UWI
ST. AUGUSTINE CAMPUS

POSTGRADUATE

# FACULTY OF Science & Technology

## REGULATIONS & SYLLABUSES

2014/2015

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# MESSAGE FROM THE DEAN

Welcome to the Faculty of Science & Technology (FST), The University of the West Indies, St. Augustine. We are extremely proud and delighted that you have chosen the FST for your post-graduate training. This new Faculty, which partially replaces the former Faculty of Science & Agriculture, has a strong history in research, innovation and development. We offer a range of post-graduate diplomas, M.Sc., M.Phil., and Ph.D. degrees in disciplines such as Mathematics, Physics, Chemistry, Computer Science, Environmental Science, and Biological Sciences.

The FST is the second largest faculty at the St Augustine Campus and also the most diverse in terms of academic programmes offered. In the FST, we have highly qualified and competent academic, administrative, technical and support staff, and many state-of-the-art laboratories. Several of our academic staff are world-renowned, and some of them were actually post-graduate students at the UWI. We recognize that post-graduate students are the lifeblood of research and innovation in our faculty and encourage you to develop new, creative and interesting ideas. We promise to support you in this effort and offer you post-graduate training that is second to none.

The FST consists of five departments: Chemistry, Computing & Information Technology, Life Sciences, Mathematics & Statistics, and Physics. This booklet contains important information on our various post-graduate programmes and courses and we encourage you to become very familiar with it.

The FST provides post-graduate students with an intellectually stimulating atmosphere conducive to development of critical thinking skills and research. For M.Phil. and Ph.D. degrees, apart from being assigned a supervisor or supervisors, we have also established advisory committees. There are also ongoing research seminars by students, staff and visiting scientists; all post graduate students are required to attend these seminars.

On behalf of the staff of the FST, I wish you a very warm welcome and success in your chosen higher degree, either taught or by research. I also wish you an enjoyable stay in our Faculty and hope that you would have a thoroughly satisfying experience and look back on these years as the most stimulating, productive and rewarding time of your life.

**Professor Indar Ramnarine**
**DEAN**

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# GENERAL INFORMATION ON POSTGRADUATE STUDIES IN THE FACULTY

**1. SCHOOL FOR GRADUATE STUDIES AND RESEARCH (SGS&R)**

The School for Graduate Studies and Research has the overall responsibility for the development of graduate studies and research on all four campuses of The University of the West Indies. The School is chaired by its Pro Vice Chancellor (PVC, Graduate Studies) and is governed by the Board for Graduate Studies and Research. There is a committee of the SGS&R on each campus called the Campus Committee for Graduate Studies and Research. The SGS&R works closely through these four (4) Campus Committees to manage and administer activities related to research and graduate studies. The School assists academic departments with the maintenance and development of coherent graduate studies programmes and, through the Board for Graduate Studies and Research, approves the establishment of new postgraduate programmes and the award of degrees.

**2. TYPES OF GRADUATE PROGRAMMES OFFERED IN THE FACULTY OF SCIENCE AND TECHNOLOGY.**

The Faculty offers a wide range of certificates, diplomas, taught Master's degree as well as research degrees (MPhil and PhD)

(a) **Taught Programmes**
The programmes for the Master of Science (MSc) degrees and for Postgraduate Diplomas consist mainly of a set of lectures, seminars, coursework assignments and either a project or a research paper. The Faculty also offers Diplomas and Certificates by distance.

(b) (i) **Research Degrees**
The Master of Philosophy (MPhil) and the Doctor of Philosophy (PhD) degrees are research degrees that primarily involve independent study, directed by one or more supervisors. All MPhil and PhD programmes of study culminate in the presentation of a thesis conveying the results of the independent study and research carried out by the graduate student. It is necessary that graduate students, supervisors, advisory committees and examiners ensure that the qualitative and quantitative distinction between the MPhil Degree and PhD Degree be understood and maintained.

**(ii) The MPhil Thesis**
The MPhil thesis reviews the state of knowledge in a particular field, creates and evaluates a new design or novel experiments in a particular aspect of an area of study or makes an appropriate critique or interpretation of the subject. The Master's thesis should be evidence of the graduate student's ability to effectively review the relevant literature in the field, to undertake independent research and to present the results in a clear, systematic and scholarly form.

It is normally expected that a Master's thesis will make some independent contribution to knowledge or understanding in the subject area in which the student is working.

**(iii) The Doctoral Thesis**
A Doctoral thesis must set forth a significant contribution to knowledge or understanding, adding to or critiquing through approved research methodologies the current theoretical underpinnings and empirical base in the student's field of study.

The thesis must be set forth in a scholarly manner demonstrating the original and independent investigations conducted and setting forth unambiguously its achievements, contributions and findings in a format appropriate to Doctoral Theses in the particular discipline.

The Doctoral Thesis must reflect not only mastery of the subject area under investigation and competence in research techniques, but also the ability to select an important problem for investigation and to deal with it in a mature, competent manner.

The Doctoral Degree is, by nature and tradition, the highest certificate of membership in the academic community. It is meant to indicate the presence of superior qualities of mind, intellectual interest and high attainment and knowledge in a chosen field. It is not conferred merely as a certificate for a prescribed course of study and research, no matter how faithfully pursued. Independent achievement at a high intellectual level is a prerequisite to its conferment. A Doctoral Thesis or parts thereof must be judged to be potentially publishable.

The award of a PhD also requires the candidate to defend his/her thesis at a public oral examination. Many research degrees now contain a taught element. The intention of these taught courses is to provide students with research techniques and skills that will not only help them complete their current research topic, but will also stand them in good stead for life after University.

With the exception of holders of MPhil degrees from recognised Universities, candidates interested in pursuing the PhD degree are normally required to register for the MPhil Degree in the first instance. If your Supervisors are happy with your progress, then provisions exist to upgrade your registration from the Master's to Doctoral level without first submitting a Master's dissertation.

If you decide to pursue a research degree, it is very important that the thesis topic you choose is of genuine and sustainable interest to you.

**3. REGISTRATION**

The academic year is divided into two (2) semesters as follows:
Semester I - August to December
Semester II - January to May

Candidates for the MPhil or PhD degree may register during the first two weeks of either Semester but it is more usual for such candidates to begin their studies at the start of the academic year. A candidate wishing to pursue a taught Master's Degree or an Advanced Diploma programme MUST begin his/her studies at the start of the academic year unless otherwise specified.

Students from Trinidad & Tobago may be registered for full-time or part-time studies. You will not be registered for full-time studies if you spend an average of twelve or more hours a week in paid employment. For a student registering as part-time, proof of leave of absence from your job must be submitted at the time of registration. Overseas students will normally be required to register as full-time studies.

No allowances will be made with respect to attendance at lectures, laboratories, tutorials or examinations for students on the condition of their employment.

**4. TIME LIMITATION**

The following table shows IN GENERAL the time limitation (in years) for postgraduate degrees:

| PROGRAMME | FULL TIME | | PART TIME | |
|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum |
| Diplomas | 1 | | 2 | |
| MSc (taught) | 1 | 2 | 2 | 4 |
| MPhil | 2 | 3 | | 5 |
| PhD | 3 | 5 | 5 | 7 |

**5. ACADEMIC SUPERVISOR**

Each research student is assigned one or more supervisors who will guide the student through his/her studies. The appointment of a supervisor(s) is recommended by the relevant Head of Department after careful consideration of the Faculty member's expertise and experience. Also, a Committee of Advisors shall be appointed by the Board for Graduate Studies and Research for each MPhil and PhD student. This Committee shall comprise a minimum of three persons, including the supervisor(s) of your research programme.

**6. ASSESSMENT**

**a. Taught Programmes**

The methods of assessment may vary, but examinations are conducted mainly by written papers supplemented by in-course testing, practical examinations, a project report, a research paper, or a combination of these methods.

Candidates are required to pass all courses and all coursework, designated by the Department as forming part of the higher degree programme for which they are registered, with a mark of 50% or better.

To qualify for a distinction, a candidate must achieve an average of 70% or better (Grade A) in the written courses and a mark of 70% or better in the research paper or project report. A candidate failing a course shall be ineligible for the award of distinction.

**Note that in calculation of averages, marks are not rounded to the nearest whole number. Hence, for example, an average mark of 69.9 in written courses does not qualify for distinction.**

**b. MPhil/ PhD Thesis and Examination**

All research degrees are examined by theses. In addition, research students will be required to pass courses amounting to a MINIMUM of 6 credits for the MPhil and 9 credits for the PhD degree. For the MPhil degree the candidate may be required to defend his/her thesis by an examination. Every candidate for the PhD must defend his/her thesis by an oral examination.

High commendation may be bestowed on a candidate for either the MPhil or the PhD degree where the Examiners are unanimous in their recommendation that such an award should be made.

A candidate who is unsuccessful in the examination for the PhD may apply to the Board for Graduate Studies and Research for transfer of registration to the relevant MPhil and for permission to resubmit the relevant thesis or a revised version of it for examination for a Master's degree. Where the application is approved, the registration for the PhD will lapse and the registration for the MPhil will be deemed to have started from the date of registration for the PhD.

**7. UPGRADING OF REGISTRATION**

Postgraduate students who are registered for the MPhil degree and who wish to be considered for the upgrading of their registration to PhD must apply to do so in the second year of registration on the written recommendation of their supervisor(s). Applications for upgrading will normally not be considered after the third year of registration. A supervisor must state why he/she considers the student to be outstanding and whether in his/her opinion the work can be developed to the level of the PhD. Applicants for upgrade must submit a written proposal outlining the work done to date and how they propose to develop this work into a PhD and must defend their proposal for upgrading at an open seminar convened for this purpose.

All recommendations from Departments for PhD upgrade registrations are subject to the approval of the Board for Graduate Studies and Research.

**8. GRADUATE RESEARCH SEMINARS:**

All postgraduate research students are required to present seminars as follows:

- MPhil - at least two
- PhD - at least three

These seminars will be examined and graded on a 'pass' or 'fail' basis. Students are also required to attend a minimum of 75% of all Departmental/Faculty seminars. A Seminar attendance register will be kept by all Departments.

# GENERAL INFORMATION ON THE FACULTY OF SCIENCE & TECHNOLOGY

## PROGRAMMES

The Faculty of Science and Technology offers training at the graduate level in the Life and Physical Sciences with a wide range of practical and business applications from Environmental Sciences and Management to Information Technology, Computational Mathematics, Material Science, Molecular Biology, Alternative Energy, Medical Physics and Natural Products to name a few. A number of these programmes are multidisciplinary in nature and are done in conjunction with other Departments/Faculties. This training allows students to acquire the range of marketable skills essential in the light of globalisation. Postgraduate programmes in the following areas are currently offered.

**POSTGRADUATE DIPLOMA:**

Biodiversity Conservation and Sustainable Development in the Caribbean (Offered by Distance Teaching)

**MASTER OF SCIENCE (MSc) DEGREES:**

- Computer Science and Technology
- Mathematics
- Statistics
- Occupational and Environmental Safety and Health
- Biodiversity Conservation and Sustainable Development In the Caribbean (Offered by Distance Teaching)
- Renewable Energy Technology
- Biotechnology

**MASTER OF PHILOSOPHY (MPhil) AND DOCTOR OF PHILOSOPHY (PhD) DEGREES:**

- Biochemistry
- Chemistry
- Computer Science
- Environmental Biology
- Mathematics
- Microbiology
- Physics
- Plant Science
- Statistics
- Zoology

## ENTRY REQUIREMENTS

Candidates seeking entry to the Diploma, or MSc, or MPhil programmes in the Faculty must satisfy the minimum requirements of the Board for Graduate Studies and Research (Lower Second Class Honours for MSc and Upper Second Class Honours or equivalent for MPhil) AND must hold a BSc degree at the prescribed level in Natural Sciences (or an equivalent qualification) from an approved University. In exceptional cases, students may be admitted with a pass degree and considerable work experience in a related area.

For direct entry into the PhD programme, a student must satisfy minimum entry requirements of the Board of Graduate Studies & Research AND have obtained a MPhil degree (or an equivalent qualification) in an appropriate field of study in science from an approved tertiary level institution.

The Faculty consists of five (5) departments

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# PROGRAMMES

**MSc/ MPhil/PhD**

The Department of Chemistry offers one taught master's programme leading to the MSc in Occupational and Environmental Health and Safety, as well as MPhil and PhD degrees by research in the areas of Natural Products, Inorganic and Materials Chemistry, Liquid Crystals, Environmental Chemistry and Waste Management, Bio-analytical Chemistry, Nuclear Magnetic and Nuclear Quadrupole Resonance Spectroscopy, Supramolecular Chemistry, Organic Synthesis, Microcalorimetric studies on Biological Systems; Corrosion Chemistry and Chemical Education.

Students may register on a part-time or full-time basis. The Board for Graduate Studies and Research offers a limited number of scholarships to students of the highest academic standing registering for MPhil/ PhD Some Departmental funding, in the form of full-time demonstratorships, is available for registered MPhil/ PhD students not on scholarship.

