote Services: HTTP, DOM parsing, SAX parsing, JSON parsing, Android and distributed agent software systems
6. Server-side concepts
7. Client access to software agent system
8. Connectivity using, for example, Bluetooth, NFC, Wireless
9. Testing strategies

Evaluation:

- Coursework: 100%
  - Three (3) programming assignments (10%, 10%, 30%) 50%
  - One individual report (critical appraisal of programming exercises) 30%
  - Two (2) quizzes, 10% each 20%

SWEN3003
WEB & MOBILE APPLICATION DEVELOPMENT I
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
SWEN1005 - Mobile Web Programming **AND**
COMP2171 - Object Oriented Design and Implementation **AND**
COMP3161 - Introduction to Database Management Systems

Course Content:

1. The Web
2. Web application architectures (e.g. MVC)
3. Interface design for web applications
4. Server-side components (e.g. Java servlets, Java Server Pages)
5. Manipulating a relational database from within a Java program, including PL-SQL and stored procedures
6. Session management
7. Scopes
8. Scope attributes
9. Request dispatching
10. Java application clients
11. Design patterns for web applications and data sources
12. Overview other frameworks (e.g.,JavaServer Faces, Struts).

Evaluation:

- Coursework: 100%
  - A component-based Web application (Design and implement a component-based Web application that provides dynamically generated responses to user actions) 50%
  - Supporting report 30%
  - Two quizzes (10% each) 20%

SWEN3004
WEB & MOBILE APPLICATION DEVELOPMENT II
(3 Credits) (Level 3) (Semester 2)

Pre-requisite:
SWEN3003 - Web & Mobile Application Development I

Course Content:
1. The Android platform
2. Development environment for Android
3. Mobile application design
4. Interface design for mobile applications
5. Android software stack
6. Android application lifecycle
7. Activities & Intents
8. Services
9. Broadcast receivers
10. Content providers
11. SQLite database
12. On-phone resources: GPS, Telephony, Audio & video, Sensors, Connectivity
13. Business application development: an Android app as a rich client communicating with a server-side application

Evaluation:
- Coursework: 100%
  - A mobile Web application assignment (this application must interact with a Web application) 50%
  - A written supporting report 30%
  - Two quizzes (10% each) 20%

SWEN3120
SOFTWARE ARCHITECTURE
(3 Credits) (Level 3) (Semester 1)

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

Course Content:
1. **Software Architecture Concepts:** Architecture Trade-off Analysis Method (ATAM); Quality attribute trade-offs; Executing ATAM evaluation
2. **Architecture Design and Analysis:** Architectural Patterns and Tactics; Software architecture analysis concepts; Quality Attributes Workshop (QAW); Quality attribute scenarios; Attribute Driven Design (ADD)

3. **Architectural Documentation:** Principles of sound documentation; Using UML and other methods of documenting architecture; View types, styles and views; Choosing relevant views; Refinement; Interface documentation; Templates; Providing Justification for architecture to clients and developers (presentations and writing)
4. **Evaluating Software Architecture:** Architecture Trade-off Analysis Method (ATAM); Quality attribute trade-offs; Executing ATAM evaluation

Evaluation:

- Final Examination (2 hours) 40%
- Coursework: 60%
    - Determine architectural drivers for a software-reliant system (group work) 15%
    - Document the software architecture (group work) 15%
    - Evaluate the software architecture (group work) 15%
    - 2 In-course tests (1 hour each)(7.5% each) 15%

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

SWEN3145
SOFTWARE MODELLING
(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 Modelling (Entity-Relationship Modelling, Class Diagrams); Behavioural Modelling (Structured Analysis, State Diagrams, Use Case Analysis, Interaction Diagrams, Failure Modes and Effects Analysis); Structure Modelling (Architectural); Domain Modelling (Domain Engineering Approaches); Functional Modelling (Component Diagrams).

Evaluation:
- Final 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 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 Modelling and Analysis (Model Checkers, Model Finders); Tools in Support of Formal Methods.

Evaluation:

- Final Examination (2 hours) 40%
- Coursework: 60%
    - Assignments/Quizzes 10%
    - Labs 10%
    - 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 Modelling.

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%

SWEN4001
ADVANCED DATABASE SYSTEMS

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

Pre-requisite:
COMP3161- Introduction to Database Management Systems

Course Content:

1. Advanced database architectures, N-Tier, Grid Computing, Distributed Databases
2. Data Models, Relational and Object-Relational technologies, query languages including advanced SQL and Object SQL
3. Advanced Design and design issues; database development and performance
4. Current trends in Database development, including knowledge management, web and mobile databases; database issues for complex data including forensic and biometric data
5. Data mining
6. Analytics

Evaluation:

- Coursework: 100%
    - Two assignments (10% and 40%) 50%
    - One research paper (future trends of database technologies) 30%
    - Two quizzes (10% each) 20%

SWEN4002
I.T. CERTIFICATION I

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

Pre-requisite:
None

Course Content:
The course content will depend upon the specific certification/course pursued.

Evaluation:
The course assessment methods will be determined by the specific certification body.

DEPARTMENT OF GEOGRAPHY & GEOLOGY

PROGRAMMES

MAJORS

1. **Applied Geography**
2. **Geography**
3. **Geology**
4. **Geosciences**

MINORS

1. **Geography**
2. **Geology**
3. **Human Geography**
   (for non-Geography & Applied Geography majors)

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				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
		LEVEL 1		
GEOG1131	Human Geography 1: Population, Migration & Human Settlement	3	1	FST Matriculation Requirements and Geography at CSEC or its equivalent
GEOG1132	Human Geography 2: World Economy, Agriculture & Food	3	2	FST Matriculation Requirements and Geography at CSEC or its equivalent
GEOG1231	Earth Environments 1: Geomorphology & Soils	3	1	FST Matriculation Requirements and Geography at CSEC or its equivalent
GEOG1232	Earth Environments 2: Climate & the Biosphere	3	2	FST Matriculation Requirements and Geography at CSEC or its equivalent
		LEVEL 2		
BIOL2408	Diving for Scientists	3	4 (Summer)	Recommended for students wishing to take GGEO3232 in their third year
GEOG2131	Urban Geographies	3	1	GEOG1131 **AND** GEOG1132
GEOG2132	Geographies of Development	3	2	GEOG1131 **AND** GEOG1132
GEOG2231	Earth Surface Processes	3	1	GEOG1231 **AND** GEOG1232
GEOG2232	Environmental Change	3	2	GEOG1231 **AND** GEOG1232
GEOG2331	Research Methods in Geography	3	1	**ALL FOUR**: GEOG1131 /GEOG1132 / GEOG1231 / GEOG1232
GEOG2333	Research Design & Management	3	3 (Summer)	***Applied Geography Major only*** Permission of HOD or Undergraduate Coordinator required GEOG2231 **AND GPA>2.5**

UNDERGRADUATE GEOGRAPHY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
GGEO2233	Water Resources	3	1	[GEOG1231 and GEOG1232] **OR** [GEOL1102 and GEOL1104]
GGEO2234	Natural Hazards and Society	3	1	**ONE** of: [GEOG1231/GEOG1232] **AND** **ONE** of: [GEOG1131/GEOG1132] **OR**: [GEOL1102 and GEOL1104]
GGEO2332	Introduction to Geographical Information Systems	3	2	**TWO** of: [GEOG1131/GEOG1132/GEOG1231/ GEOG1232] **OR** **TWO of:** [GEOL1101/GEOL1102/GEOL1103/GEOL1104]
LEVEL 3				
GEOG3131	Tropical Agricultural & Development	3	1	GEOG2132
GEOG3132	Tourism Planning & Development	3	2	GEOG2131 **OR** GEOG2132
GEOG3331	Capstone: Geography of the Caribbean	3	1	**THREE** of: [GEOG2131, GEOG2132, GEOG2231, GEOG2232]
GEOG3333	Urban and Regional Planning	3	2	GEOG2131
GEOG3334	Tropical Land Management	3	1	GEOG2231, GEOG2232 **AND** GEOG2132
GEOG3430	Geography Research Project	6	1 and 2	**Applied Geography Major only.** GEOG2331 **AND** GGEO2332 **AND TWO** from: [GEOG2131, GEOG2132, GEOG2231, GEOG2232]
GGEO3105	Applied GIS and Remote Sensing	3	4 (Summer)	GGEO2232 **OR** HOD Approval

UNDERGRADUATE GEOGRAPHY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
GGEO3231	Karst & Coastal Geomorphology	3	2	GEOG2231 **OR** GEOL2202
GGEO3232	Climate Change in the Tropics	3	1	GEOG2232 **OR** **any ONE of**: GEOL2201, GEOL2202, GEOL2203, GEOL2204, GEOL2205, **OR** Permission of HOD
GGEO3233	Hydrology & Hydrological Modelling	3	2	GGEO2233
GGEO3332	Disaster Risk Management and Development Planning	3	2	GGEO2234 **OR** Permission of HOD
GGEO3401	Research Project in Geosciences	6	1 and 2	GEOL2204 **AND** GGEO2332 **AND** any **THREE** of: GEOG2231, GEOG2232, GEOL2201, GEOL2205, GGEO2233 *Students must be pursuing the Major in Geosciences*
GEOG3433	Geography Internship and Work Experience	3	3 (Summer)	Major in Geography and Major in Applied Geography GEOG2331 Research Methods in Geography AND HOD Approval

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
		LEVEL 1		
GEOL1101	Earth Science 1: Earth Materials & Plate Tectonics	3	1	FST Matriculation Requirements
GEOL1102	Earth Science 2: Earth Processes & Earth History	3	1	FST Matriculation Requirements
GEOL1103	Earth Science 3: Minerals & Mineral Deposits	3	2	FST Matriculation Requirements
GEOL1104	Earth Science 4: Geological Maps & Environmental Geology	3	2	FST Matriculation Requirements
		LEVEL 2		
GEOL2201	Palaeontology & the History of Life	3	2	[GEOL1101 **AND** GEOL1102] OR [BIOL1262 **AND** BIOL1263]
GEOL2202	Sedimentary Geology	3	1	GEOL1101 **AND** GEOL1102
GEOL2203	Petrology of Igneous & Metamorphic Rocks	3	2	GEOL1101 **AND** GEOL1103
GEOL2204	Field Techniques for Geology	3	1 and 2	GEOL1101 **AND** GEOL1102 **AND** GEOL1104 *Geology and Geosciences Majors Only*
GEOL2205	Plate Tectonics & Geological Structures	3	1	GEOL1101 **AND** GEOL1102 **AND** GEOL1104
GGEO2233	Water Resources	3	1	[GEOG1231 **AND** GEOG1232] **OR** [GEOL1102 **AND** GEOL1104]

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
GGEO2234	Natural Hazards and Society	3	1	**ONE of:** [GEOG1231/GEOG1232] **AND** **ONE of:** [GEOG1131/GEOG1132] **OR** [GEOL1102 and GEOL1104]
GGEO2332	Introduction to Geographical Information Systems	3	2	**TWO of:** [GEOG1131, GEOG1132, GEOG1231, GEOG1232] **OR** **TWO of:** [GEOL1101, GEOL1102, GEOL1103, GEOL1104]
		LEVEL 3		
GEOL3100	Research Project in Field Geology	6	1 and 2	GEOL2204 **AND** any **THREE** of: [GEOL2201, GEOL2202, GEOL2203, GEOL2205, GGEO2233]
GEOL3102	Capstone: Caribbean Geology	3	1	GEOL2205 **AND** any **ONE** of: [GEOL2201, GEOL2202, GEOL2203, GEOL2204, GGEO2233]
GEOL3104	Sedimentology & Facies Analysis	3	2	GEOL2202 **AND** any **ONE** of: [GEOL2201, GEOL2203, GEOL2204, GEOL2205, GGEO2233]
GEOL3105	Petroleum Geology	3	2	GEOL2204 **AND** any **ONE** of: [GEOL2201, GEOL2203, GEOL2205, GGEO2233]

UNDERGRADUATE GEOLOGY COURSES OFFERED BY THE DEPARTMENT OF GEOGRAPHY AND GEOLOGY				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
GEOL3107	Geophysics & Seismicity	3	1	GEOL2204 **AND** any **ONE** of: [GEOL2201, GEOL2202, GEOL2203, GEOL2205, GGEO2233]
GEOL3108	Metallic Ores & Industrial Minerals	3	1	GEOL2203 **AND** any **ONE** of: [GEOL2201, GEOL2202, GEOL2204, GEOL2205, GGEO2233]
GGEO3105	Applied GIS & Remote Sensing	3	4 (Summer)	GGEO2232 **or HOD Approval**
GGEO3231	Karst & Coastal Geomorphology	3	2	GEOG2231 **OR** GEOL2202
GGEO3232	Climate Change in the Tropics	3	1	GEOG2232 **OR** any **ONE** of: GEOL2201, GEOL2202, GEOL2203, GEOL2204, GEOL2205, or Permission of HOD
GGEO3233	Hydrology & Hydrological Modelling	3	2	GGEO2233
GGEO3332	Disaster Risk Management and Development Planning	3	2	GGEO2234 **OR** Permission of HOD
GGEO3401	Research Project in Geosciences	6	1 and 2	GEOL2204 **AND** GGEO2332 **AND** any **THREE** of GEOG2231, GEOG2232, GEOL2201, GEOL2205, GGEO2233 *Students must be pursuing the Major in Geosciences*

PROGRAMME DETAILS

APPLIED GEOGRAPHY (MAJOR)		
Introductory Courses (Level 1)	**A major in Applied Geography requires a total of twelve (12) Level 1 credits from:**	
	GEOG1131	Human Geography 1: Population, Migration and Human Settlement
	GEOG1132	Human Geography 2: World Economy, Agriculture and Food
	GEOG1231	Earth Environments 1: Geomorphology and Soils
	GEOG1232	Earth Environments 2: Climate and the Biosphere
Advanced Courses (Levels 2 and 3)	**A major in Applied Geography requires a GPA of >2.5 at level 2 AND a total of thirty (30) credits from Levels 2 and 3, fifteen (15) of which must be Level 3:**	
	GEOG2131	Urban Geographies
	GEOG2132	Geographies of Development
	GEOG2231	Earth Surface Processes
	GEOG2232	Environmental Change
	GEOG2333	Research Design and Management (Compulsory)
	GGEO2233	Water Resources
	GGEO2234	Natural Hazards and Society
	GGEO2331	Research methods in Geography (Compulsory)
	GGEO2332	Introduction to Geographical Information Systems
	BIOL2408	Diving for Scientists (Recommended for students doing GGEO3232)
	AND a minimum of nine (9) credits from below:	
	GEOG3131	Tropical Agriculture and Development
	GEOG3132	Tourism Planning and Development
	GEOG3331	Capstone: Geography of the Caribbean
	GEOG3333	Urban and Regional Planning
	GEOG3334	Tropical Land Management
	GEOG3430	Research Project in Geography (Compulsory)
	GEOG3433	Geography Internship and Work Experience (with HOD permission, space available)
	GGEO3105	Applied GIS and Remote Sensing
	GGEO3231	Karst and Coastal Geomorphology
	GGEO3232	Climate Change in the Tropics
	GGEO3233	Hydrology and Hydrological Modelling
	GGEO3332	Disaster Risk Management and Development Planning

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
	GEOG1132	Human Geography 2: World Economy, Agriculture and Food
	GEOG1231	Earth Environments 1: Geomorphology and Soils
	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:**	
	GEOG2131	Urban Geographies
	GEOG2132	Geographies of Development
	GEOG2231	Earth Surface Processes
	GEOG2232	Environmental Change
	GGEO2233	Water Resources
	GGEO2234	Natural Hazards and Society
	GGEO2331	Research Methods in Geography (Compulsory)
	GGEO2332	Introduction to Geographical Information Systems
	BIOL2408	Diving for Scientists (Recommended for students doing GGEO3232)
	AND a minimum of nine (9) credits from below:	
	GEOG3131	Tropical Agriculture and Development
	GEOG3132	Tourism Planning and Development
	GEOG3331	Capstone: Geography of the Caribbean
	GEOG3332	Disaster Risk Management and Development Planning
	GEOG3333	Urban and Regional Planning
	GEOG3334	Tropical Land Management
	GEOG3433	Geography Internship and Work Experience (Compulsory)
	GGEO3105	Applied GIS and Remote Sensing
	GGEO3231	Karst and Coastal Geomorphology
	GGEO3232	Climate Change in the Tropics
	GGEO3233	Hydrology and Hydrological Modelling