# RESEARCH INTERESTS

Topics which are currently being actively investigated by staff include:

- isolation and structure elucidation of Natural Products from terrestrial plants and marine organisms including synthesis and bioactivity testing;
- optical, electronic, magnetic and catalytic properties of organometallic complexes;
- solar cell materials;
- perfluorated phosphine based catalysts;
- rational design and construction of supramolecular assemblies;
- environmental monitoring and hazardous waste management and disposal;
- food safety;
- biosensors for environmental clinical and forensic applications;
- applications of immobilised enzymes and biomolecules, bioseparation processes;
- nuclear magnetic and quadrupole resonance studies of dynamic equilibria;
- calorimetric studies on biological systems;
- the preparation of carbohydrates and novel boron-based catalysts for organic synthesis;
- hydration processes in cement admixtures;
- investigation of aggregate structures in biological membrane models;
- virgin and waste polymer cracking in a fluidised-bed reactor
- synthesis of chiral ligands based on the [2.2] paracyclophane framework for use in chiral synthesis;
- microbial degradation and fate of xenobiotics in environmental systems;
- air quality monitoring
- endocrine disruptors in freshwater systems;
- corrosion chemistry;
- electroanalytical methods;
- carbohydrate synthesis;
- biological/biophysical chemistry;
- oxidation of methane;
- peptide chemistry; synthesis and optimization of macrocylic pharmacophores as PPI inhibitors; passive permeability evaluation of Peptoids.
- biotransformation to produce novel chemical entities
- enzymes in ionic liquids;
- thermotropic phase behaviour of metal containing liquid crystal compounds;
- chemical education - assessment teaching and curriculum development.
- low temperature selective hydrocarbon oxidation
- photocatalysis (materials development, CO2 oxidation, water splitting)
- zeolite catalysis
- bio-renewable chemicals from agricultural waste
- Petroleum Chemistry - production and refining
- Pollution prevention and remediation
- Occupational Health and Safety

# FACILITIES

The Department is well-equipped with laboratory space, computer facilities, and instrumentation to support research programmes. Instruments include:

- Gas, Liquid and Chromatographs;
- Setaram Modular TGA/DSC/DTA/TMA (up to 1700oC);
- Setaram micro DSC III microcalorimeter (with batch and continuous flow cells, heat capacity and flow mix cells);
- Two (2) Gamry high sensitivity modular electrochemical workstations for electrochemical and corrosion measurements;
- Home-constructed Taylor-Aris equipment for diffusion measurements;
- Inert Atmosphere Glove Box;
- Bruker 300, 400 and 600 (cryoprobe) NMR spectrometers;
- FTIR (ATR), Diode-Array, and UV-VIS Spectrometers;
- Nuclear Quadrupole Double Resonance Spectrometer;
- GC- and LC-/Electron spray ionisation (ESI)-Time of Flight Mass Spectrometers;
- Rapid Stopped-flow Kinetic Spectrometer
- Perkin-Elmer Fluorescence Spectrometer
- Varian Atomic Absorption Spectrometer with graphite furnace;
- Perkin-Elmer Inductively Coupled Plasma Mass Spectrometer
- Jasco Model J-720 Spectropolarimeter;
- Olympus Phase Contrast and Polarizing Microscopes;
- Veeco Multimode V Atomic Force Microscope/Scanning Electrochemical Microscope
- Linux cluster parallel supercomputer with GROMACS and GAUSSIAN and computational software
- KSV Langmuir-Blodgett apparatus

# MSc in Occupational and Environmental Safety and Health (OESH)

Recent developments in areas such as legislation, global trade and rapidly changing technology, have placed new expectations and demands of occupational and environmental safety and health on governments, environmental management, business enterprises, educational institutions, trade unions, workers and the public. Within this scenario, there is an urgent and growing need for the development of a cadre of professionals with competencies in Occupational and Environmental Safety and Health (OESH). Developed in 2005 in Mona, Jamaica, UWI's OESH Programme addresses the growing requirement for all employers, managers, supervisors, policy makers and public leaders to have a functional awareness of the key issues related to environmental and occupational safety and health. The Master of Science in Occupational and Environmental Safety and Health commenced at the St. Augustine campus in September 2009.

## Objectives

The Master's programme is designed to prepare persons to function in key areas such as:
Enforcement - to ensure compliance, research and development, training, organisational systems and practice, policy and standards development.

Graduates would be able to develop, design, implement and manage complex OESH programmes and systems and to provide consultancy services and to educate others.

## Entry Requirements

Applicants must have either a first degree or its equivalent in basic or applied sciences; candidates with any other BSc degree or equivalent with suitable work experience will also be considered.

## Delivery Mode

Intense, modular face-to-face sessions conducted on weekends and holidays, a few weekdays (when foreign lecturers are involved) and agreed evenings. Full-time practitioners in the OESH field are especially encouraged to apply.

The programme will be delivered by international, regional and local lecturers.

## Course of Study

For the MSc in OESH, students are required to complete 34 credits of core courses and a research project of 9 credits as outlined below. Each 4 credit course consists of 48 hours of lectures and field visits and/or laboratory work where applicable. Full-time students will normally require 18 months and part-time students three years to complete the programme requirements. The full-time programme will normally consists of two semesters of coursework and examinations followed by the research project while the part-time programme involves four semesters of coursework and examinations followed by the research project.

## Course Assessment

This involves coursework, in-course tests and a three (3) hour written examination paper at the end of each semester.

## Course Listing

**Year I**

**Semester 1 (17 Credits)**

| Course Code | Course Title | Credits |
|---|---|---|
| OESH 6100 | Advanced Environmental Health | 4 |
| OESH 6200 | Advanced Occupational Safety and Health | 4 |
| OESH 6000 | OESH and Public Policy | 4 |
| OESH 6600 | Independent Study and Research Method | 4 |
| OESH 6300 | Seminar | 1 |

**Semester 2 (17 Credits)**

| Course Code | Course Title | Credits |
|---|---|---|
| OESH 6030 | Advanced Topics in OESH: OESH Disorders | 4 |
| OESH 6010 | Advanced Topics in OESH: Measurement methods and Ventilation | 4 |
| OESH 6040 | Advanced OESH Management Systems | 4 |
| OESH 6050 | Advanced Topics in OESH: Ergonomics | 4 |
| OESH 6300 | Seminar | 1 |

**Year II**

| Course Code | Course Title | Credits |
|---|---|---|
| OESH 6700 | Research Project | 9 |

## COURSE DESCRIPTIONS

**SEMESTER: 1**
**COURSE CODE: OESH 6000**
**COURSE TITLE: OESH AND PUBLIC POLICY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Understanding of the complex, dynamic and delicate relationship between business pursuits, public interests and public policy. For example, fundamentals of public policy-definition, goals and objectives of public policies (regulations, legislation). People, policy agenda, policy institutions, policy formulations, policy implementation and evaluation
**Assessment:**

| | | |
|---|---|---|
| Coursework and in-course tests | | 50% |
| Final Examination | One 2 hour written paper | 50% |

**SEMESTER: 2**
**COURSE CODE: OESH 6010**
**COURSE TITLE: ADVANCED TOPICS IN OESH: MEASUREMENT METHODS AND VENTILATION**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Respiratory system; Dermal exposure; Threshold limit vales and permissible exposure limits; Instruments/equipment used in OESH, including outdoor indoor (air, dust), workplace (air, skin), source emission (both stationary and mobile sources) and noise pollution measuring techniques, in both real-time and with time-integration; Environmental and personal exposure measurements; Calibration, service and preventive maintenance; Survey preparations and performance; Field and Laboratory Analytical Methods practices; Laboratory accreditation; Certification of analysts (biological, chemical and physical measurements); General principles of ventilation, including principles of air flow, duct losses, acceleration of air and hood losses and exhaust systems; Dilution ventilation principles including dilution ventilation for; health, fire and explosion and mixtures; Exhaust Hoods-capture velocity, worker position effect and hood design factors; Air cleaning devices; Principles of exhaust system design; Acute heat disorders.
**Assessment:**

| | | |
|---|---|---|
| Coursework | Personal and area sampling in the field, written reports: | 50% |
| Final Examination | One 3 hour written paper | 50% |

**SEMESTER: 2**
**COURSE CODE: OESH 6030**
**COURSE TITLE: ADVANCED TOPICS IN OESH: OESH DISORDERS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Understanding of advanced concepts of occupational safety and hygiene. For example, Chemical hazards in industries; Hazardous substances in industries and their target organs; Respiratory disorders-pneumoconiosis; chronic obstructive pulmonary disease; Occupational Illness vs. Work-Related; HIV/Aids as a work place issue; ILO Code of Practice on HIV/Aids and the world of work; Policy and legislation for impacting HIV/Aids in the workplace; ILO Conventions (Health and Safety).
**Assessment:**

| | | |
|---|---|---|
| Coursework | Written reports | 50% |
| Final Examination | One 3 hour written paper | 50% |

**SEMESTER: 2**
**COURSE CODE: OESH 6040**
**COURSE TITLE: ADVANCED OESH MANAGEMENT SYSTEM**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Advanced exposure Assessment techniques, including self Assessment of exposure; Exposure Assessment strategies and models, such as control banding; Delivery of occupational and environmental health services; Global warming and trans-boundary pollution transport; Hazardous waste management; Management of air quality and water resources; Basic land-use planning; Occupational and environmental audit systems; Disaster management.
**Assessment:**

| | | |
|---|---|---|
| Coursework | Laboratory reports and in-course tests | 50% |
| Final Examination | One 2 hour written paper | 50% |

**SEMESTER: 2**
**COURSE CODE: OESH 6050**
**COURSE TITLE: ADVANCED TOPICS IN OESH: ERGONOMICS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Advanced understanding of Ergonomics. For example, Work-Related Musculoskeletal Disorders; Evaluating Ergonomic Risk Factors; Application of Ergonomics to design of work space and tools; Office Ergonomics.
**Assessment:**

| | | |
|---|---|---|
| Coursework | In course test and field work with written reports | 50% |
| Final Examination | One 3 hour written paper | 50% |

**SEMESTER: 1**
**COURSE CODE: OESH 6100**
**COURSE TITLE: ADVANCED ENVIRONMENTAL HEALTH**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Advanced understanding of concepts and issues of environmental health. For example, Environmental toxicology and risk assessment; Population dynamics and geographical information systems; Environmental hazards; Indoor air quality; Ambient air quality; Soil pollution; Water pollution; Sanitation and wastewater treatment; Solid waste disposal and mining pollution; Environmental noise; Emissions control technologies for air; Environmental auditing and impact assessments; Environmental impact of tourism; National and regional guidelines, standards and regulations; International guidelines, standards and regulations;
**Assessment:**

| | | |
|---|---|---|
| Coursework | Laboratory and field studies | 50% |
| Final Examination | One 2 hour written paper | 50% |

**SEMESTER: 1**
**COURSE CODE: OESH 6200**
**COURSE TITLE: ADVANCED OCCUPATIONAL SAFETY AND HEALTH**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Develop a deep understanding of advanced concepts of occupational safety and hygiene. For example, OSH professionals and the resources available to assist them; contemporary methods of toxicology and risk assessment of workplace hazards; contemporary issues on chemical hazards in the workplace; measurement of chemical hazards in the workplace; measurement of physical hazards in the workplace; ergonomics; occupational epidemiology; national and regional guidelines, standards and regulations International guidelines, standards and regulations
**Assessment:**

| | | |
|---|---|---|
| Coursework | Laboratory | 20% |
| | Field survey and report | 30% |
| Final Examination | One 2 hour written paper | 50% |

**SEMESTER: 1 AND 2**
**COURSE CODE: OESH 6300**
**COURSE TITLE: SEMINAR**
**NUMBER OF CREDITS: 1**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Students will attend seminars or technical presentation once a week and will be required to prepare and make presentations once per semester.

**SEMESTER: 1**
**COURSE CODE: OESH 6600**
**COURSE TITLE: INDEPENDENT STUDY AND RESEARCH METHODS IN OESH**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** OESH area to be chosen in consultation with a supervisor; study must be on current issues and phenomena in OESH and is designed to prepare students for a productive research Project. Learning activities include: Critical and extensive literature review, use of library and electronic sources of information; Definition of a research question; Research goals and objectives, anticipated results of study and their significance; Research methodologies and ethics, including instrumentation where applicable; Results and their interpretation, discussion and conclusions; literature cited.
**Assessment:**

| | | |
|---|---|---|
| Coursework | Laboratory reports and in-course tests | 50% |
| One research paper | | 50% |

**SEMESTER: 1**
**COURSE CODE: OESH 6700**
**COURSE TITLE: RESEARCH PROJECT**
**NUMBER OF CREDITS: 9**
**PREREQUISITE: OESH 6600 OR EQUIVALENT**
**COURSE DESCRIPTION:** This involves an independent research programme supervised by academic staff members. OESH areas are to be chosen in consultation with a supervisor; study must be on current issues and phenomena in OESH; project designed to prepare students for productive research.

# POSTGRADUATE RESEARCH PROGRAMME

Every MPhil/PhD student is required to pursue a minimum of two 4 credit courses. One of these is a general course for all students called introduction to Research Techniques in Chemistry (CHEM 6560) and the other course is one in the student's area of interest. In addition, each MPhil or PhD student is required to register for graduate research seminars two for the MPhil and three for the PhD.

The list of courses (4 credits each) offered by Chemistry Department for MPhil/PhD students :

| **Course Code** | **Course Title** |
|---|---|
| CHEM 6160 | Metal - Organic Chemistry |
| CHEM 6161 | Physico-Chemical Properties of Inorganic Complexes |
| CHEM 6260 | Advanced Topics in Spectroscopy and Organic Synthesis |
| CHEM 6460 | Advanced Topics in Analytical Chemistry |
| CHEM 6461 | Advanced Topics in Bio-analytical Chemistry |
| CHEM 6560 | Introduction to Research Techniques in Chemistry |
| CHEM 6561 | Advanced Topics in Environmental Chemistry |
| CHEM 6562 | Advanced Topics in Polymer Chemistry |

## COURSE DESCRIPTIONS:

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6160**
**COURSE TITLE: METAL-ORGANIC CHEMISTRY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Transition metal coordination complexes and their structural motifs;Transition metal mediated organic transformations: Stotichiometric reagents; Catalysts; Carbon-hydrogen bond activation; Training in the use of the NMR Spectrometer: Running of $^{31}$P, $^{1}$H, $^{13}$C and $^{19}$F NMR spectra; NMR Spectroscopy in Inorganic Chemistry: Structure Determination of Organometallic Compounds (using NMR and other techniques); Elucidation of Fluxional processes using NMR.
**Assessment:**

| | | |
|---|---|---|
| Coursework | | 100% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6161**
**COURSE TITLE: PHYSICO-CHEMICAL PROPERTIES OF INORGANIC COMPLEXES**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Magnetochemistry of Inorganic complexes; the use and applications of nuclear magnetic resonance (NMR) spectroscopy in Inorganic Chemistry; the uses and applications of electronic spectroscopy in Inorganic Chemistry; the uses and applications of fluorescence spectroscopy.
**Assessment:**

| | | |
|---|---|---|
| Coursework | | 100% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6260**
**COURSE TITLE: ADVANCED SPECTROSCOPY AND ORGANIC SYNTHESIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** NMR - understanding modern pulse NMR; Mass spectroscopy; IR and UV Spectroscopy; synthesis: retrosynthetic analysis and synthons; reagents for functional group protection and transformation; carbon-carbon bond forming reactions via electrophile/nucleophile (donor/acceptor) reactions, rearrangements, cycloadditions.
**Assessment:**

| | | |
|---|---|---|
| Coursework | | 50% |
| Final Examination | One 3 hour written paper | 50% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6460**
**COURSE TITLE: ADVANCED TOPICS IN ANALYTICAL CHEMISTRY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Instrumental Techniques: Flow injection analysis - continuous FIA etc; Atomic Absorption Spectroscopy - Flame, Graphite Furnace etc.; Emission Spectroscopy-ICP, Optical; Gas Chromatography/Mass Spectroscopy; Chemometrics; Statistics: One-Way/Two-way ANVOA; MINITAB; T-test/F-test/Confidence Interval; Geographic Information Systems (GIS): Arch View; Modelling (GWLF); Enviromental Analytical Chemistry: Water/Wastewater Quality Management - Quality parameters and standards; Theory of Water/Wastewater treatment; unit operations and processes; Solid Waste Management; Forest and Soil Conservation; Environment Impact Assessment; Natural Resilience capacity of streams; Streeter and Phelphs model; Laboratory Management: Principles of Quality Assurance of chemical measurement; Guides for establishing a quality assurance programme for analytical chemistry laboratories.
**Assessment:**