<table>
<tr><th colspan="3">GEOLOGY (MAJOR)</th></tr>
<tr><td rowspan="5">Introductory Courses (Level 1)</td><td colspan="2">A major in Geology requires a total of twelve (12) 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 rowspan="24">Advanced Courses (Levels 2 and 3)</td><td colspan="2">A major in Geology requires a total of thirty-nine (39) credits from Levels 2 and 3 and must include:</td></tr>
<tr><td colspan="2">Level 2: 18 credits</td></tr>
<tr><td>GEOL2204</td><td>Field Methods for Geology (Compulsory)</td></tr>
<tr><td colspan="2">AND a minimum of five courses from below:</td></tr>
<tr><td>GEOL2201</td><td>Palaeontology</td></tr>
<tr><td>GEOL2202</td><td>Sedimentary Geology</td></tr>
<tr><td>GEOL2203</td><td>Igneous and Metamorphic Petrology</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: 21 credits</td></tr>
<tr><td>GEOL3100</td><td>Research Project in Field Geology (Compulsory)</td></tr>
<tr><td>GEOL3102</td><td>Caribbean Geology (Compulsory)</td></tr>
<tr><td colspan="2">AND a minimum of four (4) courses from below:</td></tr>
<tr><td>GEOL3104</td><td>Sedimentology and Facies Analysis</td></tr>
<tr><td>GEOL3105</td><td>Petroleum Geology</td></tr>
<tr><td>GEOL3107</td><td>Geophysics and Seismicity</td></tr>
<tr><td>GEOL3108</td><td>Metallic Ores and Industrials Minerals</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>
<tr><td>GGEO3233</td><td>Hydrology and Hydrological Modelling</td></tr>
<tr><td>GGEO3332</td><td>Disaster Risk Management and Development Planning</td></tr>
</table>

GEOSCIENCES (MAJOR)		
Introductory Courses (Level 1)	**A major in Geosciences requires a total of twenty-four (24) Level 1 credits from:**	
	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
	GEOG1131	Human Geography 1: Population, Migration and Human Settlement
	GEOG1132	Human Geography 2: World Economy, Agriculture and Food
	GEOG1231	Earth Environments 1: Geomorphology and Soils
	GEOG1232	Earth Environments 2: Climate and the Biosphere
Advanced Courses (Levels 2 and 3)	**A major in Geosciences requires a total of forty-two (42) credits from Levels 2 and 3 and must include:**	
	Level 2: 24 credits	
	GEOG2231	Earth Surface Processes
	GEOG2232	Environmental Change
	GEOL2201	Palaeontology
	GEOL2202	Sedimentary Geology
	GEOL2204	Field Methods for Geology
	GEOL2205	Plate Tectonics and Geologic Structures
	GGEO2233	Water Resources
	GGEO2332	Introduction to Geographical Information Systems
	Level 3: 18 credits	
	GGEO3401	Field Projects in Geosciences (Compulsory)
	AND a minimum of 12 credits, at least 6 must be GGEO from:	
	GEOL3104	Sedimentology and Facies Analysis
	GEOL3105	Petroleum Geology
	GGEO3231	Karst and Coastal Morphology
	GGEO3232	Climate Change in the Tropics
	GGEO3233	Hydrology and Hydrological Modelling
	GGEO3332	Disaster Risk Management and Development Planning

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
	GEOG1132	Human Geography 2: World Economy, Agriculture and Food
	GEOG1231	Earth Environments 1: Geomorphology and Soils
	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	Environmental Change
	GGEO2233	Water Resources
	GGEO2234	Natural Hazards and Society
	GGEO2332	Introduction to Geographical Information Systems
	GEOG3131	Tropical Agriculture and Development
	GEOG3132	Tourism Planning and Development
	GEOG3331	Capstone: Geography of the Caribbean
	GEOG3333	Urban and Regional Planning
	GGEO3231	Karst and Coastal Geomorphology
	GGEO3232	Climate Change in the Tropics
	GGEO3332	Disaster Risk Management and Development Planning

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 Risk Management and Development Planning

HUMAN GEOGRAPHY (MINOR)		
Introductory Courses (Level 1)	**FOR NON-FST AND FST STUDENTS NOT MAJORING IN GEOGRAPHY OR APPLIED GEOGRAPHY 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	Capstone: Geography of the Caribbean
	GEOG3333	Urban and Regional Planning

COURSE DESCRIPTIONS

GEOGRAPHY COURSES

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 Examination (2 hours) 60%
- Coursework: 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 Examination (2 hours) 60%
- Coursework: 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 Examination (2 hours) 60%
- Coursework: 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 Examination (2 hours) 60%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 50%
    - 2, 1250 -Word Essays 10%
    - 2500-Word Field Report 10%
    - 2 Practical Assignments 10%
    - In-course Test (1 hour) 20%

GEOG2232
ENVIRONMENTAL 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 Examination (2 hours) 50%
- Coursework: 50%
    - 2 Essays 25%
    - Practical Work 25%

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

GEOG2333
RESEARCH DESIGN AND MANAGEMENT
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
Applied Geography Programme only (Permission of HOD required)
GEOG2231 - Research Methods in Geography **AND** GPA>2.5

Course Content:
This course will provide opportunities for students to design research projects and to consider the significance of a range of issues associated with the process (practical, ethical and intellectual). These are relevant concerns to successful research planning and management in geography. These aims will be achieved through training in the management of research, research ethics; the effective dissemination of research; the relevance of data management and data analysis, and the technical presentation of results. Students will explore how to connect and manage research to enhance its impact, from defining an effective research strategy to the wider dissemination and application of results. The course includes defining research topic and specific objectives, accessing scientific literature, research project planning, research ethics and integrity. Emphasis is placed on the development of high level written and communication skills that are integral to the research process. Students will gain an understanding of the essential elements of academic and scientific writing, including clarity, precision and the use of discipline-specific structure and style and the course will be responsive to the specific research interests of students.

Evaluation:

- Two Research Skills Assignments 30%
- Research Proposal 25%
- Presentation of Research Proposal 20%
- Multiple choice test (1 hour) 25%

<u>GGEO2233</u>
<u>WATER RESOURCES</u>
(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 Examination (2 hours) 50%
- Coursework: 50%
    - 2 In-course Test (1 hour) 20%
    - Practical Examination (2 hours) 30%

<u>GGEO2234</u>
<u>NATURAL HAZARDS AND SOCIETY</u>
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1231- Earth Environments 1: Geomorphology & Soils **or**
GEOG1232 - Earth Environments 2: Climate & The Biosphere **AND**
GEOG1131 - Human Geography 1 **or** GEOG1132 Human Geography 2 **OR**
GEOL1102 - Earth Science 2: Earth Processes and Earth History **and**
GEOL1104 - Earth Science 4: Geological Maps and Environmental Geology.

Course Content:
The purpose of this course is to create opportunities for students to develop a comprehensive knowledge of the physical properties and dynamics of natural hazards within the context of disaster management and risk reduction. The course is an essential prerequisite for GEOG3332 Disaster Risk Management and Development Planning designed for students to develop their expertise in the field of disaster management.

Small Island Developing States (SIDS) are vulnerable to natural hazards, the most devastating of which are hurricanes, volcanic eruptions and earthquakes. Climate related hazards such as the recent passage in 2017 of Hurricanes Irma and Maria have been constant threats to Caribbean islands causing severe devastation to the islands of Dominica, Puerto Rico and Barbuda, rendering the latter island uninhabitable. Consequently, there is an urgent need for stakeholders to understand the risks associated with these hazards and to adopt appropriate strategies to manage or mitigate such risks.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
  - 3 Lab Classes and Reports 30%
  - Field Report 20%

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.
OR
HOD Approval

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 functionalities of GIS software applications such as ArcGIS Online, QGIS, ArcMap, ArcCatalog, and ArcToolbox.

Evaluation:

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

GEOG3131
TROPICAL AGRICULTURE & DEVELOPMENT
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
GEOG2132 - Geographies of Development.

Course Description:
Tropical Agriculture and Development introduces students to the economic and environmental processes that drive changes in tropical agricultural systems. The course explores these processes affecting agriculture and the rural communities linked to agricultural systems. More critically, it provides an analytical framework for how farmers manage their livelihood assets and resources and adapt to changes. The course also provides a historical overview of tropical agriculture and rural communities in the Caribbean while introducing students to current research in global change and Caribbean agriculture, especially research undertaken in the Department of Geography and Geology.

Evaluation:

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

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

Pre-requisites:
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 and 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 Examination (2 hours) 50%
- Coursework: 50%
  - Tutorial Essay 5%
  - Multimedia Presentation 5%
  - Tourism Development Plan 20%
  - In-course Test (1 hour) 20%

GEOG3331
CAPSTONE: GEOGRAPHY OF THE CARIBBEAN
(3 Credits) (Level 3) (Semester 2) – Compulsory Capstone Course

Pre-requisites:
Any three of:
GEOG2131 - Urban Geographies,
GEOG2132 - Geographies of Development,
GEOG2231 - Earth Surface Processes **OR** GEOG2232 - Environmental Change.

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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 - Environmental Change **AND**
GEOG2131 - Urban Geographies.

Course Description:
This course will focus on the use and management of the land resource in the semi-arid, the seasonal wet-dry and the humid tropics. The course will also explore why many tropical soils are susceptible to the processes of soil and geomorphological degradation. Hazards associated with the human use of tropical soils, such as irrigation and salinization, soil erosion and slope failure, and desertification will also be discussed, as well as the consequences of deforestation for land-use. Methods of soil erosion and land degradation assessment will be examined as

practical examples of monitoring, modelling and management of land-use problems.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - Practical Exercises 15%
    - Tutorial Essay Assignments (7.5% each) 15%
    - Field Report 20%

<u>GEOG3430</u>
<u>RESEARCH PROJECT IN GEOGRAPHY</u>
(6 Credits) (Level 3) (Year-Long)
Available to students of the Applied Geography Programme ONLY

Pre-requisites:
GEOG2331- Research Methods in Geography **AND**
GEOG2333 Research Design and Management

Course Content:
The course involves a series of steps in which the student progresses 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 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 proceed 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%
- Coursework: 20%
    - Project Proposal: 0%
      (necessary to continue but zero-rated)
    - Progress Report: 0%
      (necessary to continue but zero-rated)
    - Oral Presentation 20%

GEOG3433

GEOGRAPHY INTERNSHIP AND WORK EXPERIENCE – Compulsory for Major in Geography and available for Major in Applied Geography

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

Pre-requisites:

GEOG2231 - Research Methods in Geography **AND**
HOD Approval (on availability of host companies/institutions)

Course Content:

The internship course will provide a competitive advantage for students planning to enter the workplace directly upon completion of their Major in Geography Programme. Internships are practical learning opportunities that allow students to gain credit for working (usually unpaid) with the government, private industry or non-governmental organizations. These opportunities form an integral part of the Major in Geography Programme at UWI and enable students to apply their academic skills to a variety of work environments. As part of their internship students will have the opportunity to foster skills that are difficult to develop in a classroom environment such as organizational and administrative skills as well as professional interpersonal communication.

Evaluation:

- Performance Evaluation by employer 25%
- Oral presentation 15%
- Curriculum Vitae and Interview 10%
- Internship Report 50%

GGEO3105

APPLIED GIS & REMOTE SENSING

(3 Credits) (Level 2) (Summer)

Pre-requisite:

GGEO2332 - Introduction to GIS **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%

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

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

Pre-requisites:
GEOG2232 - Environmental 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 Examination (2 hours) 50%
- Coursework: 50%
  - 1 Oral Presentation 10%
  - Laboratory Report (about 2500 words) 20%
  - 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 model 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 Examination (2 hours) 50%
- Coursework: 50%
  - Field Trip Report 10%
  - 1 Laboratory Report 40%

GGEO3332
DISASTER RISK MANAGEMENT AND DEVELOPMENT PLANNING
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GGEO2234 Natural Hazards and Society
or Permission of Head of Department.

Course Content:
Recent impacts of disasters globally, regionally and nationally have emphasized the need to safeguard human lives and property. Demographic changes, urbanization, human settlement patterns, land-use practices and political and social dynamics have each exacerbated the vulnerability of SIDS to the effects of natural and man-made disasters. This course introduces students to the basic principles and techniques in disaster risk management. It examines how vulnerability and hazard interact to create disasters and how planning processes and interventions can help reduce disaster vulnerabilities and increase resilience at every stage of the disaster management cycle including disaster mitigation, preparation, response, and recovery. The course further assesses the international, national and local frameworks, approaches, and methods for disaster prevention, preparedness and vulnerability reduction such as the Hyogo Framework for Action, the Sendai Framework for Disaster Risk Reduction, the Comprehensive Disaster Risk Reduction Framework and the Community based disaster risk management framework.

Evaluation:
- Final Examination (2 hours) 50%
- Coursework: 50%
    - 1-hour Mid-semester Test 20%
    - Project Report 30%

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

GEOLOGY COURSES

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 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 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 Examination (2 hours) 50%
- Coursework: 50%
    - Field Projects 10%
    - 4 Practical Assignments 40%

<u>GEOL2204</u>
<u>FIELD TECHNIQUES FOR GEOLOGY</u>
(3 Credits) (Level 2) (Semester 1 & 2*)
Available for the Geology and the Geosciences Majors Only.

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%

<u>GEOL2205</u>
<u>PLATE TECTONICS & GEOLOGICAL STRUCTURES</u>
(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 on 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 Examination (2 hours) 50%
- Coursework: 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 (2) 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 (2) 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 Examination (2 hours) 50%
- Coursework: 50%
    - In-course Test 20%
    - 6 Laboratory Exercises 30%

<u>GGEO2233</u>
<u>WATER RESOURCES</u>
(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 Examination (2 hours) 50%
- Coursework: 50%
  - Practical Examination (2 hours) 20%
  - In-course Test (1 hour) 30%

<u>GGEO2234</u>
<u>NATURAL HAZARDS AND SOCIETY</u>
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
GEOG1231- Earth Environments 1: Geomorphology & Soils **or**
GEOG1232 - Earth Environments 2: Climate & The Biosphere **AND**
GEOG1131 - Human Geography 1 **OR** GEOG1132 Human Geography 2 **OR**
GEOL1102 - Earth Science 2: Earth Processes and Earth History **AND**
GEOL1104 - Earth Science 4: Geological Maps and Environmental Geology.

Course Content:
The purpose of this course is to create opportunities for students to develop a comprehensive knowledge of the physical properties and dynamics of natural hazards within the context of disaster management and risk reduction. The course is an essential prerequisite for the proposed new third-year elective course GEOG3332 Disaster Risk Management and Development Planning designed for

those students wishing to develop their expertise within the growing field of disaster management.

Small Island Developing States (SIDS) are vulnerable to natural hazards, the most devastating of which are hurricanes, volcanic eruptions and earthquakes. Climate related hazards such as the recent passage in 2017 of Hurricanes Irma and Maria have been constant threats to Caribbean islands causing severe devastation to the islands of Dominica, Puerto Rico and Barbuda, rendering the latter island uninhabitable. Consequently, there is an urgent need for stakeholders to understand the risks associated with these hazards and to adopt appropriate strategies to manage or mitigate such risk.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - 3 lab classes and reports 30%
    - Field Report 20%

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

Pre-requisites:
GEOL2204 - Field Techniques 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 - Water Resources.

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 - Water Resources.

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

Evaluation:
- Final Examination (2 hours) 70%
- Coursework: 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 - Water Resources.

Course Content:
Advanced sedimentology; Facies analysis.

Evaluation:
- Final Examination (2 hours) 50%
- Coursework: 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 - Water Resources.

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 Examination (2 hours) 50%
- Coursework: 50%
    - Field Notebook 10%
    - 4 Laboratory Practicals 40%

GEOL3107
GEOPHYSICS & SEISMICITY
(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 Examination (2 hours) 50%
- Coursework: 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 - Water Resources.

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 Examination (2 hours) 50%
- Coursework: 50%
    - Laboratory Exercises on mineral identification 10%
    - Laboratory Exercises on Resource Assessment 10%
    - Seminar and Class Discussion 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%

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 Examination (2 hours) 50%
- Coursework: 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 - Environmental 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 Examination (2 hours)		50%
• Coursework:		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 Examination (2 hours) 50%
- Coursework: 50%
    - Field Trip Report 10%
    - Laboratory Reports 40%

GGEO3332
DISASTER RISK MANAGEMENT AND DEVELOPMENT PLANNING
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
GGEO2234 - Natural Hazards and Society
OR Permission of Head of Department.

Course Content:
Recent impacts of disasters globally, regionally and nationally have emphasized the need to safeguard human lives and property. Demographic changes, urbanization, human settlement patterns, land-use practices and political and social dynamics have each exacerbated the vulnerability of SIDS to the effects of natural and man-made disasters. This course introduces students to the basic principles and techniques in disaster risk management. It examines how vulnerability and hazard interact to create disasters and how planning processes and interventions can help reduce disaster vulnerabilities and increase resilience at every stage of the disaster management cycle including disaster mitigation, preparation, response, and recovery. The course further assesses the international, national and local frameworks, approaches, and methods for disaster prevention, preparedness and vulnerability reduction such as the Hyogo Framework for Action, the Sendai Framework for Disaster Risk Reduction, the Comprehensive Disaster Risk Reduction Framework and the Community based disaster risk management framework.

Evaluation:

- Final Examination (2 hours) 50%
- Coursework: 50%
    - 1-hour Mid-Semester Test 10%
    - Project Report 40%

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 - Environmental Change,
GEOL2201 - Palaeontology & the History of Life,
GEOL2202 - Sedimentary Geology,
GEOL2205 - Plate Tectonics & Geological Structures **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

B.Sc.

1. **Biology with Education**
2. **Environmental Biology**
3. **Experimental Biology**

MAJORS

1. **Animal Biology**
2. **Horticulture**
3. **Marine Biology**
4. **Plant Biology**
5. **Terrestrial and Freshwater Ecology**

MINORS

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

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

LEVEL 2 AND LEVEL 3

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

LEVEL 2 COURSES (10 courses available)

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

* Not offered 2023/2024 Academic year

LEVEL 3 COURSES					
Possible Slot Combinations: A+B, A+C, B+C **Impossible Slot Combinations:** A1+A2, B1+B2, C1+C2					
A1	A2	B1	B2	C1	C2
Tues/Thurs Mon/Fri	Tues/Thurs Mon/Fri	Fri/Mon	Fri/Mon	Mon	Mon/Fri
BOTN3401 Principles of Plant Biotechnology	**ZOOL3405** Vertebrate Biology	**ZOOL3403** Entomology	**ZOOL3409** Aquaculture*	**BIOL3407** Oceanography	**BOTN3403** Fundamentals of Horticulture
BOTN3405 Plant Eco-Physiology	**BIOL3410** Water Pollution	**ZOOL3404** Parasitology	**BOTN3406** Tropical Forest Ecology	**BIOL3408** Coastal Ecosystems	**BIOL3403** The Biology of Soil
BIOL3404 Virology	**ZOOL3063** Comparative Animal Physiology	**BIOL3405** Pest Ecology & Management	**ZOOL3407** Human Biology*	**ZOOL3408** Sustainable Use of Fishable Resources	**BIOL3406** Freshwater Biology
BOTN3407 Post-Harvest Technology	**BOTN3402** Plant Breeding	**ZOOL3406** Immunology	**BIOL3400** Issues in Conservation Biology	**BIOL3409** Caribbean Coral Reefs	**BOTN3404** Economic Botany
BIOL3412 - Internship | **BIOL3413** - Biology Project | **BIOL3414** - Advanced Topics in Life Sciences					

* Not offered 2023/2024 Academic year

PROGRAMME DETAILS

BIOLOGY WITH EDUCATION (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. 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. Biology with Education requires a total of sixty-three (63) credits from Level 2 and must include:**	
	BIOL2164	Principles of Molecular Biology
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	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 (60) credits from Levels 2 and 3 and must include:**	
	Level 2 - thirty (30) credits from:	
	BIOL2164	Principles of Molecular Biology
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	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: twelve (12) core credits	
	BIOL3400	Issues in Conservation Biology
	BIOL3406	Freshwater Biology
	BIOL3408	Coastal Ecosystems
	BOTN3405	Plant Ecophysiology
	Level 3: and at least eighteen (18) credits from:	
	BIOL2408	Diving for Scientists
	BIOL3402	Biology of Fungi
	BIOL3403	The Biology of Soil
	BIOL3405	Pest Ecology and Management
	BIOL3407	Oceanography
	BIOL3409	Caribbean Coral Reefs
	BIOL3410	Water Pollution Biology
	BIOL3412 or BIOL3413	Internship or Research Project
	BIOL3414	Advanced Topics in Life Sciences
	BOTN3406	Tropical Forest Ecology
	ZOOL3403	Entomology
	ZOOL3405	Vertebrate Biology
	ZOOL3407	Human Biology
	ZOOL3408	Sustainable Use of Marine Fishable Resources
	ZOOL3409	Aquaculture

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 (60) credits from Levels 2 and 3 and must include:**	
	Level 2: thirty (30) credits	
	BIOL2164	Principles of Molecular Biology
	BIOL2401	Research skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	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 (30) credits from the three groups below with a minimum of three (3) credits from each group.	
	GROUP A	
	BIOL3402	Biology of Fungi
	BIOL3403	The Biology of Soil
	BIOL3404	Virology
	BIOL3405	Pest Ecology and Management
	BIOL3407	Oceanography
	BIOL3410	Water Pollution Biology
	BIOL3414	Advanced Topics in Life Sciences
	GROUP B	
	BOTN3401	Principles of Plant Biotechnology
	BOTN3402	Introduction to Plant Breeding
	BOTN3403	Fundamentals of Horticulture
	BOTN3404	Economic Botany
	BOTN3405	Plant Ecophysiology
	BOTN3407	Post-Harvest Technology

	GROUP C	
	ZOOL3063	Comparative Animal Physiology
	ZOOL3403	Entomology
	ZOOL3404	Parasitology
	ZOOL3405	Vertebrate Biology
	ZOOL3406	Immunology
	ZOOL3407	Human Biology
	ZOOL3408	Sustainable Use of Marine Fishable Resources
	Plus BIOL3411 Research Project **OR** BIOL3413 - Biology Project **OR** BIOL3412 - Internship	

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 (30) credits from Levels 2 and 3 and must include:**	
	Level 2: minimum of fifteen (15) credits from:	
	BIOL2164	Principles of Molecular Biology
	BIOL2403	Principles of Ecology
	BIOL2407	Biological Evolution
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: minimum of nine (9) credits from:	
	ZOOL3403	Entomology
	ZOOL3404	Parasitology
	ZOOL3405	Vertebrate Biology
	And 6 credits from below:	
	BIOL3404	Virology
	BIOL3405	Pest Ecology and Management
	BIOL3413	Research Project
	BIOL3414	Advanced Topics in Life Sciences
	ZOOL3063	Comparative Animal Physiology
	ZOOL3406	Immunology

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 thirty (30) Levels 2 and 3 credits, and must include:**	
	Level 2: Minimum of fifteen (15) credits which must include:	
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	Level 3: Nine (9) credits of core courses:	
	BIOL3403	The Biology of Soil
	BIOL3405	Pest Ecology and Management
	BOTN3403	Fundamentals of Horticulture
	Level 3: And six (6) credits from:	
	BIOL3402	Biology of the Fungi
	BIOL3404	Virology
	BIOL3412	Internship
	BIOL3413	Biology Research Project
	BIOL3414	Advanced Topics in Life Sciences
	BOTN3401	Principles of Plant Biotechnology
	BOTN3402	Introduction to Plant Breeding
	BOTN3404	Economic Botany
	BOTN3405	Plant Ecophysiology
	BOTN3407	Post-harvest Technology

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:	
	BIOL2164	Principles of Molecular Biology
	BIOL2401	Research Skills and Practices in Biology
	BIOL2402	Fundamentals of Biometry
	BIOL2403	Principles of Ecology
	BIOL2406	Eukaryotic Microbiology
	ZOOL2403	Maintenance Systems in Animals
	ZOOL2404	Coordination and Control in Animals
	Level 3: Nine (9) credits of core courses	
	BIOL3407	Oceanography
	BIOL3408	Coastal Ecosystems
	BIOL3409	Caribbean Coral Reefs
	And nine (9) credits from:	
	BIOL2408	Diving for Scientists
	BIOL3410	Water Pollution Biology
	BIOL3412 or BIOL3413	Internship Biology Project
	ZOOL3405	Vertebrate Biology
	ZOOL3408	Sustainable Use of Marine Fishable Resources
	ZOOL3409	Aquaculture

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 Levels 2 and 3 and must include:**	
	Level 2: minimum of fifteen (15) credits from:	
	BIOL2164	Principles of Molecular Biology
	BIOL2401	Research Skills and Practices in Biology
	BIOL2403	Principles of Ecology
	BOTN2401	Plant Form and Systematics
	BOTN2402	Physiology of Plants
	Level 3: minimum of nine (9) credits from:	
	BOTN3401	Principles of Plant Biotechnology
	BOTN3404	Economic Botany
	BOTN3405	Plant Ecophysiology
	And six (6) credits from:	
	BIOL3400	Issues in Conservation Biology
	BIOL3402	Biology of the Fungi
	BIOL3403	The Biology of Soil
	BIOL3404	Virology
	BIOL3405	Pest Ecology and Management
	BIOL3413	Research Project
	BIOL3414	Advanced Topics in Life Sciences
	BOTN3402	Introduction to Plant Breeding
	BOTN3403	Fundamentals of Horticulture
	BOTN3406	Tropical Forest Ecology
	BOTN3407	Post-Harvest Technology

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: Fifteen (15) credits from:	
	BIOL2164	Principles of Molecular Biology
	BIOL2401	Research Skills and Practices in Biology
	BIOL2403	Principles of Ecology
	BIOL2407	Biological Evolution
	BOTN2401	Plant Form and Systematics
	Level 3: Nine (9) credits from:	
	BIOL3400	Issues in Conservation Biology
	BIOL3406	Freshwater Biology
	BOTN3406	Tropical Forest Ecology
	And six (6) credits from:	
	BIOL3402	Biology of the Fungi
	BIOL3403	The Biology of Soil
	BIOL3405	Pest Ecology and Management
	BIOL3410	Water Pollution Biology
	BIOL3413	Research Project
	BIOL3414	Advanced Topics in Life Sciences
	BOTN3405	Plant Ecophysiology
	ZOOL3403	Entomology
	ZOOL3405	Vertebrate Biology

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:	
	ZOOL3063	Comparative 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 Levels 2 and 3 and must include:**	
	Level 2: Nine (9) credits which must include:	
	BIOL2403	Principles of Ecology
	BIOL2406	Eukaryotic Microbiology
	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 Form 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 (Levels 2 and 3)	**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:	
	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 Examination 60%
    - Comprehensive Paper (2 hours) 30%
    - Theory Paper (2 hours) 30%
- Course Work: 40%
    - Laboratory Reports 10%
    - 2 In-course Practical Tests 20%
    - 2 In-course Theory Tests 10%

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 Examination 60%
    - Comprehensive Paper (2 hours) 30%
    - Theory Paper (2 hours) 30%
- Course Work: 40%
    - Laboratory Reports 10%
    - 2 In-course Practical Tests 20%
    - 2 In-course Theory Tests 10%

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 **OR**
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:
BIOL0011 - Preliminary Biology I **AND**
BIOL0012 - Preliminary Biology II **OR**
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:
BIOL0011 - Preliminary Biology I **AND**
BIOL0012 - Preliminary Biology II **OR**
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:
BIOL0011 - Preliminary Biology I **AND**
BIOL0012 - Preliminary Biology II **OR**
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%

BIOL2164
PRINCIPLES OF MOLECULAR BIOLOGY
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
BIOL1017 - Cell Biology **AND**
BIOL1018 - Molecular Biology and Genetics.

Course Content:
This course introduces 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% (2x5%)
    - Case Studies 20% (2x10%)
    - MCQ In-course test (2 hrs) 20%

BIOL2401
RESEARCH SKILLS AND PRACTICES IN BIOLOGY
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1017 - Cell Biology **OR** BIOL1018 - Molecular Biology and Genetics **AND**
BIOL1262 - Living Organisms II **OR** 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:

- Course Work: 100%
    - Tutorial exercises and assignment 10%
      (Literature searches with written assignment)
    - Field Experiment & Laboratory Report 25%
      (Two written lab reports, specimen collection)
    - One 1-Hour MCQ Test (25 MCQs) 20%
    - Literature review (3,000 words) 15%
    - Dissection (In-Lab Skills) + Quiz 10%
    - Microscopy (In-Lab skills) + Quiz 10%
    - Scientific Poster 5%
    - Group Oral presentation 5%

BIOL2402
FUNDAMENTALS OF BIOMETRY
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1018 - Molecular Biology and Genetics **AND**
BIOL1262 - Living Organisms I **OR** BIOL1263 - Living Organisms II.

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 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:
BIOL1262 - Living Organisms I **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 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,
BIOL1262 - Living Organisms I **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 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:
BIOL1018 - Molecular Biology and Genetics **AND**
BIOL1262 - Living Organisms I **OR** 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 Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory Reports (1 x 10%) 10%
    - MCQ In-course Test (2 x 20%) 40%

BIOL2408
DIVING FOR SCIENTISTS (SUMMER ONLY)
(3 Credits) (Level 2) (Semester 3) **Not being offered in 2023/2024**

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: the properties of water, pressure and buoyancy, gas laws, and air consumption; Physiology of diving: 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: use of decompression tables, diver rescue techniques and emergency ascents; Diving Equipment; Diving as a tool for scientific research: introduction to the fauna and flora of coral reefs; Underwater sampling and survey methods, data collation and analysis.

Evaluation:

- Final Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test 10%
    - Oral Presentation of research Project 10%
    - 5 Open Water Skills Test 30%

BOTN2401
PLANT FORM AND SYSTEMATICS
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
BIOL1017 - Cell Biology,
BIOL1018 - Molecular Biology and Genetics **AND**
BIOL1262 - Living Organisms I **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 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 **AND**
BIOL1262 - Living Organisms I **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 Examination (2 hours) 50%
- Course Work: 50%
    - In-course Test 10 %
    - Practical Test (2 hours) 20%
    - Laboratory Reports (4 x 5% each) 20%

ZOOL2403
MAINTENANCE SYSTEMS IN ANIMALS
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
BIOL1017 - Cell Biology,
BIOL1018 - Molecular Biology and Genetics **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 Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test 10 %
    - Practical Test (2 hours) 20%
    - Laboratory Reports (4 x 5% each) 20%

ZOOL2404
COORDINATION AND CONTROL IN ANIMALS
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
BIOL1017 - Cell Biology,
BIOL1018 - Molecular Biology and Genetics **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 Examination (2 hours) 50%
- Course Work: 50%
    - MCQ In-course Test 10%
    - Practical Test (2 hours) 20%
    - 9 Laboratory Reports 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 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 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%

<u>BIOL3402</u>
<u>BIOLOGY OF THE FUNGI</u>
(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 Examination (2 hours) 50%
- Course Work: 50%
    - Oral Tutorial Presentation 10%
    - Laboratory Reports (5 x 4%) 20%
    - In-course Test 20%

<u>BIOL3403</u>
<u>THE BIOLOGY OF SOIL</u>
(3 Credits) (Level 3) (Semester 1)

Pre-requisite:
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 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:
BIOL2164 - Principles of Molecular Biology **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 Examination (2 hours) 60%
- Course Work: 40%
  - Participation in Tutorials (Submission of PBL responses) 5%
  - Laboratory Reports 15%
  - In-course Test 10%

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 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%

BIOL3406
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 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 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 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 the 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 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:
BIOL2401 - Research Skills and Practices in Biology **AND**
BIOL2403 - Principles of Ecology.

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 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%

<u>BIOL3412</u>
<u>INTERNSHIP</u>
(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
BIOL2401 - Research Skills and Practices in Biology **AND** BIOL2402 - Fundamental of Biometry.

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; PowerPoint presentations; Review of research ethics.

Evaluation:
- Project Report (at least 2000 words) 75%
- Oral Examination (includes PowerPoint presentation) 25%

BIOL3414
ADVANCED TOPICS IN LIFE SCIENCES
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
(BIOL2403 Principles of Ecology **AND** BIOL2407 Biological Evolution) **OR** (BOTN2401 Plant Form and Systematics **AND** BOTN2402 Physiology of Plants) **OR** (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 the life sciences 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 life sciences.

Course Content:
Loss of biodiversity and ecosystem balance; Agriculture and Fisheries; Behavioural Sciences; Biotechnology; Management of the Environment; Research ethics; Ethical treatment of animals; Rapid survey techniques; Embryology; Climate change; Overpopulation; Endangered Species; Human impact on biodiversity; Palaeontology; Logical framework approach; Critical thinking.

Evaluation:

- Reflective Journal Record (10 x 5%) 50%
- In-depth Analysis 50%
    - Oral 10%
    - Written 40%

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.

BOTN3401
PRINCIPLES OF PLANT BIOTECHNOLOGY
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOL2164 - Principles of Molecular Biology **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 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:
BIOL2164 - Principles of Molecular Biology **AND**
BOTN2402 - Physiology of Plants.