| | | |
|---|---|---|
| Course Work | | 15% |
| Final Examination | One 2 hour written paper | 85% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6461**
**COURSE TITLE: ADVANCED TOPICS IN BIOANALYTICAL CHEMISTRY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Protein Purification Methods: conventional methods, modern, affinity chromatography; Protein Separation and Quantitation: Electrophoresis, western blott, radial immunodiffusion; Antibodies: structure; purification and storage; labeling, immunoblotting; immunoassays; Enzyme Linded Immunoassay and Radioimmuno Assays Methods For Quantification of Biochemicals; Use of continuous flow systems incorporation bioreactors for the monitoring of analytes; Immobilization of biomolecules; Bioreactor designs; Biosensors; Controlled release of drugs: use of pH sensitive and temperature sensitive polymers, electroactive hydrogels and phospholipids and matrices for controlled release of drugs; release kinetics; Kinetics of Immobilized Enzyme Systems.
**Assessment:**

| | | |
|---|---|---|
| Coursework | | 60% |
| Final Examination | One 3 hour written paper | 40% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6560**
**COURSE TITLE: RESEARCH TECHNIQUES IN CHEMISTRY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Chemical Information Sources and Information retrieval; Format and Style of a Report - ACS Style; Operation of basic chemical instrumentation (IR, UV, Polarimeter, NMR, GC and HPLC etc.); Selected Practical Techniques for the Chemistry; Computers in Chemistry - Chemical drawing and modelling package - spreadsheet package, word processing - basic computer literacy, operating in the Windows environment; (Statistical concepts and experiment design; Data treatment; Selected Practical Techniques: Inert atmosphere techniques, purification of solvents and reagents, Analysis of alkyl lithium and organomagnesium, vacuum distillation, cooling baths, crystallization techniques, chromatography: tic, column and HPLC, liq-iiq extraction, sublimation, special reaction techniques: liq Ammonia reactions, hydrogenation, ozonolysis etc.
**Assessment:**

| | |
|---|---|
| Coursework | 100% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6561**
**COURSE TITLE: ADVANCED TOPICS IN ENVIRONMENTAL CHEMISTRY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Introduction to the environment; energy and cycles of energy; matter and cycles of matter; human impact and pollution; analytical techniques in environmental chemistry
**Assessment:**

| | |
|---|---|
| Coursework Essays, seminar presentations | 40% |
| Written exam One 3-hour written paper | 60% |

**SEMESTER: 1 AND/OR 2**
**COURSE CODE: CHEM 6562**
**COURSE TITLE: ADVANCED TOPICS IN POLYMER CHEMISTRY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Conducting Polymers, electroactive polymers, sol gel and hydrogels; Analytical application of conducting and electroactive and non-conducting polymers.
**Assessment:**

| | |
|---|---|
| Course Work | 60% |
| Final Examination One 3 hour written paper | 40% |

# DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

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# MSC/MPHIL/PHD PROGRAMMES

The Department of Computing and Information Technology offers one taught Master's programme leading to the MSc in Computer Science, (No longer offered from 2014/2015) New MSc in Computer Science and Technology with Specializations in (I) Cloud Technologies and (II) Mobile Computing, as well as MPhil and PhD degrees by research in the areas of E-learning Technologies, Mobile Learning, Distributed Computing, Networking, Artificial Intelligence, Neural Networks, Database Systems, Internet Technologies, Object-Oriented Systems, Information Visualization, Programming Aptitude, Advanced Learning Technologies.

The MPhil and PhD are research degrees awarded on the submission and successful defence of a thesis. Each MPhil/PhD student must do a minimum of 8/9 credits at graduate level. Interested applicants should consult the Head of the Department concerning available research facilities.

Students may register on a part-time or full-time basis. The Board for Graduate Studies and Research offers a limited number of scholarships to students of the highest academic standing registering for MPhil/PhD. Some departmental funding in the form of teaching assistantships and demonstratorships are available for registered MPhil/PhD students not on scholarship.

# RESEARCH INTERESTS

The current research in progress or research areas where activities are planned include:

1. **WIRELESS COMMUNICATIONS:**
   - Radio Resource Management for Next Generation Cellular Networks
   - Performance and Capacity Analysis of Wired and Wireless Networks
   - Pricing and QoS for 4G Networks
   - Mobile Apps for monitoring accessibility, retainability and throughput of wireless networks

2. **WIRELESS AND MOBILE COMPUTING**
   - Mobile Software: research is being conducted into its design and application. Educational and other areas, e.g. agriculture, are used as case studies.
   - Enabling technologies include Bluetooth and SMS.

3. **DISTRIBUTED SYSTEMS**
   - The design and performance of Internet based distributed systems, especially those based on pessimistic and optimistic protocols.

4. **ARTIFICIAL INTELLIGENCE**
   - Mainstream High-Performance-Computing for Artificial Intelligence research and applications.
   - Application of Artificial Intelligence to the Resolution of Real World Problems.

5. **e-LEARNING:** Encompassing all aspects of the use of computer technology to facilitate education, particularly Web-based Instructional Systems.
   - Integrating web-based and classroom teaching in Secondary Schools and the Caribbean.
   - Aggregating and sequencing XML Reusable Learning Objects in a peer-to-peer system.
   - Educational Data Mining (Moodle plug-in).
   - Computer Suopported Collaborative Learning.
   - Accessibility for visually impaired.
   - Mobile Application.

6. **DATA MANAGEMENT AND DATAMINING:** particularly applied to agriculture, energy sector, poverty monitoring.
   - Database Systems, Federated Databases, Data Warehousing/Data Mining.

7. **GEOGRAPHIC INFORMATION SYSTEMS**
   - Developing social simulations using multi agent simulations and GIS techniques. This is with a view of further understanding some of the topical issues in the Caribbean, for example, urban planning, crime, and migration patterns in relation to social development policy.

8. **DECISION SUPPORT SYSTEMS AND GEOGRAPHICAL INFORMATION SYSTEMS**
   - Development of theoretical decision models to solve spatial multiple criterion problems.

9. **COMPUTER SECURITY AND WATERMARKING**
   - Developing digital watermarking techniques.

10. **SOFTWARE ENGINEERING**
    - Embedded Systems.
    - Development of timetabling solutions.

11. **USABILITY, PERSONALIZATION AND EMOTIVE DESIGN**
    Research on usability, personalization and emotive (user emotions) design based on modern mathematical models (computational intelligence: fuzzy logic, neural networks, swarm optimization, etc.) is carried out at the Caribbean's first Usability Lag at the Department of Computing and Information Technology. Its multidisciplinary areas are, as follows:
    - User-experience design and development: user-experience design and development of Interactive systems/products/workplaces like websites, eServices, mobile devices, office workplaces.
    - Usability Testing: usability tests In the Caribbean's first Usability Lab for interactive systems/products/workplaces.
    - Personalization: design and development of user-adapted/personalized interactive systems and products.
    - Emotive design: research on user emotions/affect/mood/enjoyability issues in design and development of interfaces/systems/products/workplaces that adaptively and positively appeal to the emotions of the user. use of advanced technologies for recognition of emotion-based on facial expressions, EEG, ECG,

**12. MOBILE HEALTH**

- Mobile telemedicine for patients suffering from diabetes and cardio-vascular disease in the Caribbean.

# POSTGRADUATE COURSES

## MSc in Computer Science (No longer offered from 2014/2015)

## MSc in Computer Science and Technology with Specializations in Mobile Computing and Cloud Technologies (New)

**Objectives**

The objectives of this revised program can therefore be summarized as:

- To produce students who are better equipped for present and future ICT careers by teaching them to not only understand present technologies but also be able to learn and adapt as technologies continue to change. This will be achieved through more design-based assignments and less traditional solution-based assignments.
- Better integration of theory and practice through classroom presentations of theory followed by laboratory exercises.
- To take advantage of the rapid changes in education due to the Internet.
- Introduce a sustainable self-financed program and hence reduce the financial burden on the UWI
- Have a more focused program so that we offer fewer, more expertly taught courses. The areas of focus can be modified as the needs of the community vary.
- Share common courses within the campus to more efficiently utilize human resources.

**Entry Requirements**

To be admitted to this programme a candidate should possess a BSc degree in Computer Science or a major in Computer Science or equivalent (with a minimum GPA 2.5) with a minimum average of B+ (3.0) in any two (2) of the following courses or equivalent.

| Course Code | Course Title |
|---|---|
| COMP 2000 | Data Structures |
| COMP 2500 | Object-Oriented Programming |
| COMP 3000 | Design and Analysis of Algorithms |
| COMP 3100 | Operating Systems |

Candidates without the above may be considered for entry upon successful completion of qualifying courses. These qualifying courses will be chosen by the programme coordinator for each such candidate based on their background and their intended area of specialization.

**Examination**

Students will be required to pass both the coursework and the written examination. The pass mark is 50%. The grading scheme for graduate degrees is as follows: A 70 - 100%; B+ 60-69%; B 50-59%.In the case of the Research Project, evaluation will be based on the project report.

**Award of Degree**

To qualify for the award of the degree, candidates must pass all six core courses, four elective courses and the Research Project. The degree shall be awarded in two categories - Distinction and Pass. For the award of the degree with distinction, the candidate must have obtained an average mark of 70% or more, across all core courses and elective courses as well as 70% or more in the Research Project. A Candidate failing a course shall be ineligible for the award of distinction.

**Prizes**

- The Teleios Systems Ltd. prize is awarded to the candidate with: the best MSc Research Project in Computer Science
- Trinidad and Tobago Network Information Centre (TTNIC) prize for the MSc (Computer Science) Graduate with the Highest Overall Examination Average

**Course of Study**

For the MSc in Computer Science and Technology programme with specializations in Cloud Technologies and Mobile Computing, students are required to complete a set of core courses, elective courses and a research project. The core courses will cover material that is essential for any Computer Science graduate while the elective courses will be offered in the areas of specialization. Students would also be required to take a course on research methods that will help them with their research project. The research project will be a major component of the degree and will be required to be in the area of specialization of the student. Each student must take a total of 39 credits consisting of 18 core course credits, 12 elective course credits and a 9-credit research project. Students will also be required to prepare at least one conference paper (submission of which will be left up to the supervisor). A wider audience will read this condensed version of their research project.

Full time students will have to take 5 courses per semester and do their research project during the summer following their second semester. Part time students can take 2-3 courses per semester and start their project once their courses are complete.

**Specializations**

Each specialization will consist of four elective courses. Students who have opted for the specialization must pass all four electives in order to graduate. All four courses in each specialization will be offered within each academic year. The areas of specialization were chosen based on the expected ICT needs of Trinidad and Tobago and the Region in the coming years. They are Cloud Technologies and Mobile Computing.

**Cloud Technologies:** This specialization is geared toward those students wishing to pursue careers in Information Systems, Database Management, Cloud Computing and Cloud Storage.

**Mobile Computing:** This specialization is geared toward students wishing to work in the wireless communications industry, either as network designers or as application developers.

**CORE COURSES (3 CREDITS EACH)**

| Course Code | Title |
|---|---|
| COMP 6401 | Advanced Algorithms |
| COMP 6501 | Research Methods, Entrepreneurship and Intellectual Property |
| COMP 6601 | Distributed Computer Systems |
| COMP 6701 | E-Commerce and M-Commerce Systems |
| COMP 6801 | Network and Computer Security |

**ELECTIVE COURSES (3 CREDITS EACH)**
**CLOUD TECHNOLOGY SPECIALIZATION COURSES**

| Course Code | Title |
|---|---|
| COMP 6300 | Advanced Internet Technologies |
| COMP 6901 | Software Project Engineering and Management |
| COMP 6905 | Cloud Technologies |
| COMP 6XXX[1] | Distributed and Parallel Database Systems |

MOBILE COMPUTING SPECIALIZATION COURSES

| Course Code | Title |
|---|---|
| COMP 6910 | Wireless Networks |
| COMP 6915 | Mobile Applications |
| COMP 6920 | Mobile Computing |

## COURSE DESCRIPTIONS

**SEMESTER: 2**
**COURSE CODE: COMP 6104**
**COURSE TITLE: ADVANCED COMPUTER NETWORKING**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE**
This course covers various aspects of computer networking: Internet design principles, congestion/flow control, network topology, routing, network security, Web, wireless, online social networks, data centers and cloud computing. The objective of this course is to build upon the basic computer networking skills learned at the undergraduate level so that students can design and modify the underlying algorithms.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Paper Review | 20% |
| Term Project | 30% |
| Final | 50% |

**SEMESTER: 2**
**COURSE CODE: COMP 6300**
**COURSE TITLE: ADVANCED INTERNET TECHNOLOGIES**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE**
This course covers the technologies, protocols and architectures of the Internet. A major focus of this course is the technology and the drive towards Service Oriented Architecture (SOA), web services and e-business. To achieve this, we will examine the extensible markup language (XML) and associated technologies as well as JSON and REST based technologies. This is followed by exploring the technology used in web services such as web services description language (WSDL), simple object access protocol (SOAP), universal description, discovery and integration (UDDI). With this background, we will look at the concept of semantic web as well as the technologies that are being used in it. Simultaneously, another aspect of the course will look at Java-script and AJAX (Asynchronous Java-script And XML) that are used to deliver modern web-based and mobile applications. In each segment, we will also discuss the business implications of each of the protocols and their effect on application design. The objective of this course is to provide students with the tools required to design and implement advanced web based information systems.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Coursework | 20% |
| Mid-Term | 20% |
| Final | 60% |

**SEMESTER: 1**
**COURSE CODE: COMP 6401**
**COURSE TITLE: ADVANCED ALGORITHMS**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE**
In this course we first review the topics covered at the undergraduate level (data structures, sorting algorithms, growth functions etc.). We then focus on performance evaluation of such algorithms, Network Flow algorithms, Graph Theory, Network Performance, Capacity Analysis, Optimization algorithms and Resource Allocation. This course introduces students to the more sophisticate algorithms being developed for today's technologies.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination | 60% |

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 1**
**COURSE CODE: COMP 6501**
**COURSE TITLE: RESEARCH METHODS, ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This course will introduce students to three non-technical but yet important topics, Research Methods (1 credit), Entrepreneurship (1 credit) and Intellectual Property (1 credit). The course will be taught by Faculty Members as well as invited Lecturers from industry. The objective is to provide students with the tools needed for starting a business as well as preparing them for work on their thesis.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Paper Reports | 60% |
| Paper presentations | 30% |
| Class Participation | 10% |

**SEMESTER: 2**
**COURSE CODE: 6601**
**COURSE TITLE: DISTRIBUTED COMPUTER SYSTEMS**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This course explores the major issues that arise when designing and implementing distributed systems with a particular emphasis on how to deal with the shared state between separate processes within such a system. The material complements network-layer courses by building on the transport layer to provide higher level applications and services. The objective of this course is to provide the infrastructure needed for advanced information systems (database, wireless, web etc.).
**ASSESSMENT METHODS:**

| | |
|---|---|
| Homework | 30% |
| Term Project | 20% |
| Final | 50% |

**SEMESTER: 2**
**COURSE CODE: COMP 6701**
**COURSE TITLE: E-COMMERCE AND M-COMMERCE SYSTEMS**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This course will introduce students to the underlying technologies required by electronic commerce infrastructures. Various authentication, encryption and access control methods will be taught. This will be a hands-on course in which students will be required to build various components of an e-commerce site.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Project | 60% |
| Final Examination | 40% |

**SEMESTER: 2**
**COURSE CODE: COMP 6801**
**COURSE TITLE: NETWORK AND COMPUTER SECURITY**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This course covers principles of computer systems and network security. We will discuss various attack techniques and how to defend against them. A major component of the course will be the project, which will focus on building reliable code, and understanding attacks. The objective of this course is to train students in the rapidly growing area of cyber-security.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Coursework | 40% |
| Project | 60% |

**SEMESTER: 2**
**COURSE CODE: COMP 6XXX**[1]
**COURSE TITLE: DISTRIBUTED AND PARALLEL DATABASE SYSTEMS**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This course covers the principles and system organization of distributed and parallel databases. It focuses on issues of Database System Architectures, Database Design and Query Optimization in Distributed and Parallel Database Systems. Emphasis is placed on design, implementation and management of Enterprise Database Systems. The course explores several current Database technologies including Data Warehousing, XML Databases and Web-based integration as well as emerging issues such as Cloud Data Management.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Paper Reviews | 30% |
| Assignments | 30% |
| Final | 40% |

**SEMESTER: 1**
**COURSE CODE: COMP 6901**
**COURSE TITLE: SOFTWARE PROJECT ENGINEERING AND MANAGEMENT**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This course is designed to present students with an overview of advanced topics in Software Engineering. Students will be exposed to techniques that are gaining increasing attention in the industrial and research communities. Students will apply the software engineering techniques to homework assignments and mini-projects throughout the course. Students will also be exposed to Project Management techniques including proposals, monitoring and evaluation of large-scale software projects.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Project | 60% |
| Final Examination | 40% |

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 1**
**COURSE CODE: COMP 6905**
**COURSE TITLE: CLOUD TECHNOLOGIES**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
The course helps to understand the technologies and applications of cloud computing and its virtualization foundation used in servers, desktops, embedded devices and mobile devices. The objective is to train students for the growing area of cloud services.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Assignments | 60% |

**SEMESTER: 1**
**COURSE CODE: 6910**
**COURSE TITLE: WIRELESS NETWORKS**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
This is a comprehensive course on wireless networks for graduate students. It surveys various wireless networking technologies and mechanisms with an emphasis on protocol design for efficient systems. Technologies covered range from personal area networks like Bluetooth to cellular wide area networks. We will cover, Bluetooth, WiFi, 3G, and 4G cellular in some detail, and also survey some other technologies like Sensor and Ad-Hoc Networks. Emphasis will be on protocol design aspects for various wireless environments and traffic types. The objective is to train those who seek employment in the cellular industry.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Paper Review | 20% |
| Term Project | 20% |
| Final | 60% |

**SEMESTER: 2**
**COURSE CODE: COMP 6915**
**COURSE TITLE: MOBILE APPLICATIONS**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE:**
Today's applications are increasingly mobile. This course teaches students how to build mobile apps for Android and iOS, two of today's most popular platforms, and how to deploy them in the Android Marketplace and the App Store. Students learn how to write native apps for Android using Eclipse and the Android SDK, how to write native apps for iPhones, iPod touches, and iPads using Xcode and the iOS SDK, and how to write web apps for both platforms. This is course will be partially taught online. Students will follow the course online but UWI faculty will evaluate course projects. The objective of this course is to train students for the rapidly growing field of mobile app development.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Project | 100% |

**SEMESTER: 1**
**COURSE CODE: COMP 6920**
**COURSE TITLE: MOBILE COMPUTING**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE**
As mobile phones are becoming ubiquitous computing devices, a huge number of applications are emerging. Shortly, mobile phones will become the main computing device we now use in their daily life. This graduate course covers the current trends in mobile computing systems. In particular, we will focus on the fundamental challenges of building mobile systems, as compared to traditional ones, mobile applications, enabling services and protocols, and future directions. This course covers the application layers of a mobile network environment whereas the Wireless Networks course covers the lower layers.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Paper Review | 20% |
| Term Project | 30% |
| Final | 50% |

**SEMESTER: 2**
**COURSE CODE 6925**
**COURSE TITLE: APPLIED OPERATIONS RESEARCH**
**CREDITS: 3**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONALE**
The purpose of this course is to study the basic tools for quantitative methods for decision-making. The emphasis is on solution methods and strategies. The course introduces the student to a wide variety of tools used in the decision making process and demonstrates the application of these tools on real-world examples.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Coursework | 20% |
| Project | 30% |
| Final Examination | 50% |

**SEMESTER: 1 & 2**
**COURSE CODE: COMP 6950**
**COURSE TITLE: THESIS**
**CREDITS: 9**
**PRE-REQUISITES: NONE**
**COURSE DESCRIPTION & RATIONAL:**
A research-oriented or a novel application oriented MSc thesis in an area under the student's specialization. The objective is to allow students to think independently and provide a unique contribution to their field.
**ASSESSMENT METHODS:**

| | |
|---|---|
| Term Project | 100% |

# DEPARTMENT OF LIFE SCIENCES

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# RESEARCH INTERESTS AND FACILITIES

The Department of Life Sciences specialises in two (2) of the most innovative and dynamic areas of current research and development, namely (a) Small Island Biodiversity and Environmental Management and (b) Biotechnology and Molecular Biology. Research focuses on biodiversity and ecosystem services, conservation biology and natural resources management (e.g. tropical forests, fisheries and aquaculture), pollution impacts and management, climate change vulnerability impact and adaptation. There is also a long history of research and development projects in Biotechnology and Molecular Biology as they relate to agriculture and human wellness. Current research projects use approaches such as Recombinant DNA Technology. Research also focuses on providing new knowledge on the physiology and metabolism of tropical plants in important areas such as tuberisation, abscission and mechanism of resistance to pests and pathogens. Studies in Microbiology and Crop Protection are also important focal areas. In addition to the above, research is ongoing in the traditional disciplines such as Biochemistry, Botany, Zoology, Ecology, Epidemiology and control of diseases of public health importance.

The Department offers graduate programmes leading to MPhil and PhD degrees in all areas of research being pursued by academic staff as outlined above. The Department has supporting specialist research laboratories in Biotechnology and Tissue Culture, Entomology, Environmental Biology, Ecology, Parasitology, Ecotoxicology, Biosystematics, Biochemistry, Histology, Microbiology, and Aquaculture and Fisheries. The Department also maintains the National Herbarium, Zoology Museum, Land Arthropod Collection and several greenhouses.

Applicants to the MPhil or PhD research programme, should liaise with their potential supervisor for guidance in developing a clear research project and research proposal which must be submitted to the Head of Department. Guidelines for the preparation of a research proposal are available at **http://sta.uwi.edu/fsa/lifesciences/documents/researchproposal.pdf**. Supervisors listed in the application form should have agreed to do so.

# PROGRAMMES

## Diploma/ MSc in Biodiversity Conservation & Sustainable Development in the Caribbean

The online graduate degree in Biodiversity Conservation and Sustainable Development in the Caribbean is a taught programme geared towards building and strengthening capacity in environmental management, biodiversity conservation and sustainable development in the Caribbean. The programme will be offered in two forms, Graduate Diploma and MSc and can be undertaken either on a full time or part time basis. Teaching on this programme will involve a blend of internet-based distance teaching and face-to-face training.

**Objectives**

The main objective of this graduate degree is to supply the region with qualified professionals who have a comprehensive knowledge of the concepts and principles of a wide range of science and environmental management issues related to tropical biodiversity. Advanced practical skills in environmental monitoring, impact analysis, environmental management, data management and policy issues will be taught in this programme. In addition, a working knowledge and appreciation of the major disciplines within environmental science and a multidisciplinary overview of environmental data collection and analysis together with an acquired and improved range of transferable skills including group work, scientific research, data analysis, report writing and oral presentation, will be provided to learners in this programme. As such it will provide students with a set of skills that will allow them to advance their careers in the environmental management and biodiversity conservation fields within their government, public sector, NGOs and industrial organisations.

**Entry Requirements**

Candidates applying for admission are required to satisfy the relevant general regulations of the Faculty and the University's Board for Graduate Studies and Research. The prerequisite for entry into the programme is a bachelor's degree in one of the following disciplines: natural sciences, engineering, agricultural sciences, geography, education or an appropriate social sciences from an approved university, with at least lower second-class honours or a minimum GPA 2.0 (or equivalent qualification and work experience).

**Duration**

Students enrolled in the Diploma Programme will be required to complete the course in either 1 year (full time) or 2 years (part time).

Students enrolled in the MSc Programme will be required to complete the degree in 1½ years (full time) or 3 years (part time).

**Modes of Delivery**

As a post-graduate Diploma/MSc level course, a variety of methods of delivery will be employed, which include face-to-face interactions, virtual seminars, tutorials, field visits and a research project. This will be supported by distance learning and e-based course assignments as well as project and scenario based workshops, case studies and assignments in which group work and student centred learning approaches are adopted. Thus, increasing onus will be put on the student to take responsibility and control of their own learning. This will lead to the point of the final research project in which the student will be responsible for the development, management and reporting of a study with the supervisor acting as an advisor and facilitator. Additionally, the programme aims to maximise access by professionals working in government, NGO and commercial organisation by supporting face-to-face sessions with distance learning, assignments etc. which students can undertake from their home.

**Course Assessment**

A variety of course assessment techniques will be utilized throughout the programme.

**Research Project**

A Research Project is a fundamental component of the MSc programme and this is reflected, not only in the credit weighting, but by the fact that the MSc runs for an extra 6 months so that the student may have the necessary time to complete the project to a high standard.

The aim of the research project is to allow the student to synthesise and articulate several aspects of the taught programme within a single themed research topic. In addition, it will provide the opportunity for further detailed skills training in specific aspects of environmental monitoring, assessment or management of tropical biodiversity. It will allow the student to pursue an individual study on a particular research topic or issue of interest to the student and will incorporate technical skills training specific to the individual student. As such, the research project will provide the opportunity to develop a specific set of practical and reporting skills that will be of use to the student in their future career.

**Award of Diploma/Degree**

In this joint Diploma/MSc, the main awarding University will be the University delivering the most teaching to the specific student. Thus, prospective students should note that their degree will be awarded based on the number of credits taught by the various partner institutions.

# Diploma in Biodiversity Conservation and Sustainable Development in the Caribbean

The Diploma programme consists of 24 credits and students will be required to complete any seven (7) core courses and one (1) of the options in order to successfully complete it. Each course carries 3 credits.

**CORE COURSES**

| Course Code | Title |
|---|---|
| BIOL5200 | Characteristics of Biodiversity |
| BIOL5201 | Threats to Tropical Biodiversity |
| BIOL5206 | Management and Analysis of Environmental Data |
| BIOL5208 | Conservation and Management of Biodiversity |
| BIOL5210 | Field Practicum |
| BIOL5212 | Taxonomy and Biodiversity Informatics |
| BIOL5214 | Environmental Resources Policy |

**OPTIONS**

| Course Code | Title |
|---|---|
| BIOL5202 | Environmental Law and Multilateral Environmental Agreements |
| BIOL5203 | Environmental Economics |
| BIOL5204 | Environmental Impact Assessment |
| BIOL5205 | Principles and Practice of Geoinformatics |
| BIOL5207 | Sustainable Use and Management of Natural Resources |
| BIOL5209 | Pollution and Ecotoxicology |
| BIOL5213 | Advanced GIS |
| BIOL5215 | Socio-ecology and Natural Resources Management |

# MSc in Biodiversity Conservation & Sustainable Development in the Caribbean

The MSc programme consists of 45 credits. Students will be required to complete the following courses:

- Seven 3-credit core courses and one 12-credit Research Project (BIOL 6211)
- Four Optional 3-credit courses

**CORE COURSES**

| Course Code | Title |
|---|---|
| BIOL6200 | Characteristics of Biodiversity |
| BIOL6201 | Threats to Tropical Biodiversity |
| BIOL6206 | Management and Analysis of Environmental Data |
| BIOL6208 | Conservation and Management of Biodiversity |
| BIOL6210 | Field Practicum |
| BIOL6212 | Taxonomy and Biodiversity Informatics |
| BIOL6214 | Environmental Resources Policy |
| BIOL6211 | Research Project |

**OPTIONS**

| Course Code | Title |
|---|---|
| BIOL6202 | Environmental Law and Multilateral Environmental Agreements |
| BIOL6203 | Environmental Economics |
| BIOL6204 | Environmental Impact Assessment |
| BIOL6205 | Principles and Practice of Geoinformatics |
| BIOL6207 | Sustainable Use and Management of Natural Resources |
| BIOL6209 | Pollution and Ecotoxicology |
| BIOL6213 | Advanced GIS |
| BIOL5215 | Socio-ecology and Natural Resources Management |

## COURSE DESCRIPTIONS

**SEMESTER: 1**
**COURSE CODE: BIOL 5200/BIOL 6200**
**COURSE TITLE: CHARACTERISTICS OF BIODIVERSITY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course will form part of the background information to the programme. It will include basic concepts of biodiversity from the molecular- to the ecosystem-scale. This will be placed in the context of the extinction crisis and international treaties such as the Convention on Biological Diversity that have been formulated to address this crisis. It will, in particular, highlight the importance of biodiversity in terms of ecosystem function, goods and services. The course will define biodiversity in terms of species richness and diversity indices and explore the cline in diversity across different latitudes. Within this concepts such as endemicity and keystone species will also be described. The molecular genetic component of the course will cover the concepts of molecular genetics, intra-specific variation, inter and intra-specific genetic diversity, processes of evolution and speciation. The course will then go on to describe the regional ecosystems including forest, savannah, riverine, wetland, mangrove and coastal-marine systems including coral reefs. Impacted ecosystems such as urban and agricultural landscapes will also be treated. In each case, these systems will be considered holistically in relation to their diversity, distribution, ecology and ecosystem function, including the goods and services they provide.
**Assessment:**

| | |
|---|---|
| Coursework | 100% |

**SEMESTER: 1**
**COURSE CODE: BIOL 5201/BIOL 6201**
**COURSE TITLE: THREATS TO TROPICAL BIODIVERSITY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course will examine the major threats to tropical biodiversity and ecosystems. It will highlight the major threats, as described in the CBD: habitat loss and degradation, over-exploitation, climate change, pollution and introduction of alien species. It will also examine the history of human intervention in tropical environments. In specific relation to loss of genetic diversity, issues including threats to genetic diversity, loss of populations, reductions in heterozygosity and their consequences, inbreeding depression and genetic bottlenecks will be considered. Using examples, and case studies, major threats will be considered in relation to the impacts being seen on some of the ecosystems described in BIOL6100. It will include a description of human altered terrestrial and coastal environments. Consideration will also be given to the issues of environmental stress including impacts of pollution and climate change on terrestrial and marine systems. Evidence for global warming, impacts on species and ecosystems and methods for the detection of climate change will be described.
**Assessment:**
Coursework 100%