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 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 Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory and Field Trip Report 15%
    - Research and Oral Presentation 15%
    - Practical Test (2 hours) 20%

<u>BOTN3404</u>
<u>ECONOMIC BOTANY</u>
(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 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%

<u>BOTN3405</u>
<u>PLANT ECOPHYSIOLOGY</u>
(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 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 Examination (2 hours) 60%
- Course Work: 40%
    - Research Topic 10%
    - Fieldwork Report (2 hours) 30%

BOTN3407
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 Examination (2 hours) 50%
- Course Work: 50%
    - Practical Test 15%
    - Field Exercise/Field Trip Report 15%
    - Research and Oral Presentation 20%

ZOOL3063
COMPARATIVE ANIMAL PHYSIOLOGY
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ZOOL2403 - Maintenance Systems in Animals **AND**
ZOOL2404 - Coordination and Control in Animals.

Course Content:
Comparison of the following in vertebrates and arthropods:
1. **Circulatory Physiology.** Types of circulation; Physiology of open circulation; Physiology of closed circulation: vascular flow, pressure and resistance; Nervous control of myogenic and neurogenic hearts; Capillary fluid exchange; Endocrine control of heart; Electrocardiograms; Metabolic scaling: heart size, blood pressure, cardiac output
2. **Digestive Physiology.** Functions of components of the digestive system; Nervous control of feeding; Nutrient acquiring modes for particulate, mass, and fluid food; endosymbionts; Meal processing design; Nervous control of feeding and peristalsis; Chemical digestion of carbohydrates, lipids, proteins; Transmembrane proteins for absorption of monosaccharides, fatty acids and amino acids; Metabolic scaling: dietary needs
3. **Respiratory Physiology.** Respiratory media; Ventilation mechanisms and capacity; Gaseous exchange mechanisms; Diffusion of gases in animals; Respiratory pigments; Factors affecting gas delivery (oxygen and carbon dioxide dissociation curves, Bohr effect, Root effect, Haldane effect); Cellular respiration processes; Nervous and endocrine control of respiration; Transmembrane proteins for electron transport chain; Energy metabolism; Metabolic rates: scaling O2 consumption and CO2 output

4. **Excretory and Osmoregulatory Physiology.** Ammonotelic, ureotelic and purinotelic urine formation; Kidney regulation of blood composition; Transmembrane transport of water and ions; Flow and clearance of solutes and water in tubes; Osmotic concentration of urine; Endocrine control of excretion; Maintenance of salt and water balance in aquatic and terrestrial environments; Metabolic scaling: excretory units

Evaluation:

- Final Examination (2 hours) 50%
- Course Work: 50%
    - Laboratory Reports (3 x 10% each) 30%
    - 1-hour MCQ or SAQ Test 10 %
    - Multimedia Group Presentation 10%

ZOOL3403
ENTOMOLOGY
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
BIOL2401 - Research Skills and Practices in Biology **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 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 Examination (2 hours) 50%
- Course Work: 50%
    - Participation in Tutorials 5%
    - Visual Media Examination (2 hours) 15%
    - Laboratory Report (10x3%) 30%

ZOOL3405
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%

<u>ZOOL3406</u>
<u>IMMUNOLOGY</u>
(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, tumour 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%

<u>ZOOL3407</u>
<u>HUMAN BIOLOGY</u>
(3 Credits) (Level 3) (Semester 1) *(*Not being offered 2023/2024*)*

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 modelling & Evaluation software.
3. **Caribbean Fisheries:** Jamaican 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 invasion 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%

<u>ZOOL3409</u>
<u>AQUACULTURE</u>
(3 Credits) (Level 3) (Semester 1) *(*Not being offered 2023/2024*)*

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%

DEPARTMENT OF MATHEMATICS

PROGRAMMES

BSc

1. **Actuarial Science**
2. **Mathematics with Education Studies**
3. **Mathematics of Finance**
4. **Mathematics and Modelling Processes**
5. **Statistical Science**

MAJORS

1. **Mathematics**
2. **Mathematics and Economics** **

MINORS

1. **Mathematics**

** Economics can be pursued as a major or minor

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
		LEVEL 0		
MATH0100	Pre-Calculus	6	1	CXC Mathematics or equivalent
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 MATH0100 and MATH0110 or equivalent
MATH1142	Calculus I	3	1	CAPE or GCE A-Level Mathematics, or MATH0100 and MATH0110 or equivalent
MATH1151	Calculus II	3	2	Calculus I
MATH1152	Introduction To Formal Mathematics	3	2	CAPE or GCE A-Level Mathematics, or MATH0100 and MATH0110 or equivalent
MATH1154	Introduction to Mathematical Software I	1	1	Level 1 status (Basic computer literacy is desirable)
MATH1185	Calculus For Scientists and Engineers	3	1	CAPE or GCE A-Level Mathematics, or MATH0100 and MATH0110 or equivalent
STAT1001	Statistics for Scientists	3	1	CAPE or GCE A-Level Mathematics, or MATH0100 and MATH0110 or equivalent

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
		LEVEL 2		
MATH2401	Elements of Mathematical Analysis	3	1	MATH1141, MATH1142, MATH1151 and MATH1152
MATH2403	Multivariable Calculus	3	2	MATH1141, MATH1142 and MATH1151 or MATH1185
MATH2404	Introduction to Probability Theory	3	1	MATH1141, MATH1142, MATH1151 & MATH1152
MATH2407	Stochastic Modelling	3	2	MATH2404
MATH2410	A First Course in Linear Algebra	3	1	MATH1141 & MATH1152
MATH2411	Introduction to Abstract Algebra	3	2	MATH1141 & MATH1152
MATH2420	Ordinary Differential Equations	3	2	(MATH1141, MATH1142, MATH1151 & MATH1152)
MATH2421	Fourier Series and Integral Transforms	3	1	(MATH1141, MATH1142 & MATH1151) or (MATH1185)
MATH2430	Linear Optimization	3	2	(MATH1141 & MATH1152)
MATH2701	Financial Mathematics I	3	1	(MATH1141, MATH1142, MATH1151 & MATH1152)
MATH2702	Actuarial Mathematics I	3	2	MATH2701 and MATH2404

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
STAT2001	Inferential Statistics	3	2	STAT1001 or MATH2404
STAT2002	Discrete Statistics	3	2	STAT1001, MATH1142
STAT2003	Linear Models	3	2	STAT1001, STAT2001
STAT2005	Non-Parametric Statistics *(formerly STAT2002)*	3	2	STAT1001, MATH1142
LEVEL 3				
MATH3155	Complex Variables	3	1	MATH2401
MATH3402	A Course on Metric Spaces and Topology	3	2	MATH2401
MATH3411	Advanced Abstract Algebra	3	2	MATH2411
MATH3412	Advanced Linear Algebra	3	1	MATH2410
MATH3414	Selected Topics in Operations Research	3	1	MATH2404
MATH3421	Partial Differential Equations	3	1	MATH2420
MATH3422	Mathematical Modelling	3	2	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

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS				
CODES	**TITLES**	**CREDITS**	**SEMESTER OFFERED**	**PREREQUISITES**
MATH3425	Techniques in Solving Advanced Mathematical Problems	3	2	MATH2401, MATH2410
MATH3426	Numerical Solution of Ordinary Differential Equations	3	2	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
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
STAT3004	Applied Multivariate Analysis *(formerly STAT2004)*	3	1	STAT2001, MATH2410

PROGRAMME DETAILS

ACTUARIAL SCIENCE (B.Sc.)		
Introductory Courses (Level 1)	**A B.Sc. Actuarial Science requires a total of thirty-six (36) Level 1 credits from:**	
	ACCT1003	Introduction to Cost & Management Accounting
	ACCT1005	Introduction to Financial Accounting
	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
	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 B.Sc. Actuarial Science requires sixty-six (66) advanced credits from Levels 2 and 3 and must include:**	
	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
	ECON2001	Intermediate Microeconomics II
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	MATH2403	Multivariable Calculus
	MATH2411	Introduction of Abstract Algebra
	MATH2421	Fourier Series and Integral Transforms
	MATH2430	Linear Optimization
	STAT2003	Linear Models
	COMP3110	Information Systems in Organisations
	COMP3180	Web Design and Programming II
	MATH3155	Complex Variables
	MATH3412	Advanced Linear Algebra
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3423	Research Project in Mathematics
	MATH3424	Numerical Methods
	MATH3425	Techniques in Solving Advanced Mathematical Problems
	MATH3426	Numerical Solutions of Ordinary Differential Equations
	STAT3003	Design & Analysis of Experiments
	STAT3004	Applied Multivariate Analysis

MATHEMATICS WITH EDUCATION STUDIES (B.Sc.)		
	INITIAL TEACHER TRAINING (Option 1)	
Introductory Courses (Level 1)	EDPS1003	Psychological Issues in the Classroom
	EDTL1020	Introduction to Teaching and Learning
	EDTL1021	Planning for Teaching
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	Plus (6 credits optional) in-faculty courses.	
Advanced Courses (Levels 2 and 3)	**Year 2**	
	EDMA2216	Analysis and Teaching of Mathematics
	EDMC2213	Children Learning Mathematics
	EDTL2021	School Based Experience 1
	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
	Year 3	
	EDMA3208 **or** EDMA3217	History & Development of Mathematical Ideas Pedagogical Issues for the Teaching of Mathematics
	EDME3205	Teaching Mathematics in Grades 10 & 11
	EDRS3019	Report
	EDTL3017	Field Study (School Based Experience 1)
	MATH3402	A Course on Metric Spaces & Topology
	MATH3423	Research Project (Mathematics)
	MATH3425	Techniques in Solving Advanced Mathematical 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)	EDMC2213	Children Learning Mathematics
	EDMA2216	Analysis and Teaching of Mathematics
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal 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)	MATH2403	Multivariable Calculus
	MATH2404 (Summer Term)	Introduction to Probability Theory
	MATH2420 (Summer Term)	Ordinary Differential Equations
	STAT2001	Inferential Statistics
	EDME3205	Teaching Mathematics in Grade 10&11
	EDRS3019	Report
	EDTL3020	Preparing for the Field: The Teacher as Researcher
	EDTL3021	In the Field: Teaching as Experiment
	MATH3402	A Course on Metric Spaces & Topology
	MATH3423	Research Project Mathematics
	MATH3425	Techniques in Solving Advanced Mathematical Problems
	Plus any one Level 2 or 3 Mathematics Courses	
	Plus any 1 core math education course	

MATHEMATICS OF FINANCE (B.Sc.)		
Introductory Courses (Level 1)	**A BSc Mathematics of Finance requires thirty-three (33) credits are required as follows:**	
	ACCT1003	Introduction to Cost & Management Accounting
	ACCT1005	Introduction to Financial Accounting
	COMP1126	Introduction to Computing I
	COMP1127	Introduction to Computing II
	ECON1000	Principles of Economics I
	ECON1012	Principles of Economics II
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	PH10B	Ethics & Applied Ethics
Advanced Courses (Levels 2 & 3)	**A total of sixty-six (66) advanced credits are required as listed below:**	
	MATH2401	Elements of Mathematical Analysis
	MATH2403	Multivariable Calculus
	MATH2404	Introduction to Probability Theory
	MATH2407	Stochastic Modelling I
	MATH2410	A First Course in Linear Algebra
	MATH2420	Introduction of Ordinary Differential Equations
	MATH2701	Financial Mathematics I
	MGMT2023	Financial Management I
	MGMT2068	Risk & Treasury Management
	STAT2001	Inferential Statistics
	ECON3005	Monetary Theory & Policy
	ECON3072	Financial Markets
	MATH3423	Research Project (Mathematics)
	MATH3801	Financial Mathematics II
	MATH3802	Construction and Evaluation of Actuarial Models
	MATH3803	Models for Financial Economics
	MGMT3048	Financial Management II
	STAT3001	Regression Analysis
	STAT3002	Time Series
	Plus 9 credits from the following (electives):	
	COMP3161	Database Management Systems
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	ECON3007	International Finance
	MATH2421	Fourier Series and Integral Transforms
	MATH3412	Advanced Linear Algebra
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations

MATHEMATICS AND MODELLING PROCESSES (B.Sc.) - *Revised*		
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 & Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	MATH1154	Introduction to Mathematical Software I (NEW)
	STAT1001	Statistics for Scientists
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 must 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
	MATH3426	Numerical Solution of Ordinary Differential Equations
	PLUS 6 advanced credits from the below	
	MATH3425	Techniques in Solving Advanced Mathematical Problems
	STAT2003	Linear Models
	STAT2005	Non-parametric Statistics
	STAT3003	Design & Analysis of Experiments
	STAT3004	Applied Multivariate Analysis

STATISTICAL SCIENCE (B.Sc.) - *Revised*		
Introductory Courses (Level 1)	**A B.Sc. in Statistical Science requires a total of twenty (24) Level 1 credits including the list below:**	
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	STAT1001	Statistics for Scientists
Advanced Courses (Levels 2 and 3)	**This programme requires sixty (60) advanced credits from Levels 2 and 3 and must include:**	
	MATH2401	Elements of Mathematical Analysis
	MATH2404	Introduction to Probability Theory
	MATH2407	Stochastic Modelling
	MATH2410	A First Course in Linear Algebra
	STAT2001	Inferential Statistics
	STAT2003	Linear Models
	STAT2005	Non-Parametric Statistics (*formerly STAT2002*)
	MATH3423	Research Projects
	STAT3001	Regression Analysis
	STAT3002	Time Series
	STAT3003	Design and Analysis of Experiments
	STAT3004	Applied Multivariate Analysis (*formerly STAT2004*)
	Plus a minimum of 2 Level 2 courses and a minimum of 2 Level 3 courses from:	
	MATH2403	Multivariable Calculus
	MATH2411	Introduction to Abstract Algebra
	MATH2420	Ordinary Differential Equations
	MATH2421	Fourier Series and Integral Transforms
	MATH2430	Linear Optimization
	MATH2701	Financial Mathematics I
	MATH3155	Complex Variables
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3424	Numerical Methods
	MATH3425	Techniques in Solving Advanced Mathematical Problems
	MATH3426	Numerical Solution of Ordinary Differential Equations
	MATH3801	Financial Mathematics II

	MATH3802	Evaluation of Actuarial Models
	MATH3803	Models for Financial Economics
	MATH3804	Actuarial Mathematics II
	MATH3805	Mathematics of Pension Funds
	Plus 9 FOUN credits and 6 advanced credits from anywhere in the University.	

MATHEMATICS (MAJOR)		
	A major in Mathematics requires a total of twelve (12) 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
	A major in Mathematics requires a minimum of thirty-six (36) credits from Levels 2 and 3 and must include:	
Advanced Courses (Levels 2 and 3)	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:	
	MATH2421	Fourier Series and Integral Transforms
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3423	Research Project
	MATH3424	Numerical Methods
	MATH3425	Techniques in Solving Advanced Mathematical Problems
	MATH3426	Numerical Solutions for Differential Equations
	STAT3002	Time Series

MATHEMATICS (MAJOR) AND ECONOMICS (MAJOR)		
	This double major requires students satisfying both faculty requirements. They are required to satisfy the following Level 1 courses:	
	COMP1126 **OR** COMP1220	Introduction to Computing I Computing & Society
	ECON1001	Principles of Economics I
	ECON1012	Principles of Economics II
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
	Level 2 courses	
	ECON2000	Intermediate Microeconomics I
	ECON2001	Intermediate Microeconomics II
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	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
Advanced Courses (Levels 2 and 3)	**Level 3 courses**	
	ECON3049	Econometrics
	MATH3155	Complex Variables
	MATH3402	A Course on Metric Spaces & Topology
	MATH3412	Advanced Linear Algebra
	Plus three (3) economics electives from Level II/III	
	Plus two (2) economics electives from Level III	
	Plus three (3) mathematics electives	
	MATH2421	Fourier Series and Integral Transforms
	MATH3414	Selected Topics in Operations Research
	MATH3424	Numerical Methods
	MATH3425	Techniques in Solving Advanced Mathematical Problems

MATHEMATICS (MAJOR) AND ECONOMICS (MINOR)		
	Level 1 courses	
Introductory Courses (Level I)	COMP1126 **OR** COMP1220	Introduction to Computing I Computing & Society
	ECON1001	Principles of Economics I
	ECON1012	Principles of Economics II
	MATH1141	Introductory Linear Algebra and Analytic Geometry
	MATH1142	Calculus I
	MATH1151	Calculus II
	MATH1152	Introduction to Formal Mathematics
	STAT1001	Statistics for Scientists
	Level 2 courses	
Advanced Courses (Levels 2 and 3)	ECON2000	Intermediate Microeconomics I
	ECON2001	Intermediate Microeconomics II
	ECON2002	Intermediate Macroeconomics I
	ECON2003	Intermediate Macroeconomics II
	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
	Level 3 courses	
	MATH3155	Complex Variables
	MATH3402	A Course on Metric Spaces & Topology
	MATH3412	Advanced Linear Algebra
	Plus three (3) mathematics electives	
	One (1) economics elective from Level 3 (students are encouraged to do ECON3049: Econometrics)	

MATHEMATICS (MINOR)		
Introductory Courses (Level 1)	**A minor 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 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
	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 Spaces & Topology
	MATH3411	Advanced Abstract Algebra
	MATH3414	Selected Topics in Operations Research
	MATH3421	Partial Differential Equations
	MATH3422	Mathematical Modelling
	MATH3424	Numerical Methods
	MATH3425	Techniques in Solving Advanced Mathematical Problems
	MATH3426	Numerical Solution of Ordinary Differential Equations
	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 Examination (3 hours) 70%
- Course Work: 30%
    - 2 Mid-semester Examinations (15% each)

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 Examination (3 hours) 70%
- Course Work: 30%
    - 2 Mid-semester Examinations (15% each)

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 MATH1140 and 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 Examination (2 hours) 70%
- Course Work 30%
    - 2 Mid-semester Examinations (15% each)

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 Examination (2 hours) 70%
- Course Work 30%
    - 2 Mid-semester Examinations (15% each)

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 Examination (2 hours) 70%
- Course Work 30%
    - 2 Mid-semester Examinations (15% each)

MATH1152
INTRODUCTION TO FORMAL MATHEMATICS
(3 Credits) (Level 1) (Semester 2)

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 Examination (2 hours) 70%
- Course Work 30%
  - 2 Mid-semester Examinations (15% each)

MATH1154
INTRODUCTION TO MATHEMATICAL SOFTWARE I
(1 Credit) (Level 1) (Semester 2)

Pre-requisites:
Level 1 status
(Basic computer literacy is desirable)

Course Content:
1. **Introduction to programming:** installation of the package; introduction to various components; creation of directories and saving files; help and documentation
2. **Matrices and vectors:** creation of matrices; manipulation and basic operations; indexing and matrix dimensions; element-wise operation; basic linear algebra computations
3. **Use of built-in functions:** built-in functions related to matrices; elementary mathematical functions

4. **Language fundamentals:** array operations; relational operations; logical operations; manipulation of character strings; output formats
5. **Plots and graphics:** creation of 2-D and 3-D plots; modification of plots; specialized 2-D and 3-D plots; overlay of plots; arrangement of plots in arrays; creation of two-dimensional grid systems; saving graphs in various formats and printing of graphs; animations
6. **Symbolic computations:** algebraic manipulations; differentiation and integration
7. **Control structures:** decision statements; looping structures; nesting; exiting commands
8. **Functions:** labelling of function file; elements of a function; saving and executing a function either with or without explicit output; calling of functions; global and local variables; output commands; saving output files
9. **Programming skills:** guidelines for writing good functions; interactive input; program debugging

Evaluation:

- Course Work 100%
    - Lab Submissions 20%
    - Two equally weighted lab assignments 20%
    - One 1-hour laboratory-based examination 20%
    - One 2-hour laboratory-based examination 40%

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 Examination (2 hours) 70%
- Course Work 30%

STAT1001
STATISTICS FOR THE SCIENTIST
(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:

- Summarising and Interpreting Data - Picturing Distributions with Graphs, Describing distributions with numbers.
- Random Variables.
- Probability and Probability Distribution arising from a Binomial, Poisson or Normal distribution.
- Elementary ideas of sampling methods.
- Sampling and Estimation - Sampling Distribution & Central Limit Theorem.
- Confidence Intervals – for a population mean, a population proportion, difference in two population means and difference in two population proportions.
- Hypothesis Testing – for a population mean, a population proportion, difference in two population means and difference in two population proportions. Hypothesis Testing via the Rejection region approach and P-value approach.
- Introduction to Correlation & Simple Linear Regression - Scatter plots, Correlations, Least-Squares Regression.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work 50%
    - Mid-semester 20%
    - Project 15%
    - Take-home Assignment 15%

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

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 Examination (2 hours)		70%
• Course Work:		30%
• 2 Mid-semester 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

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 Examination (2 hours) 70%
- Course Work: 30%
    - 2 Mid-semester 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

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 mass function, cumulative distribution function; Binomial, uniform, geometric, Poisson distributions; Bernoulli and Hypergeometric 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 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: 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 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

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 Eigenvectors, diagonalization of matrices.

Evaluation:

- Final Examination (2 hours) 70%
- Course Work: 30%
    - Graded Assignments 10%
    - Mid-semester 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

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 Examination (2 hours) 70%
- Course Work: 30%
    - Mid-semester Examination

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.

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 Examination (2 hours) 70%
- Course Work: 30%
    - 2 Mid-semester Examinations

MATH2421
FOURIER SERIES AND INTEGRAL TRANSFORMS
(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

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 Examination (2 hours) 60%
- Course Work: 40%
    - 2 Mid-semester Examinations 20%
    - 5 Take Home Assignments 20%

MATH2430
LINEAR OPTIMIZATION
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
MATH1141 - Introductory Linear Algebra and Analytic Geometry **AND**
MATH1152 - Introduction to Formal Mathematics

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 Examination (2 hours) 70%
- Course Work: 30%
    - 2 Mid-semester Examinations

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

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 Examination (2 hours) 70%
- Course Work: 30%
    - 2 Take Home Assignments 10%
    - 1 Mid-semester Examinations 20%

MATH2701
FINANCIAL MATHEMATICS I
(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

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 Examination (2 hours) 75%
- Course Work: 25%
    - Mid-semester Examinations

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 Examination (2 hours) 75%
- Coursework: 25%
    - Mid-semester Examinations

STAT2001
INFERENTIAL STATISTICS
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
STAT1001 - Statistics for the Scientist
MATH1142 - Calculus I

Co-requisite:
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.
    a. Simple and Composite hypotheses, Types of Error, Power of test, p-value.
    b. Neyman-Pearson method, Generalised Likelihood Ratio Test;
    c. Use of asymptotic results to construct tests: - Central Limit Theorem.
    d. Asymptotic distributions of maximum likelihood estimators and generalised likelihood ratio test statistics.

2. **Parameter Estimation:** Unbiasedness, bias, mean square error consistency, 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.

Evaluation:

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

STAT2003
LINEAR MODELS
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
STAT1001 - Statistics for the Scientist **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, Matrix plot; Quantile function: theoretical distributions and empirical distributions, QQ plots; Parameter estimation.
2. **Simple and Multiple 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.
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%

STAT2005
NON-PARAMETRIC STATISTICS (*formally STAT2002*)
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
STAT1001 - Statistics for the Scientists
MATH1142 - Calculus I

Course Content:

- **Introduction:** Advantages and Disadvantages of Nonparametric Methods.
- **Scales of Measurements:** Nominal, Ordinal, Interval and Ratio; Weak measurement.
  versus Strong statistics; Mosteller and Tukey Data Types.
- **Inference on Location:** Signed test, Wilcoxon signed rank, Wilcoxon Sum rank, Mann-Whitney U.

- **Inference on Dispersion:** Siegel-Tukey test, Freund-Ansari test.
- **Rank Correlation:** Spearman's rank (treatment of ties and no ties).
- **Test of Randomness:** Run test, Chi-square test.
- **Goodness of Fit:** Kolmogorov-Smnirov test, Chi-square test.
- **Design of Experiment:** Kruskal-Wallis test, Freidman's test.
- **Categorical Data:** Contingency tables, Fisher's exact test.

Evaluation:

- Final Written Examination (2 hours) — 70%
- Course Work: — 30%
    - Problem Papers — 15%
    - Mid-semester Examination — 15%

MATH3155
COMPLEX VARIABLES
(3 Credits) (Level 3) (Semester 2)

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; 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.
5. **Series:** Convergence of sequences and series; Power series: absolute and uniform convergence, integration and differentiation; Taylor and Laurent series.
6. **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 Examination (2 hours) — 60%
- Course Work: — 40%
    - 1 In-course Test (10% each) — 20%
    - 2 Assignments — 20%

MATH3401
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 functions on the interval, Lebesgue's Theorem, consequences of Lebesgue's Theorem.

Evaluation:

- Final Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test (10% each) 20%
    - 2 Assignments 20%

MATH3402
A COURSE ON METRIC SPACES AND TOPOLOGY
(3 Credits) (Level 3) (Semester 1)

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 Examination (2 hours) 60%
- Course Work: 40%
    - In-course Tests (10% each) 20%
    - 2 Assignments 20%

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 Examination (2 hours) 70%
- Course Work: 30%
    - 1 In-course Test 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 Examination (2 hours) 60%
- Course Work: 40%
    - In-course Test 20%
    - 4 Assignments (5% each) 20%

MATH3414
SELECTED TOPICS IN OPERATIONS RESEARCH
(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 Examination (2 hours) 70%
- Course Work: 30%
    - Computer-based Group Project 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 Examination (2 hours)		60%
• Course Work:		40%
• Mid-semester Examination	20%	
• 4 Assignments (5% each)	20%	

MATH3422
MATHEMATICAL MODELLING
(3 Credits) (Level 3) (Semester 2)

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:** Modelling 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 Examination (2 hours)		60%
• Course Work:		40%
• In-course Test	20%	
• Group Project	20%	

<u>MATH3423</u>
<u>RESEARCH PROJECT IN MATHEMATICS</u>
(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 during 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; Simpson's rule; the composite Trapezoid and Simpson's rules; errors of approximation; Gaussian quadrature.
5. **Lab:** Practical implementation in the computer laboratory.

Evaluation:

- Final Examination (2 hours) 60%
- Course Work: 40%
    - 1 In-course Test 20%
    - 2 Laboratory Assignments (10% each) 20%

MATH3425
TECHNIQUES IN SOLVING ADVANCED MATHEMATICAL PROBLEMS

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

Pre-requisites:
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 Examination (2 hours) 55%
- Course Work: 45%
    - Group Presentation 45%

MATH3426
NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
MATH2401 - Element of Mathematical Analysis **AND**
MATH2410 - A First Course in Linear Algebra.

Course Content:

- **Essential concepts:** Review of Calculus, finite differences, existence and uniqueness theorem, initial value problems (IVPs), boundary value problems (BVPs), boundary eigen value problems (BEVPs).
- **Error Analysis:** Roundoff error, truncation error, error propagation, stability and convergence of a numerical scheme.
- **Solution of IVPs:** Euler's method, Runge-Kutta method, Predictor-Corrector methods, stability analysis.
- **System of linear equations and higher order ODEs.**
- **Stiff differential equations.**
- **Solution of BVPs:** Solution of linear and nonlinear BVPs by shooting, finite difference methods and collocation method.
- **Solution of BEVPs:** Finite difference and shooting methods.
- **Practical implementation** in the computer laboratory.

Evaluation:

- Final Examination (2 hours) 60%
- Course Work: 40%
    - One in-course Test (1 hour) 20%
    - Two Lab assignments (10% each) 20%

MATH3801
FINANCIAL MATHEMATICS II
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
MATH2404 - Introduction to Probability Theory,
MATH2701 - Financial Mathematics I,
MGMT2023 - Financial Management I, **AND**
MGMT3048 - Financial Management II.

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 Examination (2 hours) 70%
- Course Work: 30%
    - 2 Assignments (5% each) 10%
    - 1 In-course Test 20%

MATH3802
EVALUATION OF ACTUARIAL MODELS
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
MATH2404 - Introduction to Probability Theory,
MATH2702 - Actuarial Mathematics I, **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 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 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 1)

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 $\left(\overline{xy}\right)$.
4. **Insurances and Annuities:** Problems on Insurances and Annuities based on Joint Life status and Last survivor status, Problems on Reversionary Annuities.
5. **The Common Shock Model:** Definitions, Modelling Dependence, Applications to all types of Insurance and Annuity Problems.
6. **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.
7. **Markov Chain Models**: Calculate the probability of being in a particular state and transitioning between states based on continuous-time Markov chain models, discrete approximations of continuous-time Markov chain models and discrete-time Markov chain models. Calculate present values of cash flows by redefining the present-value-of-benefits and present-value-of-premium random variables to Markov chain models. Calculate the benefit reserves and premium using a Markov chain model with specific cash flows.

Evaluation:

- Final Examination (2 hours) 75%
- Course Work: 25%
    - 2 Assignments (5% each) 10%
    - Mid-semester Examination 15%

MATH3805
MATHEMATICS OF PENSION FUNDS

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

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.
3. **Cost Methods (I):** Individual Cost Methods.
4. **Cost Methods (II):** Aggregate Cost Methods.

Evaluation:

- Final Examination (2 hours) 70%
- Course Work: 30%
    - 2 Assignments (5% each) 10%
    - Mid-semester Examination 20%

MATH3806
TOPICS IN GENERAL INSURANCE

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

Pre-requisites:
MATH2404 - Introduction to Probability Theory **AND**
MATH2701 - Financial Mathematics I.

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 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:
MATH2410 - A First Course in Linear Algebra **AND**
STAT2001 - Inferential Statistics.

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 Examination (2 hours) 60%
- Course Work: 40%
    - Problem Papers/Laboratory Assignments 10%
    - Mid-semester Examination 10%
    - Mini-project 20%

STAT3002
TIME SERIES
(3 Credits) (Level 3) (Semester 2)

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, $E(Y \text{ at time } t+k | \text{knowledge up to time } t)$
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 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 1)

Pre-requisites:

STAT2001 - Inferential Statistics.

Course Content:

1. **Introduction:** Collecting data by experiment, Principles of experimental design, Simple design ideas.
2. **Background Theory:** Models, matrix formulation, GLMs, parameter estimation, contrasts inference, ANOVA.
3. **Completely Randomised Designs:** Fixed and Random effects model, residual analysis, contrasts and Tukey's test.
4. **Randomised Block Designs:** Fixed, Random and Mixed models, Randomised block designs, Efficiency, additivity, interaction, missing values, Balanced incomplete block, Latin Squares, Transformation, analysis of covariance.
5. **Multifactor Experiment:** Factorial treatment structure, nested models, 2^k and 3^k experiments, confounding, partial confounding, fractional replication in 2^k experiments.

Evaluation:

- Final Examination (2 hours) 60%
- Course Work: 40%
    - Problem Papers 10%
    - Mid-semester Examination 15%
    - Written Project 15%

STAT3004
Applied Multivariate Analysis
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
STAT2001 - Inferential Statistics.
MATH2410 - A First Course in Linear Algebra.
Course Content:

- **Matrix Algebra & Random Vectors**: Introduction, Review of matrix and vector algebra;
  Positive definite matrix; Random vectors and matrices; Mean vectors and Covariance matrices.
- **Multivariate Normal Distribution:** Introduction, Density and its properties, Maximum likelihood estimators of μ and Σ.
- **Inferences:** Sampling distribution of $\bar{X}$ and S, Hotelling's T^2, and Confidence regions.
- **Methods:** Principal Component Analysis, Discriminant Analysis, Factor Analysis and Cluster Analysis.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
  - Assignments 15%
  - Mid-semester Examination 20%
  - Lab Project 15%

DEPARTMENT OF PHYSICS

PROGRAMMES

BSc

1. **Biomedical Instrumentation**
2. **Biomedical Radiation Science** ***Not being offered 2023/2024****
3. **Climate Science and Electronic Systems**
4. **Electronics and Alternative Energy Systems**
5. **Electronics and Computer Science**
6. **Physics with Education**

MAJORS

1. **Electronics**
2. **Energy and Environmental Physics**
3. **General Physics**
4. **Materials Science**
5. **Medical Physics**

MINORS

1. **Electronics**
2. **Energy and Environmental Physics**
3. **General Physics**
4. **Materials Science**
5. **Medical Physics**
6. **Renewable Energy Management**

NOTICES

1. Students have the option of pursuing a standard Major or a specially designed programme. If students opt to pursue one of the specially designed programmes:
    - All the courses listed under the programme must be completed.
    - It cannot be completed with any other Major or Minor.
    - The Electronics Research Project (ELET3490) must combine the discipline with electronics.

2. The prerequisites that are listed **may** be replaced by an equivalent course from an accredited degree-granting institution. Decisions about course equivalence will be made on a case-by-case basis. Students are encouraged to contact the Department Office for further information.

3. The following courses are offered by the Faculty of Engineering and a full description of the courses can be found at https://www.mona.uwi.edu/engineering/student-resources under the academic resources section.