**SEMESTER: 1**
**COURSE CODE: BIOL 5202/BIOL 6202**
**COURSE TITLE: ENVIRONMENTAL LAW AND MULTILATERAL ENVIRONMENTAL AGREEMENTS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course will provide students with a background to the sources for existing environmental laws, and of the specific framework for regulation of the environment in the Caribbean region. It will examine the ways in which human behaviour with respect to the environment is regulated at the international level, with specific reference to key biodiversity-related MEAs. This will involve a brief review of the legal and institutional framework within which international law making on the environment takes place. The course will provide students with a basic understanding of the existing legal environmental regimes of selected Caribbean countries.
The course will then articulate this regional framework within its international context. The course will introduce students to some of the factors that surround and influence the negotiation and implementation of international environmental law. Key MEAs, including the Convention on Biological Diversity, the Biosafety Protocol, the UN Convention on Climate Change, Cartagena Convention, RAMSAR, CITES and Principle on Forests will be used as examples to illustrate the key issues. Students will also be introduced to key regional environmental agreements, including the Cartagena Convention, SPAW Protocol. Additionally, students will be introduced to key issues specific to biodiversity conservation including bio-piracy, liability and redress, access and benefits sharing, and existing legal models for management of cross-border resources including migratory species and cross-jurisdictional protected natural areas.
**Assessment:**
Coursework 100%

**SEMESTER: 2**
**COURSE CODE: BIOL 5203/BIOL 6203**
**COURSE TITLE: ENVIRONMENTAL ECONOMICS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The course will begin by introducing basic economic principles and exploring the limits of human nature in dealing with environmental degradation. It will then consider environmental economics from several perspectives, examine various economic tools and discuss their limitations. Using examples, it will then apply these tools to everyday scenarios that illustrate the possibilities and limitations of economics in resolving environmental and natural resource issues.
**Assessment:**
Coursework 100%

**SEMESTER: 2**
**COURSE CODE: BIOL 5204/BIOL 6204**
**COURSE TITLE: ENVIRONMENTAL IMPACT ASSESSMENT**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The course provides a general overview of the variety of environmental assessment tools currently available and an introduction to Environmental Impact Assessment (EIA) including definition, goals, objectives and purpose of EIA, definition of key terms, history of Environmental Impact Assessment and the legislative, policy and institutional framework for EIA. It will describe the EIA process, with emphasis on biodiversity conservation and sustainable use; the development of the Terms of Reference (TOR) including screening, scoping and public participation; and the assessment of project impacts, including understanding the ecosystem, assessment of significant impacts of the project and impact management. It will then consider reporting Environmental Impact Statement (EIS) and Environmental Management Plans, review of the EIS, linked to the TOR; and follow up monitoring, auditing, adaptive management and enforcement. Special consideration will be given to public participation, EIA standards, EIA for island, and Strategic Environmental Assessments.
**Assessment:**
Coursework 100%

**SEMESTER: 1**
**COURSE CODE: BIOL 5205/BIOL 6205**
**COURSE TITLE: PRINCIPLES & PRACTICE OF GEOINFORMATICS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course will provide an overview of the principles of geoinformatics including an introduction to geographic information systems, Global Positioning Systems and field survey techniques. Following an introduction to geoinformatics and definitions, the course will cover spatial data acquisition using GPS and field survey techniques, GIS data structures and capabilities. It will describe GIS and network analysis and spatial data analysis, and GIS functionality. Finally it will consider hardware and software systems and the design and implementation of GIS.
**Assessment:**
Coursework 100%

**SEMESTER: 1**
**COURSE CODE: BIOL 5206/BIOL 6206**
**COURSE TITLE: MANAGEMENT & ANALYSIS OF ENVIRONMENTAL DATA**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course will provide practical training in data management and in statistical analysis of environmental data. Students will initially review fundamental univariate and bivariate statistical techniques, including basic parametric and non-parametric statistics. Students will then complete task sheets which, thereby, demonstrate an understanding of the application of appropriate tests to datasets. These sheets will be completed using R. The course will then progress to explore the use of multivariate statistical techniques to analyse detailed environmental datasets. Students will also be introduced to the use of Bayesian statistics, and biodiversity specific data analysis software including DISTANCE and Vortex.
**Assessment:**
Coursework 100%

**SEMESTER: 1**
**COURSE CODE: BIOL 5207/BIOL 6207**
**COURSE TITLE: SUSTAINABLE USE & DEVELOPMENT OF NATURAL RESOURCES**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course will address important tropical ecosystem based industries including forestry, wildlife, agriculture, fisheries, energy, the pharmaceutical industry and tourism. In order to be sustainable, these industries will have to adopt environmental activities as core to their business, rather than consider them as an externality. Topics covered in this course will include an analysis and determination of land capability and optimal land use. Social aspects of land use and land degradation, and participatory approaches in sustainable development, will be discussed. The need for the integration of soil and water conservation in farming systems, and integration of water needs in agriculture with industrial and potable supply requirements. Agro-ecosystems will be considered in relation to sustainable mono-cropping, multiple cropping and agro-forestry systems for tropical environments. Sustainable forestry and timber production will also be examined. Participants to the course will also be exposed to development and exploitation of biodiversity for renewable energy (bio-fuels) and carbon sequestration in the context of REDD+ and related discussions in the Climate Change arena. Finally, current issues of fishery management will be examined as countries try to achieve sustainability in tropical capture fisheries, including management of freshwater environments for fisheries production, the integration of aquaculture production systems into agricultural and water conservation practices.
**Assessment:**
Coursework 100%

**SEMESTER: 2**
**COURSE CODE: BIOL 5208/BIOL 6208**
**COURSE TITLE: CONSERVATION & MANAGEMENT OF BIODIVERSITY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The course will include development of priorities for species conservation, conservation of genes and genetic diversity, selection and design of protected areas, the application of island biogeography theory and SLOSS, population dynamics and population viability analysis to protected area design. Students will gain an understanding of the principles of protected area selection site management. The use of zoning schemes, particularly in relation to coastal zone management schemes will also be covered. The use of management plans will be discussed together with the assessment of management effectiveness. The course will also examine ex-situ conservation programmes and re-introductions of species as well as aspects of habitat restoration. The important role and participation of the public will also be considered with regard to the selection, design and management of protected areas as well as through the potential benefits of tourism and ecotourism.
**Assessment:**
Coursework 100%

**SEMESTER: 1**
**COURSE CODE: BIOL 5209/BIOL 6209**
**COURSE TITLE: POLLUTION & ECOTOXIOCOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course is designed to give students an understanding of the basic principles of pollution monitoring and ecotoxicology and how toxicants are distributed, taken up, assimilated and impact the environment. The course will also distinguish between structural and functional endpoints and how these can highlight the potential impacts of industry on the natural environment. The course will also look are particular pollutants that are of concern to Trinidad, such as: pesticides, industrial effluents and heavy metals. Students will also be able to understand how environmental monitoring tools such as toxicology, environmental chemistry and ecology can be used together to understand the relationship between industry and ecology by using these tools to conduct Ecological Risk Assessments.
**Assessment:**
Coursework 100%

**SEMESTERS: 3 (SUMMER)**
**COURSE CODE: BIOL 5210/BIOL 6210**
**COURSE TITLE: FIELD PRACTICUM (BELIZE OR SURINAME)**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course comprises the main practical portion of the programme. It will provide students with the opportunity to apply and test their understanding of concepts covered in the taught courses of the programme, as well as allow them to develop their practical skills techniques, provide a face to face setting for interaction with faculty and with other distance learners on the programme. The course will go over the appropriate collection and survey techniques for various biological taxonomic groups. Status surveys and other population ecological work will be covered. Socio-economic survey work will also be undertaken in the field. (Students are expected to fund their own expenses incurred during and for this field course).
**Assessment:**
Coursework 100%

**SEMESTER: 3 - 1**
**COURSE CODE: BIOL 6211**
**COURSE TITLE: RESEARCH PROJECT**
**NUMBER OF CREDITS: 12**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The Research Project is a fundamental component of the M.Sc. programme and this is reflected, not only in the credit weighting, but by the fact that the M.Sc. runs for an extra 6 months so that the student may have the necessary time to complete the project to a high standard. Students will come to the Course Leader and/or University Focal Point during the first semester of the M.Sc. with potential ideas for their research project. A list of potential projects will be also be made available for those students who do not have a specific topic in mind. During the first two semesters, the student and Course Leader and/or University focal point will meet either face-to face or through a virtual platform (as determined by the Course Leader), at least twice, to further develop the research project idea, develop clear aims and objectives, and identify appropriate second supervisors. The research project may cover any feasible aspect of environmental management of tropical biodiversity. It may involve a pure research study toward a fundamental aspect of tropical biodiversity or address more applied issues in biodiversity conservation. It may involve field or laboratory based work or may be a desk study involving data analysis or interrogation of legal documents. It may support studies being undertaken by staff within UWI or the partner Universities of the MSc. Programme, or it may address an issue related to a student's employer. For students from outside of Trinidad, the project may be undertaken within Trinidad or in the student's home country. The project should, however, give the student a chance to further develop technical skills learnt during the field practicum and a more detailed understanding of some theoretical component of the course.
**Assessment:**
Coursework 100%

**SEMESTER: 3 (SUMMER)**
**COURSE CODE: BIOL 5212/6212**
**COURSE TITLE: TAXONOMY AND BIODIVERSITY INFORMATICS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course is a core course in the programme, providing an understanding of the description and classification of organisms which is fundamental for biodiversity conservation. It provides an overview of the status of taxonomy and various classification systems, as well as a summary of the speciation process, biogeography and the field of molecular systematics. Species are identified as the building block for taxonomic classification and species concepts are discussed in detail. During the course, students will learn of the role of natural history museums and herbaria together with their collections in conservation. Collection and preservation methods for various taxa are presented and their curation is discussed. Identification methods and tools, including taxonomic keys, are presented and used as part of the course. The course includes a bioinformatics component that focuses on the use of online databases, as well as those found at local institutions. These include biodiversity databases, molecular databases and natural history collection databases. By the end of the course, students learn to use various databases to derive biodiversity information. The use of database management software is also emphasized as a tool for the creation of new biodiversity databases.
**Assessment:**
Coursework 100%

**SEMESTER: 2**
**COURSE CODE: BIOL 5213/6213**
**COURSE TITLE: ADVANCED GIS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: BIOL 5205/6205**
**COURSE DESCRIPTION:** This course commences with a brief review of GIS fundamentals including its historical development, data sources, data structures, hardware and software environments. It will provide students with an advanced view of database development and management and image processing. Students will then review land cover preparation and develop an understanding of the range of available spatial statistical tools and sources for various types of spatial data. The students will then be introduced to Windows-based visual basic environments and spend some time developing their skills in developing GIS modules for these environments, as well as introduce them to the range of GIS platforms available for biodiversity problem-solving. The final third of the course will focus, through case studies, on the use of GIS to problem-solve in the fields of fisheries, threatened species management and climate change modelling. Students will then be presented with biodiversity problems which can be addressed through GIS, and asked to develop individual solutions for these GIS based problem sets.
**Assessment:**
Coursework 100%

**SEMESTER: 2**
**COURSE CODE: BIOL 5214/6214**
**COURSE TITLE: ENVIRONMENTAL RESOURCES POLICY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This policy course provides an overview of the basic foundations for environmental resource policy, its evolution and the linkages with a wide scope of socio-economic and socio-ecological issues. It affords students the opportunity to understand the various concepts of environmentally and ecologically sustainable development processes emerging from social consciousness of environmental impacts on natural resources and their management. It provides a learning process for understanding the basic principles involved in setting environmental resource goals and articulating a vision for various environmental resource policies. Key natural resource issues are reviewed from the perspective of developing policy making processes using best practices. It provides students with a level of understanding of the relevant issues and techniques for scoping and developing environmental resource policies. Students are afforded the opportunity to prepare policy briefs for specific environmental and natural resource issues including a step-by-step policy making exercises and simulations of practical problems and issues involved in the policy making process. Overviews of carefully selected international environmental instruments and their nexus with natural resource management and environmental drivers facilitate an understanding of the globalization of environmental policy making. It provides opportunities for students to have basic understanding and appreciation for environmental resource governance models and how these impact policy.
**Assessment:**
Coursework 100%

**SEMESTER: 2**
**COURSE CODE: BIOL 5215/6215**
**COURSE TITLE: SOCIO-ECOLOGY AND NATURAL RESOURCES MANAGEMENT**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Successful natural resources management requires the development of consensus of all stakeholders on the goals of such management and the activities to be undertaken to achieve such goals. The need for such a consensual approach is especially important in biodiversity management situations where indigenous, tribal and rural communities have traditionally used or hold rights to access and utilization of such resources. To enable the students to understand the context for these types of challenging resource management scenarios, the course begins by introducing current sociological thinking on the nature of, and relationships between, human values, beliefs, and attitudes to nature. It then reviews western scientific approaches to renewable resources management in the context of traditional economically driven resource production. The students will then review through case studies regional examples of natural resources use by rural, tribal indigenous peoples and compare and contrast the basis for these interactions with western, science-based natural resources management. Finally, the students will be introduced to the basic tools currently used by natural resource managers to assess impacts on management interventions on rural and indigenous peoples, and tools for integrating these communities in resource management decision making.
**Assessment:**

| | |
|---|---|
| Coursework | 100% |

# Post Graduate Diploma, and Master of Science (MSc.) in Biotechnology

The development of a master's and PG diploma programme is conceived because of the urgent necessity of the UWI and the Caribbean region to immediately invest in biotechnology, which is considered to be the most promising and fastest-growing technology of the present era. The field of biotechnology is recognized for its potential to offer solutions to worldwide problems, from food security and health to clean energy and environmental sustainability. Situated in a strategic location, Trinidad and Tobago and rest of the Caribbean have the unique advantage to explore this growing global demand in biotechnology. This postgraduate programme will provide the basic expertise, skill sets, necessary infrastructure and knowledge base which would serve to ultimately build capacity in this region. It would create avenues for advanced research and enhance intellectual capacity to enable the development of industrial and business activity, leading to generation of employment opportunities in this frontier field. This programme will be offered at both the Post Graduate Diploma and the Masters levels.