Course Code	Course Name
BMNG1210	Introduction to Biomedical Engineering
BMNG2210	Biomedical Instrumentation I
BMNG3110	Biomedical Instrumentation II
ECSE1109	Programming for Engineers I
ECSE2209	Control Systems Engineering
ELNG1101	Physics for Engineers
ELNG3030	Power Electronics & Protection Circuits
ELNG3060	Power Plant Instrumentation

4. Courses not being offered for the 2023/24 academic year:
    - Semester 1: **PHYS2000** - Fundamentals in Energy Statistics
    - Semester 2: **PHYS3000** - Energy Information Management
    - The **Biomedical Radiation Science** Programme is not being offered this academic year.

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
			LEVEL 0		
PHYS0411	Introduction to Mechanics	3-P	1	**Any of the following:** → CXC Physics → CSEC Physics → GCE O-Level Physics	
PHYS0412	Introduction to Oscillations & Heat	3-P	1		
PHYS0421	Introduction to Electricity & Magnetism	3-P	2		
PHYS0422	Introduction to Nuclear Physics & Optics	3-P	2		
			LEVEL 1		
ELET1405	Practices in Basic Electronics	3	2	**Any of the following:** → CAPE/A-Level Physics → CSEC Physics and CAPE/A-Level Maths → CSEC Physics, MATH0100 and MATH0110 → PHYS0421	
ELET1500	Electrical Circuit Analysis and Devices	3	2		
PHYS1411	Mechanics	3	1	**Any of the following:** → CAPE/A-Level Physics → CSEC Physics and CAPE/A-Level Maths → CSEC Physics, MATH0100, and MATH0110 → PHYS0411	

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
PHYS1412	Waves, Optics & Thermodynamics	3	1	**Any of the following:** → CAPE/A-Level Physics → CSEC Physics and CAPE/A-Level Maths → CSEC Physics, MATH0100, and MATH0110 → PHYS0412 and PHYS0422	
PHYS1421	Electricity & Magnetism	3	2	**Any of the following:** → CAPE/A-Level Physics → CSEC Physics and CAPE/A-Level Maths → CSEC Physics, MATH0100, and MATH0110 → PHYS0421	
PHYS1422	Modern Physics	3	2	**Any of the following:** → CAPE/A-Level Physics → CSEC Physics and CAPE/A-Level Maths → CSEC Physics, MATH0100, and MATH0110 → PHYS0422	
LEVEL 2					
ELET2210 / COMP2802	Speech Processing	3	2	ELET2460, COMP1126 and COMP1127	
ELET2405	Practices in Electronics Design I	3	1	**Any of the following:** → PHYS1421, ELET1405 and ECSE1109 → ELNG1101, ELET1405 and ECSE1109	

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
ELET2410	Analysis and Design of Analog Circuits	3	2	**Any of the following:** → ELET1405, PHYS1411, PHYS1412, and PHYS1421 → ELET1405 and ELNG1101	
ELET2415	Practices in Electronics Design II	3	2	**Any of the following:** → PHYS1421, ELET1405 and ECSE1109 → ELNG1101, ELET1405 and ECSE1109	
ELET2420	Semiconductor Devices	3	1	**Any of the following:** → ELET1405, PHYS1411, PHYS1412, PHYS1421and PHYS1422 → ELET1405 and ELNG1101	
ELET2450	Embedded Systems	3	1	**Any of the following:** → PHYS1421, ELET1405 and ECSE1109 → ELNG1101, ELET1405 and ECSE1109	
ELET2460	Signals & Systems	3	1	**Any of the following:** → ELET1405, PHYS1411, PHYS1412, and PHYS1421 → ELET1405 and ELNG1101	

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
ELET2480	Communication Systems	3	2	**Any of the following:** → ELET1405, PHYS1412, and PHYS1421 → ELET1405 and ELNG1101	
ELET2530	Digital Electronics and Systems	3	1	**Any of the following:** → PHYS1421and ELET1405 → ELNG1101 and ELET1405	
ELET2570	Microprocessors and Computer Architecture	3	2	ELET2530	
PHYS2000	Fundamentals in Energy Statistics	3	1	None	
PHYS2200	Practices in Medical Physics 1	3	2	PHYS1411, PHYS1412, PHYS1421	PHYS2296
PHYS2296	Physics of the Human Body	3	2	PHYS0411	
PHYS2299	Radiation Protection, Safety and Regulations	3	1	Available only to students enrolled in Biomedical Radiation	
PHYS2300	General Physics Lab I	3	1	PHYS1412, PHYS1421, PHYS1422	PHYS2351, PHYS2386
PHYS2351	Quantum Mechanics and Nuclear Physics	3	1	PHYS1411, PHYS1412, PHYS1422	MATH1185
PHYS2386	Electromagnetism & Optics	3	1	PHYS1412, PHY1421	
PHYS2396	Computer Applications in Physics	3	2	None	

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
PHYS2424	Reactor Applications in Medicine	3	2	Available only to students enrolled in Biomedical Radiation	
PHYS2500	Materials Science Lab I	3	2	PHYS1411, PHYS1412, PHYS1421, PHYS1422	PHYS2561
PHYS2561	Fundamentals of Materials Science	3	2	**Any of the following:** → PHYS1411, PHYS1412, PHYS1421, PHYS1422, and GCE A-Level Chemistry → PHYS1411, PHYS1412, PHYS1421, PHYS1422, and CAPE Chemistry (Units I & II) → PHYS1411, PHYS1412, PHYS1421, PHYS1422, CHEM0901, and CHEM0902	
PHYS2600	Fluid Dynamics and Environmental Physics Lab	3	2	PHYS1411, PHYS1412	PHYS2671
PHYS2671	Fluid Dynamics	3	1	PHYS1411, PHYS1412	
PHYS2701	Essentials of Renewable Energy Technologies and Solutions	3	1	None	
			LEVEL 3		
ELET3211 / COMP3802	Speech and Language Technology	3	1	ELET2210 or COMP2802	
ELET3405	Practical Analysis of Advanced Electronic Circuits and Systems	3	1	ELET2405, ELET2415	

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
ELET3430	Instrumentation and Measurements	3	1	ELET2410, ELET2530	
ELET3440	Introduction to Robotics	3	2	ELET2530, ELET2450	
ELET3450	Satellite Communication & Navigational Systems	3	2	ELET2480	
ELET3460	Digital Signal and Image Processing	3	2	ELET2460	
ELET3470	Wave Transmission & Fibre Optics	3	1	ELET2480	
ELET3480	Wireless Communication Systems	3	1	ELET2480	
ELET3490	Electronics Research Project	4	1 and 2	**Any of the following:** → ELET2410 and Head of Department's Approval → ELET2450 and Head of Department's Approval	
ELET3600	Energy Systems Laboratory	3	1	PHYS3671, PHYS3681	ELET3611
ELET3611	Integrating Alternative Energy	3	2	ELET2420	PHYS3671, PHYS3681
PHYS3000	Energy Information Management	3	2	PHYS2000	
PHYS3200	Advanced General Physics Lab	3	2	PHYS2300	PHYS3351, PHYS3386

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
PHYS3300	Advanced Practices in Medical Physics	3	1	PHYS2200	
PHYS3312	Modern Radiotherapy Physics	3	2	PHYS2296	PHYS3389
PHYS3341	Biomedical Optics and Biomechanics	3	1	PHYS2296	
PHYS3351	Modern Physics 2	3	2	PHYS2351	
PHYS3386	Electromagnetism	3	1	ELET2480 OR PHYS2386	
PHYS3389	Medical Radiation Physics & Imaging	3	2	PHYS2296	
PHYS3395	Astronomy & Cosmology	3	2	PHYS1411, PHYS1412, PHYS1422	
PHYS3399	Research Project (Non-Electronics)	4	1 and 2	Head of Department's Approval	
PHYS3400	Physics in Practice Internship	3	Summer	At least a 'B' grade in PHYS2386 or ELET1500 AND Head of Department's Approval	
PHYS3401	Special topics in Biomedical Radiation Science	3	1	Available only to students enrolled in Biomedical Radiation	
PHYS3500	Advanced Materials Science Laboratory	3	1	PHYS2500	
PHYS3561	The Physics of Crystalline Materials	3	1	PHYS2561	
PHYS3562	The Physics of Non-Crystalline and Amorphous Materials	3	2	PHYS2561	

UNDERGRADUATE COURSES OFFERED BY THE DEPARTMENT OF PHYSICS					
CODES	**TITLES**	**CREDITS**	**SEMESTER**	**PREREQUISITES**	**CO-REQUISITES***
PHYS3565	Thermodynamics and Kinetics of Materials	3	2	PHYS2561	
PHYS3661	Physics of the Atmosphere & Climate	3	2	PHYS1411, PHYS1412	
PHYS3671	Solar Power	3	1	PHYS3661	
PHYS3681	Wind & Hydro Power	3	2	PHYS2671, PHYS3661	
PHYS3701	Advanced Renewable Energy Technologies and Solutions	3	2	PHYS2701	

SPECIAL PROGRAMME DETAILS

BIOMEDICAL INSTRUMENTATION (B.Sc.)

At least 99 credits are required for this programme. The courses are outlined below.

	Semester I		Semester II	
YEAR 1	ECSE1109	Programming for Engineers I	COMP1161	Introduction to Object-Oriented Programming
	MATH1141	Introduction to Linear Algebra & Geometry	ELET1405	Practices in Basic Electronics
	MATH1185	Calculus for Scientists and Engineers	ELET1500	Electrical Circuit Analysis & Devices
	PHYS1411	Mechanics	PHYS1421	Electricity and Magnetism
	PHYS1412	Waves and Optics	PHYS1422	Modern Physics
YEAR 2	ELET2405	Practices in Electronics Design I	BMNG2210	Biomedical Instrumentation I
	ELET2450	Embedded Systems	ECSE2209	Control Systems Engineering
	ELET2460	Signals & Systems	ELET2410	Analysis & Designs of Analog Circuits
	ELET2530	Digital Electronics and Systems	ELET2415	Practices in Basic Electronics II
	PHYS2300	General Physics Lab 1	ELET2570	Microprocessors & Computer Architecture
			PHYS2296	Physics of the Human Body
YEAR 3	BMNG3110	Biomedical Instrumentation II	ELET3460	Digital Signal and Image Processing
	ELET3405	Practical Analysis of Advanced Electronic Circuits and Systems	ELET3490	Electronics Research Project
	ELET3430	Instrumentation & Measurements	ELNG3030	Power Electronics & Protection Circuits
	PHYS2351	Quantum Mechanics & Nuclear Physics		
	PHYS2386	Electromagnetism and Optics		
	PHYS3341	Biomedical Optics and Biomechanics		
3 Foundation courses – 9 credits				

BIOMEDICAL RADIATION SCIENCE (B.Sc.)

This programme is offered in partnership with the Faculty of Medical Sciences and the Faculty of Engineering.
At least 96 credits are required. The courses are outlined below.

	Semester I		Semester II	
YEAR 1	BAMS1010	Introduction to Anatomy and General Histology and Embryology	BMNG1210	Introduction to Biomedical Engineering
	DIMA1004	Medical Law and Ethics	DIMA1003	Introduction to Medical Imaging Modalities
	DIMA1011	Radiation Protection, Radiation Biology and Dosimetry	ELET1500	Electrical Circuit Analysis & Devices
	PHYS1411	Mechanics	PHYS1422	Modern Physics
	STAT1001	Statistics for Science	PHYS2200	Practices in Medical Physics I
	FOUN1014 OR FOUN1019	Critical Reading and Writing OR Critical Reading and Writing in the Disciplines		
YEAR 2	CHEM1820	Introductory Chemistry II	BAMS2000	Medical Uses of Radiopharmaceutical
	OESH3100	Environment Hazard Assessment and Risk Management and Control	CHEM1910	Introductory Chemistry III
	OESH3220	Occupational Hygiene	DIMA2011	Research Methodology
	PHYS2299	Radiation Protection, Safety, and Regulations	PHYS2296	Physics of the Human Body
	DIMA2008	Radiographic Equipment and Maintenance	FOUN1301	Law, Governance, Economy, and Society
		BMRS ELECTIVE OPTION #1		

YEAR 3	CAIHR3000	Stable Isotopes in Medicine	CHEM2810	Radiochemistry
	PHYS3300	Practices in Medical Physics II	DIMA2012	Seminars
	PHYS3401	Special topics in Biomedical Radiation Science	PHYS2424	Reactor Applications in Medicine
	STAT2002	Discrete Statistics	PHYS3312	Modern Radiotherapy Physics
	FOUN1101	Caribbean Civilization	PHYS3399	Non-Electronics Research Project
		BMRS ELECTIVE OPTION #2	PHYS3389	Medical Radiation Physics & Imaging

BMRS ELECTIVE OPTION #1

Any **ONE (1)** of the following:

→ *PHYS2351 Quantum Mechanics and Nuclear Physics*

→ *PHYS2386 Electromagnetism and Optics*

→ *PHYS2396 Computer Applications in Physics*

→ *PHYS3400 Physics in Practice Internship*

BMRS ELECTIVE OPTION #2

Any **ONE (1)** of the following:

→ *CHEM2402 Chemistry in Our Daily Life*

→ *PHYS2701 Essentials of Renewable Energy Technologies and Solutions*

CLIMATE SCIENCE AND ELECTRONIC SYSTEMS (B.Sc.)

At least 99 credits are required for this programme. The courses are outlined below.

	Semester I		Semester II	
YEAR 1	ECSE1109	Programming for Engineers I	COMP1161	Introduction to Object-Oriented Programming
	MATH1141	Introduction to Linear Algebra & Geometry	ELET1405	Practices in Basic Electronics
	MATH1185	Calculus for Scientists and Engineers	ELET1500	Electrical Circuit Analysis & Devices
	PHYS1411	Mechanics	PHYS1421	Electricity and Magnetism
	PHYS1412	Waves and Optics	PHYS1422	Modern Physics
YEAR 2	ELET2405	Practices in Electronics Design I	ELET2410	Analysis & Designs of Analog Circuits
	ELET2450	Embedded Systems	ELET2415	Practices in Basic Electronics II
	ELET2460	Signals & Systems	ELET3460	Digital Signal Processing
	ELET2530	Digital Electronics and Systems	PHYS2600	Fluid Dynamics & Environmental Physics Laboratory
	PHYS2761	Fluid Dynamics	PHYS3661	Physics of the Atmosphere & Climate
YEAR 3	ELET3405	Practical Analysis of Advanced Electronic Circuits & Systems	COMP2171	Object-Oriented Design & Implementation
	COMP2140	Software Engineering	COMP3161	Database Management Systems
	ELET3430	Instrumentation & Measurements	ELET2480	Communication Systems
	PHYS2386	Electromagnetism & Optics	ELET3490	Electronics Research Project*
	PHYS2351	Quantum Mechanics & Nuclear Physics	ELNG3030	Power Electronics & Protection Circuits
3 Foundation courses – 9 credits				

ELECTRONICS AND ALTERNATIVE ENERGY SYSTEM (B.Sc.)

At least 99 credits are required for this programme. The courses are outlined below.

	Semester I		Semester II	
YEAR 1	ECSE1109	Programming for Engineers I	COMP1161	Introduction to Object-Oriented Programming
	MATH1141	Introduction to Linear Algebra & Geometry	ELET1405	Practices in Basic Electronics
	MATH1185	Calculus for Scientists and Engineers	ELET1500	Electrical Circuit Analysis & Devices
	PHYS1411	Mechanics	PHYS1421	Electricity and Magnetism
	PHYS1412	Waves and Optics	PHYS1422	Modern Physics
YEAR 2	ELET2405	Practices in Electronics Design I	ELET2410	Analysis & Designs of Analog Circuits
	ELET2450	Embedded Systems	ELET2415	Practices in Basic Electronics II
	ELET2460	Signals & Systems	ELET3460	Digital Signal Processing
	ELET2530	Digital Electronics and Systems	PHYS2600	Fluid Dynamics & Environmental Physics Laboratory
	PHYS2761	Fluid Dynamics	**NEW**	Renewable Energy Systems Design
YEAR 3	ELET3405	Practical Analysis of Advanced Electronic Circuits & Systems	ELET3490	Electronics Research Project
	ELET3430	Instrumentation & Measurements	ELET3611	Integrating Alternative Energy
	ELET3600	Energy Systems Laboratory	ELNG3030	Power Electronics and Protection Circuits
	PHYS2351	Quantum Mechanics & Nuclear Physics	ELNG3060	Power Plant Instrumentation
	PHYS3671	Solar Power	PHYS3681	Wind & Hydro Power
3 Foundation courses – 9 credits				
Students should consult the Department of Physics for guidance on registering for the RESDM course. Students are strongly encouraged to model an early iteration of their final research project as a project assignment for the RESDM course.				

ELECTRONICS AND COMPUTER SCIENCE (B.Sc.)