## ACADEMIC AIMS AND OBJECTIVES

This programme is intended to meet the needs of a broad range of professionals whose basic learning and knowledge are in life sciences, medicine and agriculture. The potential users of this programme would be natural and applied scientists, teachers, medical, paramedical and technical professionals. This is an entirely new programme and is designed to provide the basic learning, necessary skill sets, knowledge and hands-on experience in contemporary biotechnology which would ultimately contribute to the higher learning, capacity building and career advancement of enrolled users.

- To Produce qualified biotechnologists with the competence to provide services to Medical Biotechnology, Agricultural Biotechnology, Industrial Biotechnology, Environmental Biotechnology and Bioinformatics and Biotechnology-based business development;
- To build national and regional technological and infrastructural capacities for imparting terminal education, training and research on contemporary biotechnology;
- To develop and foster collaborations with developed countries and institutes of Global excellence, facilitating the exchange of knowledge and development of cooperation in related industries;
- To strategically prepare the Caribbean region to actively interact with the developing World in the Biotechnology services, research and development;

**LEARNING OUTCOMES**

Students completing the programme would be able to:

- Demonstrate a comprehensive understanding of the latest theory and techniques of molecular biology, bioinformatics and biotechnology;
- Apply current tools of biotechnology to solve problems related to the environmental conservation, crop genetic improvement, nutrition, human and animal health; bioprocessing industries; environmental conservation;
- Develop practical industrial applications within existing industries or new venture (entrepreneurship) activities;
- Exercise individual judgment and initiative in biotechnological principles and applications;
- Analyse and appraise the social & environmental impacts of biotechnology;
- Establish new work programmes in the fields of biotechnology;
- Develop a research question in a specialized area of biotechnology and evaluate this research with appropriate justification*;
- Compose, execute and present a suitable high quality research project in biotechnology*.

*Not applicable for the Postgraduate Diploma programme.

## ENTRY REQUIREMENTS:

Admission requirements for this programme are as follows:

- First degree from a recognized University in Biology/ Biochemistry/Agriculture or other Natural Sciences, Medicine and Veterinary Science with a minimum of lower second class honours
- Significant work experience in a related field would be an asset;
- Candidates applying for the program should have completed and secured a minimum "B" grade in at least three of the following Level II/III undergraduate courses or their equivalents (UWI-St. Augustine, Mona and Cave Hill or other recognized Universities/Colleges in the region/ elsewhere)
  - Genetics
  - Microbiology
  - Molecular biology
  - Microbial Biotechnology
  - Plant Biotechnology
- Students successfully completing the Biotechnology minor/specialization at UWI-St. Augustine or major at UWI, Mona would be eligible subject to fulfillment of the grade and GPA requirements
- Persons without adequate coverage of these areas may be required to pursue and pass (at least 50% final marks) appropriate qualifying courses before admission into the MSc or diploma programme
- Candidates not meeting the grade or GPA requirements but who have sufficient work experience in a relevant area may also be admitted under special circumstances. As part of the selection process, the department reserves the right to interview applicants for further exploration of their qualifications, experience and interest. They may be further required to complete minimum pre-requisite courses based on their needs as directed by the Programme Coordinator or Department Head
- Students enrolled for PG Diploma can apply to transfer to the MSc. programme before completion of their coursework. Students granted permission to transfer would be required to pay the additional fees and complete the additional coursework

## DELIVERY:

Lectures would be delivered via face-to-face and blended learning modes (e.g. WebEx) and available to students from both St. Augustine and Mona campuses simultaneously. All lectures, assignments, handouts, and review materials would be available online to all students registered under the programme. Lectures are supplemented with laboratory work and tutorials.

## PROGRAMME CONTENT AND STRUCTURE

| **Core Courses** | **Credit** | **Semester** |
|---|---|---|
| Molecular biology and R-DNA technology | 3 | 1 |
| Microbial and Environmental Biotechnology | 3 | 1 |
| Advances in Plant Genetic engineering and Plant Biotechnology | 3 | 2 |
| Medical and Veterinary Biotechnology | 3 | 1 |
| Industrial Biotechnology and Bioprocessing | 3 | 1 |
| Bioinformatics | 3 | 1 |
| Immunotechnology and Molecular therapies | 3 | 2 |
| Bioethics, Biosafety and Intellectual Property Rights (IPR) in Biotechnology | 3 | 2 |

| **Optional Courses** | **Credit** | **Semester** |
|---|---|---|
| Molecular diagnostics | 3 | 2 |
| Molecular Plant breeding | 3 | 2 |
| Genomics and Proteomics technologies | 3 | 2 |
| Applied Bioinformatics | 3 | 2 |
| Directed reading and seminar | 3 | 2 |
| Entrepreneurship in Biotechnology | 3 | 2 |

**Research Project:**
1 semester research work + Presentation and Report
**12 credits Supervised**

- **Credits**
  - The proposed M.Sc. program would comprise 45 compulsory credits:
    - 8 core courses (3 credits each)
    - 3 optional courses from 6 (3 credits each)
    - Research Project (12 credits)
  - The Postgraduate Diploma programme would comprise of 30 compulsory credits:
    - 8 core courses and 2 optional courses
- **Programme duration:**
  - The master's course would be 1.5 years full-time or 2.5 years part-time
  - The PG diploma would be 1 year full-time or 2 years part-time;

## REGULATIONS AND ASSESSMENT

Students should refer to the Manual of Procedures for Graduate Diplomas and Degrees, the regulations for Graduate Diplomas and Degrees, the Graduate Studies Guide for Students and Supervisors, and the Thesis Guide.

Assessment of Students' Performance
Examinations are held according to the UWI's regulations:

- In order to pass a course, a candidate must attend at least 75% of the lectures, tutorials and laboratory sessions; He/she must have submitted the relevant project/ reports pertaining to all laboratory or industry work and must have satisfied the examiners in the associated examinations and course work;
- Examinations associated with each course shall be conducted by means of written and/or practical papers, normally taken at the end of the semester in which the candidate has registered. However, performance in course work in the form of essays, in-course tests, projects, or continuous assessments of theoretical and /or practical work, all contribute towards the final grade awarded in a course;
- All the online submissions should go through plagiarism screening through "Turnitin" software tool. The University's policy on plagiarism would be strictly enforced for all the submitted course work.
- All the activities related to course work have their own deadline and this has to be strictly adhered to. Any delay in submission would lead to rejection of submission or proportional reduction of marks.
- When theoretical and/or practical coursework contributes towards an examination, candidates must satisfy the examiners (≥50% marks) in each component;
- Candidates who score 50% and above would be deemed to have successfully passed the course;
- In respect of any candidate who fails the coursework or written examination at the first attempt, a second attempt may be allowed upon approval from the Board of Examiners and the Campus Committee for Graduate Studies and Research;
- Candidates permitted a second attempt at a course, having failed either the coursework or the written examination at the first attempt, will be required to rewrite only that component (written examination or coursework) failed, unless the Campus Committee in any particular case decides otherwise. Marks allotted to the component passed at the first attempt will be credited to the candidate at his or her second attempt at the course;
- No candidate will be permitted to repeat the examination in any one course on more than one occasion, unless approval is given by the Board for Graduate Studies and Research;
- Candidates who repeat the examination in any course shall not be eligible for the award of a diploma or degree with distinction.
- A student in the master's programme who fails the Research Project may, upon approval by Board of Examiners and the Campus Committee for Graduate Studies and Research, be granted a Diploma providing all the course requirements are met

**Grading System**

| Percentage | Grades |
|---|---|
| 70 – 100 | A |
| 60 – 69 | B+ |
| 50 – 59 | B |
| 0 - 49 | F |

**Progress through the Programme**

- Full-time students required to complete all courses (core and optional) within one academic year (5 – 6 courses per semester). After completing all core and the required optional courses, full-time master's students would then be allowed to start the research project, which should be completed within one or two semester;
- Part-time students are required to complete the courses within two academic years (2 – 3 courses per semester). After completing all core and optional courses, part-time master's students would then be allowed to start the project which should be completed within two semesters.

**Time limits for completion and enforced withdrawals**
Candidates would be required to withdraw from the programme if he/she fails more than six (6) credits in any one semester or fails any course or course component in a second sitting;

However, if the candidate has exhausted the maximum time limit with a deficit of no more than 6 credits for completion of the degree requirement, the Board of Examiners may recommend to the Campus Committee for Graduate Studies (after consultation with the Programme Coordinator) an extension of the period of study by one or two semesters.

**Re-admission to the programme after enforced withdrawal**
Candidates, who have had to withdraw from the programme because of poor academic performance, may re-apply for admission after one year of separation.

## COURSE OUTLINES:

**SEMESTER: 1**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: MOLECULAR BIOLOGY AND R-DNA TECHNOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology/Principles of Molecular Biology or equivalent**
**COURSE DESCRIPTION**: Recombinant DNA technology is fundamental to molecular biotechnology and encompasses many scientific disciplines including molecular biology, microbiology, biochemistry, immunology, genetics, chemical engineering and cell biology. RDNA technology also generates a wide range of consumer products including crops, livestock, drugs, vaccines and diagnostic tools, and livestock. Topics covered under this course are, Gene Regulation, Recombinant DNA Technology, Gene synthesis, Sequencing, and Amplification of DNA, Manipulation of Gene Expression in Prokaryotes, Heterologous Protein Production in Eukaryotic cells, Directed Mutagenesis and Protein Engineering, Molecular Diagnostics, Therapeutic Agents, Large-Scale Production of Proteins from Recombinant Microorganisms, Transgenic Animals, Regulating use of Biotechnology. This course is a techniques-based course that seeks to provide students with the required knowledge which serves as a basis for experimental, applied and industrial biotechnology. The student, upon completion of this course, should acquire a comprehensive understanding and practical expertise in basic molecular biology and biotechnology techniques. This foundation is important for the understanding and practical experimentation of several more advanced techniques and their applications in many biology-related fields. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work and a final examination (50% for each component).

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 50 % (Lab report:10%, Term paper & journal paper discussion: 20%, Two mid-sessional tests:20%)
- Final Written Exam (three hour duration): 50 %

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 1**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: MICROBIAL AND ENVIRONMENTAL BIOTECHNOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology/Principles of Molecular Biology or equivalent**
**COURSE DESCRIPTION:** This course examines current applications of microbial organisms for industrial and environmental applications. It also illustrates specific applications of biotechnology to solve environment related problems. The course provides a theoretical and working knowledge of the principles, techniques and current applications of microbial organisms for manufacturing components of food and consumer products, biologics and biomaterials using recombinant DNA and is organized following the steps in discovery and development of biologics. An introduction to microbial growth kinetics is included as well as discussions on generating products from genetically modified microorganisms. The second part of the course will introduce the applications of biotechnology to address important environmental issues. Applications: application of biotechnology to environmental quality evaluation, monitoring, remediation of contaminated environments and energy production, production of biofuels (biogas, bioethanol, biohydrogen), applications in the paper and plastic industry as well as in other industrial processes in order to promote processes minimizing environmental deterioration. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work and a final examination (50% for each component).

Upon successful completion of this course, students must be able to:
- illustrate the development of recombinant microorganisms for specific applications in science and industry.
- investigate the applications of recombinant and native microorganisms for synthesis and extraction of novel proteins and chemical compounds.
- evaluate the choice of techniques for experiments in Biotechnology.
- explain, illustrate and interpret the principles, mechanisms of bioremediation.
- evaluate the applicability of various tools in environmental biotechnology, their applicability and related developed technologies.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 50 % (Lab report:10%, Term paper & journal paper discussion: 20%, Two mid-sessional tests:20%)
- Final Written Exam (three hour duration): 50 %

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: ADVANCES IN PLANT GENETIC ENGINEERING AND PLANT BIOTECHNOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology and R-DNA technology**
**COURSE DESCRIPTION**: This course emphasizes the advancements that have taken place in plant transformation technologies and genetic engineering methodologies for introduction of beneficial traits into economically important plants. The topics include an advanced study of Plant cell and tissue culture; Molecular basis of plant organ differentiation; Micropropagation for virus elimination, Anther and microspore culture, dihaploid plants, in vitro fertilization, Embryo rescue and wide hybridization, Protoplast culture and fusion, Somaclonal variation- in vitro mutagenesis, in vitro germplasm, conservation; Production of secondary metabolites; Plant genetic transformation methods (direct and indirect); Molecular basis of transgenesis; Expression systems in plants; Transgene design-Promoters & Marker genes; Transcription factors in transgene expression; Molecular Markers; Analysis of transgenic plants; Plant genetic engineering for herbicide tolerance, Disease and pest resistance, Abiotic stress tolerance, Improving nutritional quality and yield; Biopharming; Plant based production of biofuels, bioplastics, industrial and therapeutic proteins. Limitations and environmental concerns and Marker free transgenic plants, avoidance of horizontal gene transfer; Recent developments in plant genetic engineering. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work and a final examination (50% for each component).

Upon successful completion of this course, students must be able to:
- analyse the importance of plant tissue culture and related techniques for specific applications in agriculture and industry.
- explain, illustrate and interpret the principle of transgenesis, design of components involved and mechanism of transgene integration and expression.
- assess the methods of plant transformation and discuss their mechanisms, advantages and limitations.
- justify the application of genetic engineering in the development of transgenic plants with novel traits.
- discuss the role of plant genetic engineering in addressing the current needs of the century, addressing global challenges in food production, energy, human health, industrial needs and environmental conservation.
- appraise the potential environmental concerns associated with transgenic crops and formulate solutions.
- summarize the current advances and emerging technologies in the field of plant biotechnology.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 50 % (Lab report:10%, Term paper & journal paper discussion: 20%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 50 %

**SEMESTER: 1**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: MEDICAL AND VETERINARY BIOTECHNOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology/Principles of Molecular Biology or equivalent**
**COURSE DESCRIPTION:** This course emphasizes the scientific developments that have taken place in the fields of medical and veterinary biotechnology. The information gathered from this course is essential to apply the biotechnology principles for specific actions towards human health care and animal production. The topics include, advanced study of Animal and human cell, tissue and organ culture and their medical applications; Genetic engineering of animal cells and their applications; Principles of tissue engineering; Stem cells and tissue engineering as research tools in drug discovery/ screening and in regenerative medicine; Embryo Transfer in domestic animals and humans; Micromanipulation and in- vitro Fertilization; Animal cloning; Transgenic animals, transgenic animals in xenotransplantation; Organ transplantation; Risks and safety & biohazards. Fish Biotechnology. Sequencing human genomes; Physical mapping of human genome; Cloning of Human Disease Genes; Human Gene Therapy; Pharmaco-genetics; Applications of biotechnology towards human population growth. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/ group discussions conducted through blended learning modes. Assessment involves course work and a final examination (50% for each component).