At least 99 credits are required for this programme. The courses are outlined below.

	Semester I		Semester II	
YEAR 1	COMP1126	Introduction to Computing I	COMP1161	Introduction to Object-Oriented Programming
	COMP1127	Introduction to Computing II	COMP1220	Computing and Society
	MATH1141	Introduction to Linear Algebra and Geometry	ELET1405	Practices in Basic Electronics
	MATH1185	Calculus for Scientists and Engineers	ELET1500	Electric Circuit Analysis and Devices
			ELNG1101	Physics for Engineers
YEAR 2	COMP2140	Software Engineering	COMP2201	Analysis of Algorithms
	COMP2201	Discrete Mathematics for Computer Science	ELET2410	Analysis and Designs of Analog Circuits
	ELET2405	Practices in Electronics Design I	ELET2415	Practices in Basic Electronics II
	ELET2450	Embedded Systems	ELET2480	Communication Systems
	ELET2460	Signals and Systems	ELET2570	Microprocessors and Computer Architecture
	ELET2530	Digital Electronics and Systems		
YEAR 3	COMP2190	Net-Centric Computing	COMP2171	Object-Oriented Design and Implementation
	COMP3101	Operating Systems	COMP3161	Database Management Systems
	COMP3220	Principles of Artificial Intelligence	COMP3901	Capstone Project
	ELET3405	Practical Analysis of Advanced Electronic Circuits & Systems		**ELCS ELECTIVE**
		ELCS ELECTIVE		**ELCS ELECTIVE**
3 Foundation courses – 9 credits				

ELCS ELECTIVE OPTION #1 Any **ONE (1)** of the following:	**ELCS ELECTIVE OPTION #2** Any **TWO (2)** of the following:
→ *COMP3191* *Principles of Computer Networks* → *COMP3911* *Internship in Computing I* → *ELET2420* *Solid State Electronic Devices* → *ELET3430* *Instrumentation and Measurements* → *ELET3470* *Wave Transmission and Fibre Optics* → *ELET3480* *Wireless Communication Systems* → *INFO2180* *Web Design and Programming I* → *INFO3170* *User Interface Design for IT*	→ *COMP3652* *Language Processors* → *COMP3702* *Theory of Computation* → *COMP3801* *Real-Time Embedded Systems* → *COMP3911* *Internship in Computing I* → *ELET3440* *Introduction to Robotics* → *ELET3450* *Satellite Communication and Navigational Systems* → *ELET3460* *Digital Signal and Image Processing* → *INFO3110* *Information Systems in Organisations* → *INFO3155* *Computer and Network Security* → *INFO3180* *Web Design and Programming II*

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 ELET1405). Foundations of Education courses (see 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.

REQUIREMENTS FOR A MAJOR IN THE DEPARTMENT OF PHYSICS

- To complete a major offered by the Physics Department, students must successfully attain the thirty-six (36) advanced level (level 2 and level 3) credits.

- 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.
    - *For example, a double major with a major in Electronics and a major in General Physics.*

- A combined major and a minor <u>within</u> the department is possible <u>only if the major is Electronics OR if the minor is either Renewable Energy Management or Electronics.</u>
    - *For example, a major in Medical Physics with a minor in Electronics or Renewable Energy Management.*

- Double majors may be done with any Physics Department major and a major from another Department.
    - *For example, a major in Material Science with a major in Chemistry.*

- Students pursing the major in Electronics <u>may</u> opt to "specialise" in one of two streams, either Telecommunications or Robotics & Instrumentation. A recommended set of courses for those streams is provided below. Please note that these are suggestions and are not meant to restrict your choice of courses or course combinations.

- Note that as ELET2420 is a core course for some non-Electronics majors, it cannot be counted as a free elective in Electronics majors.

- Mathematics courses that are listed are required for completion of Physics majors. For more information on Mathematics courses, please contact the Department of Mathematics. Students pursuing both MATH1142 and MATH1151 otherwise do not need to do MATH1185.

- Preliminary Chemistry courses or their equivalent are needed for the Materials Science Major.

The table below outlines the courses required for majors in the Department of Physics.

MAJOR	**YEAR 1**		**YEAR 2**		**YEAR 3**		**ELECTIVES**
	SEMESTER 1	**SEMESTER 2**	**SEMESTER 1**	**SEMESTER 2**	**SEMESTER 1**	**SEMESTER 2**	
ELECTRONICS	MATH1141	ELET1500	ELET2405	ELET2410	ELET3405	ELET3490	Any **Two (2)** Level 2 or 3 ELET courses.
	MATH1185	ELET1405	ELET2450	ELET2415		ELNG3030	
	PHYS1411	PHYS1421	ELET2460	ECSE2209			
	PHYS1412	PHYS1422	ELET2530	ELET2570			
	ECSE1109	COMP1161					
ELECTRONICS *TELE-COMMUNICATIONS*	MATH1141	ELET1500	ELET2405	ELET2410	ELET3405	ELET3450	
	MATH1185	ELET1405	ELET2530	ELET2415	ELET3470	ELET3460	
	PHYS1411	PHYS1421	ELET2450	ELET2480	ELET3480	ELET3490	
	PHYS1412	PHYS1422	ELET2460	ELET2570		ELNG3030	
	ECSE1109	COMP1161		ECSE2209		ELET3440	
ELECTRONICS *ROBOTICS & INSTRUMENTATION*	MATH1141	ELET1500	ELET2530	ECSE2209	ELET3405	ELET3490	
	MATH1185	ELET1405	ELET2450	ELET2410	ELET3430	ELET2570	
	PHYS1411	PHYS1421	ELET2460	ELET2415	ELET3480	ELNG3030	
	PHYS1412	PHYS1422		ELET2480			
	ECSE1109	COMP1161					

MAJOR	**YEAR 1**		**YEAR 2**		**YEAR 3**		**ELECTIVES**
	SEMESTER 1	**SEMESTER 2**	**SEMESTER 1**	**SEMESTER 2**	**SEMESTER 1**	**SEMESTER 2**	
ENERGY & ENVIRONMENTAL PHYSICS	MATH1141	ELET1405	ELET2420	PHYS2600	ELET3600	ELET3611	
	MATH1185	PHYS1421	PHYS2300	PHYS3661	PHYS2386	PHYS2396	
	PHYS1411	PHYS1422	PHYS2351		PHYS3671	PHYS3681	
	PHYS1412		PHYS2671				
GENERAL PHYSICS	MATH1141	ELET1405	ELET2420		MATH2230	PHYS2396	Any **<u>Two (2)</u>** Level 2 or 3 PHYS or ELET courses. **Note:** Highly Recommended PHYS3399 PHYS3565
	MATH1185	PHYS1421	PHYS2300		PHYS3386	PHYS3200	
	PHYS1411	PHYS1422	PHYS2351			PHYS3351	
	PHYS1412		PHYS2386			PHYS3395	
MEDICAL PHYSICS	MATH1141	ELET1405	ELET2460	PHYS2200	PHYS3300	PHYS3389	Any **<u>Two (2)</u>** Level 2 or 3 PHYS or ELET courses. **Note:** Highly Recommended MATH2230 PHYS3399
	MATH1185	PHYS1421	PHYS2300	PHYS2296	PHYS3341		
	PHYS1411	PHYS1422	PHYS2351	PHYS2396			
	PHYS1412		PHYS2386				

REQUIREMENTS FOR A MINOR IN THE DEPARTMENT OF PHYSICS

- A minor in Physics/Electronics requires 18 credits of advanced level (level 2 and level 3) courses.
- Students are required to ensure that they have the required pre-requisite for Level 2 and Level 3 courses.

MINOR	LEVELS 2 AND 3	
Electronics	ELET2405 ELET2410 ELET2415	ELET2450 ELET2460 ELET2530
Energy & Environmental Physics	PHYS2351 PHYS2386 PHYS2396	PHYS2600 PHYS3661 PHYS3671
General Physics	PHYS2300 PHYS2351 PHYS2386	PHYS2396 PHYS3351 PHYS3386
Medical Physics	PHYS2200 PHYS2300 PHYS2351	PHYS2386 PHYS2296 PHYS3389
Materials Science	PHYS2351 PHYS2386 PHYS2500	PHYS2561 PHYS3561 PHYS3562

REQUIREMENTS FOR MINOR IN RENEWABLE ENERGY MANAGEMENT

YEAR 1 Semester I		YEAR 1 Semester II	
***One (1)** of the following:*		ACCT1005	Financial Accounting
ECON1005	Introduction to Statistics	ECON1000	Principles of Economics I
SOCI1005	Introductory Statistics for the Behavioural Sciences		
STAT1001	Statistics for the Sciences*		
YEAR 2 Semester I		**YEAR 2 Semester II**	
PHYS2701	Essentials of Renewable Energy Technologies and Solutions	PHYS3701	Advanced Renewable Energy Technologies and Solutions
MGMT2026	Production & Operations Management	MGMT2224	Introduction to Entrepreneurship
YEAR 3 Semester I		**YEAR 3 Semester II**	
ELET3600	Energy Systems Laboratory		
MGMT3056	Project Management		

*STAT1001 is an alternative pre-requisite for MGMT2026.

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: Conduction, convection and radiation. First 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%

ELET1405
PRACTICES IN BASIC ELECTRONICS
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:

EITHER CAPE/A-Level Physics **OR**
PHYS 0421 - Introduction to Electricity and Magnetism,
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 multi-meters.
- **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%

ELET1500
ELECTRICAL CIRCUIT ANALYSIS AND DEVICES
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
CAPE/A-Level Physics **OR**
PHYS 0421 - Introduction to Electricity and Magnetism,
CSEC Physics with CAPE/A-Level Maths or
MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

Anti-requisite:
ECSE1102 Engineering Circuit Analysis and Devices

Course Content:

1. **DC Circuits:** Quantities and Units; Voltage, Current, and Resistance; Ohm's Law, Energy, and Power; Series Circuits; Parallel Circuits; Series-Parallel Circuits.
2. **AC Circuits:** Introduction to Alternating Current and Voltage; Network Theorems; Capacitors; RC Circuits; Inductors; RL Circuits; RLC Circuits and Resonance; Series-Parallel ac Networks; Time Response of Reactive Circuits; Magnetism and Electromagnetism; Magnetic Circuits; AC Network Theorems; AC Power; Decibels, Filters, and Bode Plots; Transformers; Poly-phase Systems; Pulse Waveforms and the R-C Response; Non-sinusoidal Circuits.
3. **Devices:** Introduction to semiconductor theory; Diodes and Applications; Transistors and Applications; The Operational Amplifier; Basic Op-Amp Circuits, Active Filters.
4. **Circuit Theory in Laplace domain.**
5. **Transient and steady state solutions**: Complex number models; Complex power; Power factor correction.

Evaluation:

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

PHYS1411
MECHANICS
(3 Credits) (Level 1) (Semester 2)

Pre-requisites:
CAPE/A-Level Physics **OR**
PHYS0411 - Introduction To Mechanics **OR**
CSEC Physics with CAPE/A-Level Maths or
MATH0100 - Pre-calculus **and** MATH0110 - Calculus and Analytical Geometry.

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 2)

Pre-requisites:
CAPE/A-Level Physics **OR**
PHYS 0412 - Introduction to Oscillations and Heat,
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 (e.g., 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 0421 - Introduction to Electricity and Magnetism,
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; Electro-magnetic 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**
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, de Broglie'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%

ELET2210
SPEECH PROCESSING
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
ELET2460 - Signals and Systems,
COMP1126 - Introduction to Computing I **AND**
COMP1127 - Introduction to Computing II

Anti-requisite: COMP3802

Course Content:
Speaking; Hearing; Sounds and symbols; Articulatory and acoustic phonetics; Phonology; Prosody; Speech spectra; Sampling; Fourier Transform; Linear filters; Linear prediction; Cepstral analysis.

Evaluation:

- Final Written Examination (2 hours) 30%
- Course Work: 70%
    - 2 equally weighted programming projects 50%
    - 2 equally weighted hour-long In-course Tests 20%

NB: Students must pass both coursework and exam components, separately.

<u>ELET2405</u>
<u>PRACTICES IN ELECTRONICS DESIGNS I</u>
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
ECSE1109 - Programming for Engineers I **OR** Equivalent
ELET1405 - Practices in Basic Electronics

This course is practical in nature and is evaluated through several laboratory experiments and a course project. While guidance will be provided, the course takes a student-centred approach, requiring students to undertake some amount of independent research and to think critically. These ultimately serve to enhance students' problem-solving skills and build confidence.

Course Content:

8. **Course Assignments/Experiments:** Students are required to complete up to 6 practical assignments (experiments). The first two experiments serve as an introduction to microcontrollers and associated technologies and relate to the design and development of intelligent-based embedded systems. The remaining experiments brings students through the process of developing a smart electronic system by designing and implementing a small electronic device. Manuals for each experiment are available on the course site.

9. **Course Project:** Students will individually design and implement electronic systems utilising the skills and information garnered during the execution of the laboratory activities and independent research. This should be done concurrently with the laboratory experiments as the skills and technologies are introduced.

Note: To complete the experiments and project, students are required to purchase the necessary electronic components and materials. The list of items will be communicated to students at the beginning of the course.

Evaluation:

- Design Project 70%
- Laboratory Reports 30%

ELET2410
ANALYSIS AND DESIGN OF ANALOG CIRCUITS
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1411 - Mechanics,
PHYS1412 - Wave, Optics and Thermodynamics,
PHYS1421 - Electricity and Magnetism,

ELET1405 - Practices in Basic Electronics **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:
ECSE1109 - Programming for Engineers I **OR** Equivalent
ELET1405 - Practices in Basic Electronics

This course is practical in nature and is evaluated through several laboratory experiments and a course project. While guidance will be provided, the course takes a student-centred approach, requiring students to undertake some amount of independent research and to think critically. These ultimately serve to enhance students' problem-solving skills and build confidence. It is highly recommended that students take ELET2405 before taking this course.

Course Content:
1. Course Assignments/Experiments: Students are required to complete up to 6 practical assignments (experiments) that are designed to give students a hands-on introduction to various technologies utilised in the development of Internet of Things (IoT) systems, remote data acquisition and transfer systems, and web-based data storage, retrieval, and display. Students are also exposed to the use of various serial communication technologies and environmental sensors. Manuals for each experiment are available on the course site.
2. Course Project: Students are required to individually design and implement electronics systems utilising the skills and information garnered during the execution of the laboratory activities and independent

research. This should be done concurrently with the laboratory experiments as the skills and technologies are introduced.

Note: To complete the experiments and project, students are required to purchase the necessary electronic components and materials. The list of items will be communicated to students at the beginning of the course.

Evaluation:

- Design Project 70%
- Laboratory Reports 30%

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,
OR
ELNG1101 – Physics for Engineers
AND
ELET1405 - Practices in Basic Electronics **AND**
CAPE/A-Level Mathematics OR (MATH0100 and MATH0110) 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%	

ELET2450
EMBEDDED SYSTEMS
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1421 - Electricity and Magnetism
OR
ELNG1101 - Physics for Engineers
AND
ECSE1109 - Programming for Engineers I **OR** Equivalent
AND
ELET1405 - Practices in Basic Electronics

Course Content:

1. **Embedded Systems Overview:** Introduction and Background; Embedded Systems; Processors in Embedded Systems; 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; 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; Pre-processor Commands; C Types, Operators and Expression; C Control Flow (For, While, If/Else, Switch, etc. Control Structure.); Function and Program Structure.
9. **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; Modem AT Commands.
10. **Design & Development:** Design Plans (Project Specifications, etc.); Sourcing and Selection of Controllers and Components; Designing Circuits; Flowcharts and Programs; Implementation and Packaging; Documentation.
11. **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,
OR
ELNG1101 – Physics for Engineers
AND
ELET1405 - Practices in Basic Electronics **AND**
CAPE/A-Level Maths) OR (MATH0100 and MATH0110) 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:** What 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.

ELET2480
COMMUNICATION SYSTEMS
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1412 - Wave, Optics and Thermodynamics,
PHYS1421 - Electricity and Magnetism,
ELET1405 - Practices in Basic Electronics **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%

ELET2530
DIGITAL ELECTRONICS AND SYSTEMS
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1421 - Electricity and Magnetism,
ELET1405 - Practices in Basic Electronics **AND**
CAPE Mathematics (or equivalent).