Upon successful completion of this course, students must be able to:
- describe the techniques of animal and human cell culture, tissue engineering and other related technologies for specific applications in health, medicine and related industries.
- explain and illustrate the principle of animal cloning, development of transgenic animals and justify their importance in scientific research and human and veterinary medical research and technology.
- explain the advancements in human genomics and justify their relevance to human health and welfare.
- examine the relevance of biotechnology towards human welfare, population control and eugenics
- discuss the potential difficulties, risks and ethical concerns involved in biotechnological applications to humans and animals.
- summarize the current advancements and emerging technologies in medical and veterinary biotechnology.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 50 % (Lab report:10%, Term paper & journal paper discussion: 20%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 50 %

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: IMMUNOTECHNOLOGY AND MOLECULAR THERAPIES**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular biology and R-DNA technology AND Medical and Veterinary Biotechnology**
**COURSE DESCRIPTION:** This course emphasizes the scientific advancements that have taken place in the fields of immunotechnology and molecular therapies and their impacts in human medicine and health. The topics include, Natural immunity, acquired immunity; Monoclonal antibodies, genetics of immunoglobulins and antibody diversity, antigen presentation; In vivo regulation of immune responses, B and T cell activations, hypersensitivity, mucosal immunity; Introduction to transplantation immunology tolerance, tumor immunology and vaccines; Production of human monoclonal antibodies and their applications; T cell cloning; Application of T cell cloning in vaccine development; Immunity to viruses, bacteria and parasites; Genetic control of immune response; Principles and strategy for developing vaccines; Study of molecular mechanisms of important diseases including cancer, genetic, metabolic and inflamammatory disorders and contemporary targeted molecular therapies for such disease with examples; Medical Nanobiotechnology, Nanotherapeutics: Cancer treatment, Wound care products, Implantable materials and devices, Nanosurgery. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:
- explain and illustrate the types of immunity and molecular and genetic basis of immunity.
- analyse the importance of immuno-regulation in relation to disease resistance.
- evaluate approaches for the immunological interventions for treatment of diseases.
- explain the advancements in human immunology and immunotherapy.
- summarize the developments in nanobiotechnology applied to human medicine and therapy.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 60 % (Course work assignment:10%, Term paper: 10%, Lab report: 5%, Journal article discussion: 15%, Two mid-sessional tests: 20%
- Final Written Exam (three hour duration): 40 %

**SEMESTER: 1**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: INDUSTRIAL BIOTECHNOLOGY AND BIOPROCESSING**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology/Principles of Molecular Biology or equivalent**
**COURSE DESCRIPTION:** This course investigates the application of biotechnology to industries including manufacturing of medicinal bioproducts, recombinant proteins, health products, biomaterials, enzymes and generation of alternative energy. The topics include Bioreactor design and operation, fermentation processes, Process optimization, Down-stream processing; Isolation and screening of industrially important microbes; Improvement of the strains; Effluent treatment processes; Recombinant Protein expression systems; development of products, ranging from pharmaceuticals, vitamins and amino acids; Enzyme catalysis and kinetics; Methods of protein modification; Peptide engineering; Metabolic engineering; Introduction to Nanobiotechnology; Nanomaterials and Nanobiomaterials; Characterization of Nanostructures, Nano Synthesis and Fabrication; Biofuels, Biomass conversion. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work and a final examination (50% for each component).

Upon successful completion of this course, students must be able to:
- investigate the status of biotechnology in industrial World.
- analyse the importance of industrial biotechnology to downstream processing.
- identify the novel biotechnological approaches to derive clean energy.
- explain the advancements that has taken place in protein engineering.
- summarize the developments in nanobiotechnology and their applications to human health and in the synthesis of novel industrial materials.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 50 % (Lab report:5%, Term paper & journal paper discussion: 25%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 50 %

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: BIOETHICS, BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (IPR) IN BIOTECHNOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology/Principles of Molecular Biology or equivalent**
**COURSE DESCRIPTION:** This course emphasizes the basic ethics to be considered and practiced in biotechnology research. Research ethical standards and procedures are considered as codes and guiding principles in biotechnology research. The study topics include Ethical concerns in biotechnology; Examination of integrity and misconduct in biotechnology research; Applications of Genetic engineering – safety and ethical considerations; Ethics in genetic testing and screening; Medical safety and biosafety of Biotechnology products; Environmental release of Genetically Modified Organisms (GMOs) on biodiversity and biosafety; Impact of GMOs on Agriculture and environment; GMO foods: ethics, benefits and risks, regulations and public acceptance, labelling; Legal implications and public concerns in human gene therapy; Bio-safety Regulations and IPR (Intellectual Property Rights) Requirement of a patentable invention; Rights/ Protection and Remedies against infringement. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:

- analyse and compare the biosafety regulations and the policies of different countries including Trinidad and Tobago.
- explain the rules of manufacture, import and export of GMOs into or out of the country.
- summarize the existing regulations on in transgenic plants and associated research.
- assess the medical safety and biosafety of Biotechnology products to humans, animals and environment.
- describe the Intellectual Property Rights associated with scientific inventions in biotechnology.
- appraise the ethical, cultural, religious and sociological difficulties in accepting genetically modified products.

**CONTACT HOURS:**

- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**

- Coursework 60 % (Lab report:10%, Term paper: 15%, Journal article discussion: 15%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 40 %

**SEMESTER: 1**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: BIOINFORMATICS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular Biology/Principles of Molecular Biology or equivalent**
**COURSE DESCRIPTION:** Bioinformatics course reveals the science of analyzing and deducing the structure and function of genes and proteins through computational methods and software and statistical tools. This is a fast developing field and therefore continuous updating and introduction new components are expected to take place frequently. This course covers, introduction to Bioinformatics-concepts; Biological databases including Protein and Gene Information Resources; DNA sequence analysis software tools, Pairwise alignment techniques, database searching, multiple sequence alignment, phylogenetics; ORFinder; Secondary structure prediction etc., Secondary database searching; Microarray data analyses; Structure prediction methods; Introduction to computational methods for protein structure prediction; Homology modeling, Computer aided drug design. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:

- explain and illustrate the various bioinformatic techniques for analyses of genes and proteins.
- select the right computational methods used for analyses to address problems in molecular biology and genomics.
- practice and apply various bioinformatic tools in biotechnology research and analysis.
- prepare students for more advanced bioinformatics courses involving method development.

**CONTACT HOURS:**

- Lecture/tutorial: 2 hours per week
- Laboratory class: 5 hours fortnightly

**ASSESSMENT:**

- Coursework 60 % (Coursework assignmentt:10%, Lab report and project: 20%, Journal paper discussion: 10%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 40 %

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: GENOMICS AND PROTEOMICS TECHNOLOGIES**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular biology and R-DNA technology or equivalent**
**COURSE DESCRIPTION:** This course emphasizes the basic ethics to be considered and practiced in biotechnology research. Research ethical standards and procedures are considered as codes and guiding principles in biotechnology research. The study topics include Ethical concerns in biotechnology; Examination of integrity and misconduct in biotechnology research; Applications of Genetic engineering – safety and ethical considerations; Ethics in genetic testing and screening; Medical safety and biosafety of Biotechnology products; Environmental release of Genetically Modified Organisms (GMOs) on biodiversity and biosafety; Impact of GMOs on Agriculture and environment; GMO foods: ethics, benefits and risks, regulations and public acceptance, labelling; Legal implications and public concerns in human gene therapy; Bio-safety Regulations and IPR (Intellectual Property Rights) Requirement of a patentable invention; Rights/ Protection and Remedies against infringement. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:
- investigate the advancements that has taken place in the post-genome era biology.
- explain various structural and functional genomic approaches used in contemporary research.
- describe a gene based on in-depth analysis of a genome.
- describe and practice the methods and to perform analysis of the genomics and proteomics data, and choose the relevant research tools.
- appraise the importance of genomics and proteomics and assess their applicability in multiple fields of science.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Group discussion and library: 5 hours fortnightly
-

**ASSESSMENT:**
- Coursework 60 % (Coursework assignemnt:10%, Term paper: 15%, Journal article discussion: 15%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 40 %

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX[1]**
**COURSE TITLE: MOLECULAR DIAGNOSTICS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular biology and R-DNA technology AND Medical and Veterinary Biotechnology**
**COURSE DESCRIPTION:** This course provides comprehensive introduction to the basic principles of the rapidly growing field of molecular diagnostics and hands on experience on many of the important techniques. The course addresses many direct and amplified nucleic acid test methods and protein based probing techniques applied in medical diagnostics and plant disease diagnostics. It also prepares students to become professionals and be competent in performing and interpreting molecular-based laboratory tests, explaining the appropriate use and meaning of molecular-based tests and validating new molecular methods in a clinical laboratory and apply required quality control. The course covers the following topics: Biotechnological applications in diagnostics and development of therapeutics; Application of molecular diagnostic techniques in genetic, malignant and infectious diseases and disorders. Identification of pathogens, identity-based testing and genetic finger printing; Biotechnological developments in disease diagnosis in the post-genomics era; Use of molecular techniques in the disease diagnostics lab, with an emphasis on nucleic acids and proteins; Quality control in a clinical diagnostic lab; Techniques associated with detection of plant pathogens and plant disease diagnosis. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:
- explain various molecular diagnostics and illustrate their principles and mechanisms.
- identify appropriate specimen collection and handling measures for molecular diagnostics.
- outline examples of procedures for each molecular diagnostic classification.
- discuss clinical applications of molecular diagnostics.
- develop and apply diagnostic procedures for noted pathogens and diseases.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Lab: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 60 % (Coursework assignemnt:10%, Lab report 10%, Term Paper and Journal article discussion: 20%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 40 %

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX**[1]
**COURSE TITLE: MOLECULAR PLANT BREEDING**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Advances in Plant Genetic engineering and Plant Biotechnology**
**COURSE DESCRIPTION:** This course offers an introduction to principles of molecular biology methods and tools used for plant genetic improvement and conservation of biodiversity. The covered topics include review of basic molecular biology techniques and genomic approaches in plant breeding; molecular markers, Marker-assisted breeding (MAB), Linkage mapping, QTL analysis, Pedigree-based analysis; Management of agro-biodiversity; Targeted transgene expression, Targeted gene silencing and targeted mutagenesis for crop improvement; Current advancements in transgenesis in genetic improvement of plants; Molecular phylogeny; Horizontal gene transfer in nature and their risks; Genetic and evolutionary applications to problems of restoration and conservation of biodiversity and New approaches in conservation of biodiversity. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions (GD) conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:
- explain how the genomic approaches and molecular tools are used for plant breeding and crop improvement.
- assess the importance of molecular marker technology in contemporary plant breeding and explain their effects citing successful examples.
- formulate a conceptual marker assisted breeding programme for a major crop of the Caribbean and a most wanted trait.
- construct phylogenetic trees and conduct studies on Molecular phylogeny.
- apply genetic and molecular evolutionary principles for restoration and conservation of biodiversity.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Group discussion/Lab: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 60 % (Coursework assignemnt:10%, Term paper: 15%, Journal article discussion: 15%, Two mid-sessional tests: 20%)
- inal Written Exam (three hour duration): 40 %

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX**[1]
**COURSE TITLE: APPLIED BIOINFORMATICS**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Bioinformatics**
**COURSE DESCRIPTION:** This advanced course aims to provide students with knowledge, critical understanding and practical experience of using computational methods and bioinformatic approaches to interpret output data and functional genomics, genomics, transcriptomic and proteomic technology platforms. The course coverage includes Genomic sequencing and mapping Techniques; Human Genome project; Sequence Databases; Biological Databases– Primary and Secondary; Genotype databases, molecular structure databases and genome databases; PERL and Bioinformatics: Basics of PERL; Hidden Markov Models; Modelling Protein sequence families; Protein Modeling and In silico Drug Design; Protein modeling and analysis; Modeling protein structures using High Throughput methods; Virtual Library design; Structural Mining: Protein Ligand work analysis; Study of drug-interactions, Docking; Intermediate and Advanced; Evolutionary analysis; Metabolomics, Working with Discovery Studio (Molecular Modeling). The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/ group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:
- apply data generated by different molecular techniques to appropriate bioinformatics analytical tools and interpret results.
- develop and apply bioinformatics approaches and skills to address research questions and problems of practical relevance.
- critically evaluate the approaches and technologies employed in functional genomics research.
- demonstratate operational procedures for the commonly used bioinformatics databases and bioinformatics software packages.
- set up and complete bioinformatics project by appropriate selection and utilization of bioinformatics tools.

**CONTACT HOURS:**
- Lecture/tutorial: 2 hours per week
- Lab: 5 hours fortnightly

**ASSESSMENT:**
- Coursework 60 % (Coursework assignemnt:10%, Lab project and report: 20%, Journal article discussion: 10%, Two mid-sessional tests: 20%)
- Final Written Exam (three hour duration): 40 %

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**COURSE CODE: BIOL 6XXX**[1]
**COURSE TITLE: DIRECT READING AND SEMINAR**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: N/A**
**COURSE DESCRIPTION:** This advanced course aims to provide students with an opportunity to undertake directed reading on a selected topic of their interest or on a title/problem selected for further research (as M.Sc research project/M.Phil research project). The topics should be related to any of the courses listed in the post-graduate programme. The teaching and learning methods involve weekly tutorial/discussion with the assigned supervisor. Assessment involves 100% course work with submissions including, concept proposal, monthly reports, seminar presentation and final write up.
Upon successful completion of this course, students must be able to:

- demonstrate an advanced level of reading on a given specific title in biotechnology.preparation and reporting
- critically analyze scientific information and literature, logically discuss and submit as a comprehensive document in a required size and structure.
- summarize and present on a topic relevant to a particular learned aspect of Biotechnology with clarity.
- demonstrate time management, scientific writing and oral presentation skills.

**CONTACT HOURS:**

- Tutorial/Discussion: 1 hours per week
- Lab: 5 hours fortnightly

**ASSESSMENT**:

- Coursework 100% (Concept proposal: 20%, Monthly reports:20%, Seminar: 20%, Submitted Paper/Write up: 40%

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

**SEMESTER: 2**
**COURSE CODE: BIOL 6XXX**[1]
**COURSE TITLE: ENTREPRENEURSHIP IN BIOTECHNOLOGY**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: Molecular biology and R-DNA technology**
**COURSE DESCRIPTION:** Successful biotechnology enterprise requires trained skilled professionals who are also knowledgeable with the complexities of biotechnology commercialization. This course builds a required basic foundation on biotechnology enterprise and entrepreneurship, providing a venue for learners to better understand the entire biotechnology enterprise and issues unique to the industry. The goal for this course is to give non-business students the tools necessary to be totally conversant in the financial and managerial aspects of science-based businesses particularly on biotechnology. The covered topics include Macro- and micro-economics of biotechnology businesses, Entrepreneurial models and skills in developing biotechnology industries from research to market, Market research, Proposal preparation for funding – financing biotechnology ideas, Team building and leadership, Production economics and management, Branding and marketing issues, Bioethics and analysis and approval and Intellectual Property and technology transfer. The teaching and learning methods include lectures/tutorials, group discussion, journal paper discussion and assignments/term papers. The teaching and learning methods involve lectures supplemented by laboratory sessions/virtual lab/group discussions conducted through blended learning modes. Assessment involves course work (60%) and a final examination (40%).