Course Content:

1. **Introductory and Basic Concepts:** Digital and analog quantities; Representation of digital quantities (binary digits, logic levels, etc.); Converting analog quantities to digital (quantization); Overview of binary and hexadecimal numbering systems; Basic logic gates and their operations: NOT, AND, OR, NAND, NOR, EX-OR and EX-NOR; Theory and operations of simple logic circuits; Characteristics and parameters of logic circuits (timing diagram, propagation delay, fan-out, etc.) and Integrated circuit technologies (TTL, CMOS, programmable arrays, etc.).
2. **Boolean Algebra:** Boolean operation and expressions; Laws of Boolean algebra; Simplification of Boolean expressions (SOP, POS, Karnaugh Maps); and Describing logic with an HDL.
3. **Basic Combinational Logic Circuits and Analysis:** Basic combinational logic circuits; Boolean expression to logic circuits and vice-versa; Combinational logic using NAND and NOR gates; Logic circuit operations with waveform inputs and combinational logic with VHDL.
4. **Functions with Combinational Logic:** Basic and parallel adders; Comparators; Decoders and Encoders; Multiplexers and Demultiplexers.
5. **Sequential Logic:** SR and D latches; Flip-flops and their operating characteristics and flip-flop applications.
6. **Functions with Sequential Logic:** Counters and Shift Registers: Basics of counters, asynchronous and synchronous counters, cascading counters, counter applications, basic shift register operation, serial and parallel shift registers, bidirectional shift registers and shift register applications.
7. **Memory and Storage:** Memory basics; Random access memory family members, operation and characteristics; Read only memory family members, operation and characteristics; Flash memory operation and characteristics; Magnetic and optical storage.
8. **Programming Logic and Software:** Programming logic: SPLDs and CPLDs, PLDs real-world examples (Altera, Xilinx, etc.); Programmable logic: FPFAs, Real-world FPGA examples (Altera, Xilinx, etc.) and Programmable logic software.
9. **Signal Conditioning and Processing:** Conversion of analog signals to digital signals; Analog-to-digital conversion methods; Digital-to-analog conversion methods; Decoders and encoders.

Evaluation:

- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 1 In-course Test 15%
    - Assignments 25%
    - Project/Paper 10%

ELET2570
MICROPROCESSORS AND COMPUTER ARCHITECTURE
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS1421 - Electricity and Magnetism,
ELET1405 - Practices in Basic Electronics **AND**
CAPE Mathematics (or equivalent).

Co-requisites:
ELET2530 – Digital Electronics and Systems

Course Content:
1. **Review of Digital Design and VHDL:** Combinational Logic; Structural Modeling; Sequential Logic; Finite State Machines.
2. **Arithmetic Logic Unit (ALU):** Arithmetic Circuits; ALU; Number Systems.
3. **Microprocessor I:** Instruction Data Set. Machine Language Assembly Language; Machine Language; Programming; Addressing Modes.
4. **Microprocessor II:** Control and Datapath Design, Single-Cycle Processor Performance Analysis; Single-Cycle Processor.
5. **Microprocessor III:** Control and Datapath Design. Multi-Cycle Processor Performance Analysis; Multicycle Processor; Pipelined Processor
6. **Memory Systems and I/O:** Memory System; Caches; Virtual Memory; Memory-Mapped I/O; Memory Map; I/O Devices Buses and Organization
7. **Interrupts:** A Taxonomy of Interrupts; Hardware and Software Interrupts
8. **Comparison of Legacy and Modern Architectures**
9. **Introduction to Microprogramming**

Evaluation:
- Final Written Examination (2 hours) 50%
- Course Work: 50%
    - 1 In-course Test 15%
    - Assignments 25%
    - Project/Paper 10%

PHYS2000
FUNDAMENTALS OF ENERGY STATISTICS
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
None

Co-requisite:
None

Course Content:
General Definitions, System Units and Conversion Factors, Reserves and Potential, Energy Prices, Infrastructure and Transfers, and Energy Sector Indicators.

Evaluation:

- Assignments/Quizzes) 20%
- In Course Test(s): 20%
- Project Presentation & Report 20%
- Final Written Exam (2 hours) 40%

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**
OR
ELNG1101 – Physics for Engineers

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:
PHYS0411 – Introduction to Mechanics

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:
PHYS1412 - Wave, Optics and Thermodynamics,
PHYS1421 - Electricity and Magnetism **AND**
PHYS1422 - Modern Physics.
OR
ELNG1101 – Physics for Engineers

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,
PHYS1422 - Modern Physics.
OR
ELNG1101 - Physics for Engineers

Co-requisite:
MATH1185 - Calculus for Scientists and Engineers.

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 Assignments 10%
    - 5 Pop Quizzes 20%
    - 2 In-course Practical Examinations 30%

PHYS2386
ELECTROMAGNETISM AND OPTICS
(3 Credits) (Level 2) (Semester 1)

Pre-requisites:
PHYS1412 - Wave, Optics and Thermodynamics,
PHYS1421 - Electricity and Magnetism **AND**
OR
ELNG1101 - Physics for Engineers

Course Content:

1. **Electricity and Magnetism:** Electric fields and magnetism in matter; Displacement current and charge conservation; Electromagnetic waves and Maxwell's equations; Plane wave equations; 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%

<u>PHYS2396</u>
<u>COMPUTER APPLICATIONS IN PHYSICS</u>
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
None

Course Content:

1. **Introductory Material:** Introduction to software packages (e.g., MATLAB/SciLAB, MathCAD) and programming languages (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-Raphson 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 B.

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
OR
ELNG1101 - Physics for Engineers.

Co-requisites:
PHYS2671 - Fluid Dynamics.

Course Content:
Measurement of fluid drag on spheres and disks; Investigation of Bernoulli and Poiseuille's 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)

Pre-requisites:
PHYS1411 - Mechanics,
PHYS1412 - Wave, Optics and Thermodynamics,
OR
ELNG1101 - Physics for Engineers.
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; Poiseuille's 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; 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**: 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: ~1500) 15%
    - Oral presentation 10%

ELET3211
SPEECH AND LANGUAGE TECHNOLOGY
(3 Credits) (Level 3) (Semester 1)

Pre-requisites:
ELET2210 - Speech Processing **OR**
COMP2802 - Speech Processing

Anti-requisite(s):
COMP3802

Course Content:
Introduction to Speech Technology; Speech Signal Processing; Probability Theory for Speech Processing; Hidden Markov Models and Deep Neural Networks for Speech Processing; Acoustic modelling; Language modelling; Approaches to

Decoding; Model Adaptation; Speech Recognition Examples; Speaker identification technologies; Speech Synthesis

Evaluation:

- Final Written Examination (2 hours) 30%
- Course Work: 70%
    - 2 equally weighted programming projects 50%
    - 2 equally weighted hour-long In-course Tests 20%

ELET3405

PRACTICAL ANALYSIS OF ADVANCED ELECTRONIC CIRCUITS AND SYSTEMS

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

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 the 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**
ELET2530 - Digital Electronics and Systems.
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 Industrial Measurement System 20%

ELET3440
INTRODUCTION TO ROBOTICS
(3 Credits) (Level 3) (Semester 2)

Pre-requisites:
ELET2530 - Digital Electronics and Systems **AND**
ELET2450 - Embedded Systems.

Course Content:

1. **What is Robotics?** Brief History of Robotics; Basic Robots; Examples of Robots.
2. **Robots & Embedded Controllers:** Design of Robot Platforms; Robot Embedded Controllers; Interfacing Controllers with External Device.
3. **Software/Hardware Development Tools:** Code Compilers; Code Assemblers; Code Simulation/Debugging Software; Hardware Programmers.
4. **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.
5. **Robot Related Control:** On-Off Control, PID Control, Velocity and Position Control, Multiple Motors Control.
6. **Wireless Communication for Robots:** Basic layout of Communication System; Design of Simple Wireless Communication System; Remote Control of a Robotic Platform.
7. **Mobile Robot Design:** Exploring Designs for Driving Robot; Exploring Designs for Walking Robots; Exploring Designs for Autonomous Robots.
8. **Robot Applications:** Discussions on selected robot-based applications, such as Industrial Robots, Maze Exploration Robots.
9. **Emerging Topics:** Selected topics from new developments in the field of robotics.

Evaluation:

- Final Written Examination (2 hours) 40%
- Course Work: 60%
    - 1 In-course Test 20%
    - 2 Written Assignments 10%
    - 3 Practical Assignments 30%

ELET3450
SATELLITE COMMUNICATION & NAVIGATIONAL 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%

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 waveguides, 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) (Semesters 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 hours 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%
- Ongoing Assessment 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 - Integrating 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%

PHYS3000
ENERGY INFORMATION MANAGEMENT
(3 Credits) (Level 2) (Semester 2)

Pre-requisites:
PHYS2000

Co-requisite:
None

Course Content:
Review of Energy Statistics, Energy data sources, collection and compilation, Introduction to Standard International Energy Product Classification – Caribbean context, Data Management Frameworks, Energy Flows, and Energy Balances.

Evaluation:

- Assignments/Quizzes) 20%
- In Course Test(s): 20%
- Report 10%
- Project Presentation 10%
- Final Written Exam (2 hours) 40%

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-requisite:
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 Perturbation Theory; Variational Principle.
2. **Relativity:** Lorentz Transformation Equations; Simultaneity; Time Dilation; Length Contraction; Velocity Addition; Minkowski's Space-time Diagrams Space-time 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%

PHYS3386
ELECTROMAGNETISM
(3 Credits) (Level 3) (Semester 1)

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 coefficients; 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,
PHYS1422 - Modern Physics
OR
ELNG1101 - Physics for Engineers

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) obtain 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 have, at a minimum, a 'B' Grade in PHYS2386 Electromagnetism and Optics, or a 'B' Grade in ELET1500 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) Quiz will be administered online, and the student must obtain a minimum grade of B.	10%
One Report (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.	50%

Performance Evaluation 20%

(Graded by supervisor)

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 20%

(Graded by a panel comprising lecturers in the department and a company representative)

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
OR
ELNG1101 - Physics for Engineers.

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 Geostrophic 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 agreements (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 15%
    - Group project/Laboratory Work 10%
    - Oral presentation 10%

OTHER PROGRAMME AND FOUNDATION COURSE

1. Science and Media and Communication (BSc.)
2. Science, Medicine and Technology In Society (FOUN1201/FD12A)

SCIENCE AND MEDIA AND COMMUNICATION (B.SC.)

The programme is a double major or major/minor which contains a named science major AND a media and communication major or minor.

The programme will be taught jointly by The Caribbean School 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. Satisfy entry requirements for CARIMAC, which may include being interviewed or being asked to submit a portfolio.
3. Undergo mandatory academic counselling.

If you are interested in pursuing this programme, you MUST contact the Dean's Office, Faculty of Science and Technology at fst@uwimona.edu.jm.

SCIENCE, MEDICINE AND TECHNOLOGY IN SOCIETY (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 endeavour 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

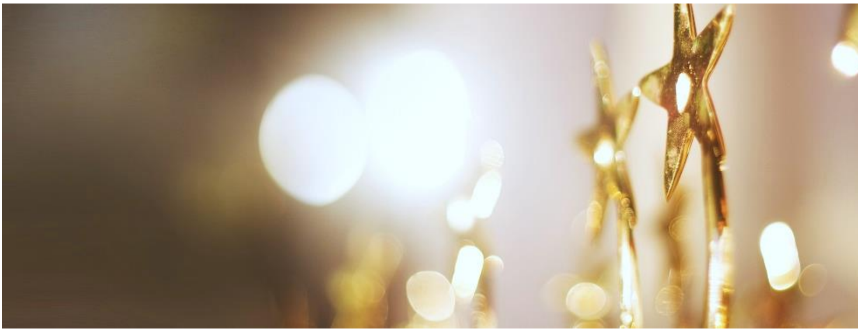
- Unit 1 – I sues of Current Interest-Introduction
- Unit 2 Part I – Induction and Deduction
- Unit 2 Part II – The Hypothetico-Deductive Approach: Scientific Fact and Changing Paradigms
- Unit 2 Part III – Observation and Experimentation
- Unit 3 – The relationship between Science, Medicine and Technology

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 Organisms
- 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 AND BURSARIES

DEPARTMENT OF CHEMISTRY

- **The Cedric Hassall Scholarship**

The Cedric Hassall Prize is the premier award in the Department of Chemistry. It was first awarded as a prize in 1971 and was given to the Chemistry student who had shown the best overall performance in the examinations associated with the first year of advanced Chemistry courses. This prize has been upgraded to a Scholarship and is awarded to a final year student majoring in Chemistry who satisfies the above criteria. The scholarship is named in honour of Professor Cedric Hassall (1919-2017), the first Professor of Chemistry at the University and former Head of the Department of Chemistry (1948-1957), who delivered the inaugural lecture to the original batch of medical students. It 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 was established largely through the initiative of Professor Gerald Lalor during his tenure as Head of the Department.

- **The Wilfred Chan Award**

Wilfred Chan completed the requirements for the BSc degree in 1952 and 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 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 advanced Organic Chemistry courses. The awardee should not simultaneously hold any other Chemistry Department prize.

- **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 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 and who is pursuing a major in Chemistry. The awardee should not simultaneously hold any other Chemistry Department prize.

- **The Kenneth E Magnus Applied Chemistry Prize**

Kenneth Magnus was a member of the first batch of students who graduated from the then University College of the West Indies. He completed a Master's and a PhD in the Department of Chemistry at UWI. He subsequently lectured in the Department retiring as Professor of Applied Chemistry. During his tenure at the UWI, Professor Magnus served in the capacity as Head of the Department of

Chemistry (1977-1986) and Dean of the Faculty of Natural Sciences. He was the driving force behind the establishment of the Applied Chemistry Programme in 1969 and subsequently the Food Chemistry Programme in 1982.

The Kenneth Magnus Prize is awarded to a final year student who is currently enrolled as an Applied Chemistry Major and who has the best academic performance in the courses comprising the major. The awardee should not simultaneously hold any other Chemistry Department prize.

- **The Food Chemistry Prize**

The Food Chemistry Prize was first awarded in 2016. It is awarded to a final year student who is currently enrolled as a Food Chemistry Major and who has the best academic performance in the courses comprising the major. The awardee should not simultaneously hold any other Chemistry Department prize.

- **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 (1957-1969). The award named in his honour is presented annually to the student with the best academic performance in the Introductory Level Chemistry courses and who is proceeding to Level 2 Chemistry 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 in Chemistry and who is proceeding to Level 2 Chemistry 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 in Chemistry and who is proceeding to Level 2 Chemistry courses. The awardee should not be in receipt of any other Chemistry Department prize in the year of consideration.

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.

- **NCB Best 2nd Year Computer Science/Software Engineering Award**

The National Commercial Bank Jamaica Ltd. celebrates the achievement of excellence in a field of study that will directly impact the digital economy. The winner of this award is the student with the highest average in first year, and Semester I of the second year Computer Science/ Software Engineering courses.

- **NCB Best 2nd Year Information Technology Award**

The National Commercial Bank Jamaica Ltd. recognizes the accomplishments of future contributors to the ICT sector in Jamaica. The winner of this award is the student with the highest average in first year, and Semester I of the second year Information Technology Engineering courses.

- **The Ezra Mugisa Award**

The Ezra Mugisa Award was introduced in 2020/2021 by the Department of Computing in honour of Dr. Ezra Mugisa in recognition of his contribution to the Department and as a motivation to the students of Computer Science. This award is a tribute to the work of Ezra Mugisa who retired from the University in 2018. He distinguished himself as an invaluable member of the Department of Mathematics & Computer Science and later the Department of Computing. He joined the UWI, Mona Campus in 1982 as a Data Controller in the then Sub-Department of Computer Science and subsequently obtained his Ph.D. in Computer Science at Imperial College, University of London. Dr. Mugisa taught numerous courses at both the B.Sc. and M.Sc. levels and served a number of terms as Head of the Computer Science Section and later as Head of the Department of Computing. The award is presented to a second-year student with the highest average in first year and Semester I of the second year Computing courses.

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**

This scholarship was inaugurated in 1981 to identify outstanding students in the undergraduate Geology programme and to single out such talent for recognition and support. This award is made to a student who possesses outstanding scholastic abilities and has secured excellent grades at two successive University Examinations. The Level I Geology Prize (Sponsored by the Geological Society of Jamaica) is awarded to the geology student with the best Level I results. The Level II Geology Prize (Sponsored by the Geological Society of Jamaica) is awarded to the geology student producing the best geology field map in GEOL2204. The Level III Geology Prize (sponsored by the Geological Society of Jamaica) is awarded to the geology student producing the best final year research project.

DEPARTMENT OF LIFE SCIENCES

- **The Don Skelding 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 then 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 former 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.*

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 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 of Astrophysics 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.

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) - Preliminary and Level 1 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.

TECHNOLOGY

UWI
MONA CAMPUS
JAMAICA, WEST INDIES

Inspiring Excellence , Producing Leaders

FST

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