Upon successful completion of this course, students must be able to:

- formulate strategies for a viable biotechnology industry or enterprise.
- create financial and funding strategies for success under specific economic situations.
- demonstrate principles of human interrelationships to research, design and development activities.
- navigate through schematic steps in the development of a biotechnology derived product: from its inception as intellectual property, to scale-up, to the final product.
- investigate the marketing strategies specifically related to biotechnology products.
- analyse organizational problems arising from a legal and technology framework.
- explain the issues related to bioethics in the development of biotechnology products.
- compose a road map from an idea to a final product in biotechnology.

**CONTACT HOURS**:

- Lecture/tutorial: 2 hours per week
- Lab: 5 hours fortnightly

**ASSESSMENT:**

- Coursework 60 % (Project: 20%, Term Paper: 10%, Journal group discussion: 10%, Two mid-sessional tests: 20%
- Final Written Exam (three hour duration): 40%

**SEMESTER: N/A**
**COURSE CODE: BIOL 6XXX**[1]
**COURSE TITLE: RESEARCH PROJECT**
**NUMBER OF CREDITS: 12**
**PREREQUISITE: N/A**
**COURSE DESCRIPTION:** The aim of the research project is to allow the student to synthesise and articulate several aspects of the taught programme within a single themed research topic. In addition, it will provide the opportunity for further detailed skills training in aspects of biotechnology, molecular diagnostics, molecular ecology etc., It will allow the student to pursue an individual study on a particular research topic or issue of interest to the student and will incorporate technical skills training specific to the individual student. As such, the research project will provide the opportunity to develop a specific set of practical and reporting skills that will be of use to the student in their future career. The teaching and learning methods involve weekly tutorial/discussions with the assigned supervisor. Assessment involves 100% course work with submissions including, concept proposal, monthly reports, seminar presentation and final write up.

Upon successful completion of this course, students must be able to:

- demonstrate an advanced knowledge and understanding of a specific practical problem or a technical aspect of biotechnology and recognize the underlying philosophies. preparation and reporting
- to analyze scientific information and literature critically on the specific topic.
- summarize and present on a topic relevant to a learned aspect of Biotechnology.
- choose and optimize appropriate research and experimental methodologies during study of the problem.
- demonstrate skills in time management, scientific writing and oral presentation.

**COURSE CONTENT:** The individual research project is required for the M.Sc. award. The project will be on a topic proposed by the student and agreed by the appropriate supervising faculty. The Research Project is a fundamental component of the M.Sc. programme and this is reflected, not only in the credit weighting, but by the fact that the M.Sc. runs for an extra 6 months (full-time) or 10 months (part-time) following completion of coursework so that the student may have the necessary time to complete the project at a high standard. The project is an opportunity for the student to put into practice the concepts, tools and research methods learned during the programme, within a specific area of enquiry. The research project may cover any feasible aspect of Biotechnology. It may involve a pure research study toward any branch of biotechnology but limited to the available infrastructure and facility and time limits. Students are expected to consult with the Course Coordinator during the second semester with potential ideas for their research project. A list of potential projects will also be made available for those students who do not have a specific topic in mind at the beginning of the second semester. For students from outside of Trinidad, the project may be undertaken within Trinidad or in the student's home country. Each student will be assigned a supervisor from within the UWI and one external supervisor in case the research is done outside the campus. The outcome will be an extended research paper or report, as part of the degree requirements. The research project will be examined by two internal examiners and one external examiner.
The specifications for thesis structure were mentioned in the UWI-Sta. graduate studies website, http://sta.uwi.edu/admissions/postgrad/.

The submitted work has to be presented as a seminar (on 12th week) for a 45 min. duration followed by a 10 min discussion. The presentation and participation in discussion and time management will be assessed by the committee and audience.

**CONTACT HOURS:** Tutorial: 1 hour per week

**ASSESSMENT: Coursework 100 %**

- Research Concept proposal: 10%
- Monthly reports: 10%
- Research poster: 20%
- Research Presentation: 20%
- Research Paper/Thesis: 40%

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

## ADDITIONAL COURSES

The following four (4) credit courses offered by the Department of Life Sciences are available for MPhil/ PhD students:

| Course Code | Course Title |
|---|---|
| BIOL 6062 | Bioethics |
| BIOL 7063 | Light Microscopy & Digital Image Processing |

## COURSE DESCRIPTIONS

**SEMESTER: 2**
**COURSE CODE: BIOL 6062**
**COURSE TITLE: BIOETHICS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The course is designed to expose postgraduate students to a wide assay of topics from various disciplines. The field of bioethics is not dominated by a single discipline but rather it concerns cross disciplines, that is, they are both scientific and ethical. Hence this course provides the opportunity for sustained, cross-disciplinary work in the fields of biology, natural sciences, medicine, philosophy, sociology, demography and theology. It enables a student to pursue topics where life sciences and ethics converge. Some of the areas that postgraduates should have some working knowledge of and which shall be helpful while pursuing the course in bioethics include genetics, use of scientific technology, allocation of resources, philosophy of science, environmental studies and so on.
**Assessment:**

| | |
|---|---|
| Coursework | 60% |
| Final Examination | 40% |

**SEMESTER: 3 (SUMMER) I**
**COURSE CODE: BIOL 7063**
**COURSE TITLE: LIGHT MICROSCOPY & DIGITAL IMAGE PROCESSING**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The course provides theoretical and practical background information, as well as hands-on experience, with a variety of advanced light microscopy and image processing techniques. Since individual supervision is provided during the integrated lecture and practical sessions, enrolment is limited to about six students whose research will benefit significantly from what the course has to offer. Students must consult with the lecturer prior to registering for BIOL7063
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination | 60% |

[1] NOTE: Where course codes were not available at the time of publication of this information guide, please consult the department office.

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# RESEARCH INTERESTS AND FACILITIES

The Department of Mathematics and Statistics offers MSc Degrees in Mathematics and in Statistics. The Department also offers programmes leading to the MPhil and PhD degrees. The MSc degrees are awarded on the basis of taught courses and a research project.

The MPhil and PhD are research degrees awarded on the submission and successful defence of a thesis. Each MPhil/ PhD student must also do a minimum of 8/9 credits at graduate level, as recommended by his/her Supervisor. After evaluation by his/her supervisor, MPhil and PhD candidates may be required by the Department to take substantially more credits of taught courses than the University stipulated minimum.Interested applicants should consult the Head of the Department concerning available research facilities.

Transfer from the MPhil to the PhD degree programme is possible but depends on the progress of the research undertaken and the recommendation of the supervisor and the approval of the Board for Graduate Studies and Research.

In Mathematics, the current research areas are Graph Theory and Combinatorics, Fluid Dynamics, Mathematical Modelling and Biomathematics.

# PROGRAMMES

## MSc in Statistics

**Objectives**

To provide graduates with a comprehensive and advanced knowledge of Statistics so as to enable them to function effectively as professional Statisticians and to provide them with an adequate background for further study and research in Statistics.

**PROGRAMME CO-ORDINATOR: DR. ROBIN ANTOINE**

**Entry Requirements**

To be admitted to the programme a candidate should possess a BSc degree with at least Lower Second Class Honours or its equivalent (GPA 2.0). Candidates are expected to have a minimum grade B (quality point 3.0) in the following courses or its equivalent:

| Course Code | Title |
|---|---|
| MATH 2110 | Linear Algebra |
| MATH 2120 | Analysis & Mathematical Methods I |
| MATH 2140 | Introduction to Probability |
| MATH 2150 | Introduction to Statistics |

In addition to the above, the following courses offered by the Department of Mathematics and Statistics will be an asset: MATH 3450 (M 35A) Statistical Theory I and MATH 3460 (M 35B) Statistical Theory II. Applicants who do not satisfy these requirements may be admitted upon successful completion of qualifying courses.

**Course of Study**

For the MSc programme in Statistics, students are required to complete (32 credits) consisting of:

(i) 5 core courses (20 credits)

**AND**

(ii) 3 elective courses (12 credits) with an 8-credit Research Project (STAT 6000) which must be chosen in collaboration with at least one Lecturer in Statistics.

The course of study shall extend over one (1) year of full time study or two (2) years of part time study, however, at the present time, only a part-time programme is available.

**Examination**

Students will be required to pass both the coursework and the written examination. The pass mark is 50%. The grading scheme for graduate degrees is as follows: A 70 - 100%; B+ 60-69%; B 50-59%. In the case of the Research Project, evaluation will be based on the project report.

**Award of Degree**

To qualify for the award of the degree, candidates must pass all five Core courses, three Elective courses and the Research Project. The degree shall be awarded in two categories - Distinction and Pass. For the award of the degree with distinction, the candidate must have obtained an average mark of 70% or more, across all Core courses and Elective courses as well as 70% or more in the Research Project.

A candidate failing a course shall be ineligible for the award of distinction.

**CORE COURSES: (4 CREDITS EACH)**

| Course Code | Title |
|---|---|
| STAT 6100 | Applied Probability Theory |
| STAT 6110 | Applied Statistical Inference |
| STAT 6120 | Linear Statistical Methods |
| STAT 6130 | Sampling Theory & Techniques |
| STAT 6140 | Experimental Design and Analysis |

**SELECT 3 OF THE FOLLOWING ELECTIVE COURSES (4 CREDITS)**

| Course Code | Title |
|---|---|
| STAT 6150 | Stochastic Process & Applications |
| STAT 6160 | Data Analysis |
| STAT 6170 | Multivariate Analysis |
| STAT 6181 | Computational Statistics I |
| STAT 6182 | Computational Statistics II |

# COURSE DESCRIPTIONS

**SEMESTER: 1**
**COURSE CODE: STAT 6100**
**COURSE TITLE: APPLIED PROBABILITY THEORY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Foundations of Probability; Distributions of One and Several Discrete and Continuous Random Variables; Expectations, Moments, Moment Generating Functions and Characteristic Functions; Order Statistics; The Bivariate and Multivariate Normal Distributions; Sampling Distributions; Distributions of Quadratic Forms; Poisson Process; Markov Chains and Markov Processes; Convergence in Distribution and Convergence in Probability.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 2**
**COURSE CODE: STAT 6110**
**COURSE TITLE: APPLIED STATISTICAL INFERENCE**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Point and Interval Estimation; Maximum Likelihood Estimation; Hypothesis Testing; The Neyman-Pearson Theory; Likelihood Ratio Tests; The Elements of Bayesian Inference.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 1**
**COURSE CODE: STAT 6120**
**COURSE TITLE: LINEAR STATISTICAL METHODS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Generalized Inverses of Matrices; Distribution of Linear and Quadratic Forms; Regression of Full Rank Models; Models of Less than Full Rank; Estimation and Tests of Hypotheses for Full Rank and Non-full Rank Models; Reduction of Sum of Squares; ANOVA for Balanced and Unbalanced Designs Components of Variance Models.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: STAT 6130**
**COURSE TITLE: SAMPLING THEORY AND TECHNIQUES**
**NUMBER OF CREDITS: 4**
**COURSE DESCRIPTION:** Theory of Equal and Unequal Probability Sampling; Selected Topics from Simple Random Sampling, Stratified Sampling, Systematic Sampling and PPS Sampling; Ratio and Regression Estimation; Two-stage and k-stage Sub-sampling Procedures; Double Sampling Procedure; Repetitive Surveys; Non-sampling Errors.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 2**
**COURSE CODE: STAT 6140**
**COURSE TITLE: EXPERIMENTAL DESIGN AND ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Designs for Eliminating One-way, Two-way, Three-way and Multi-way Heterogeneity; Fixed, Mixed and Random Effects Models; Incomplete Block Designs; Factorial and Fractional Factorial Designs; Responses Surface Methods; Confounded Designs; Analysis of Covariance.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 2**
**COURSE CODE: STAT 6150**
**COURSE TITLE: STOCHASTIC PROCESSES AND APPLICATIONS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE(S): STAT 6100**
**COURSE DESCRIPTION:** Markov Chains; Markov processes with discrete states in continuous time; Queueing Theory; Renewal Theory; Branching Processes, Epidemic Theory.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 1**
**COURSE CODE: STAT 6160**
**COURSE TITLE: DATA ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Topics selected from Trimmed Means and Winsorised Means; Transformations; Assessment of Normality; Detection of Outliers; Robust Methods; Monte Carlo Methods; Jackknife and Bootstrap Techniques; Regression Diagnostics; Censored Data Analysis; Graphical Methods of Data Analysis; Use of Statistical Software; Generalised Linear Models and Categorical Data Analysis.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 2**
**COURSE CODE: STAT 6170**
**COURSE TITLE: MULTIVARIATE ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Multivariate Distributions; Normal, Wishart, T and Others with Applications; Regression Correlation and General Linear Hypothesis in the Multivariate setting; MANOVA and MANOCOVA; Principal Component Analysis; Factor Analysis; Cluster Analysis; Multidimensional Scaling.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: STAT 6180**
**COURSE TITLE: ADVANCED TOPICS IN STATISTICS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The Bootstrap; The E-M algorithm Markov Chain Monte Carlo Methods; Empirical Bayes Methods.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 1**
**COURSE CODE: STAT 6181**
**COURSE TITLE: COMPUTATIONAL STATISTICS I**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course is meant to cover the basics methods in computational statistics. Techniques such as bootstrap, jack-knife, MCMC with particular reference to both hierarchical Bayesian and Empirical Bayes will be covered. The theoretical underpinnings of the course will be covered in conjunction with relevant computational aspects. The course will be hands on and practical and will rely heavily on the statistical software R. Matlab will be utilized where there is a need for numerical computations. We will rely on both real data and simulated data for illustrating the main concepts in the course. Datasets from different subject areas will be utilized.The course is the first in a sequence of two computational statistics courses.
**Assessment:**
Coursework 100%

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: STAT 6182**
**COURSE TITLE: COMPUTATIONAL STATISTICS II**
**NUMBER OF CREDITS: 3**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course is meant to cover the techniques in statistics that are computational in nature that would not have ordinarily been covered by the other courses in the statistics masters program. The course covers topics such as spatial statistics, advanced Bayesian models and some data mining techniques. Both the theoretical underpinnings of the material and the application through computational aspects. The course will be hands on and practical and will rely heavily on the statistical software R. Matlab will be utilized where there is a need for numerical computations. We will rely on both real data and simulated data for illustrating the main concepts in the course. Datasets from different subject areas will be utilized.The course is the first in a sequence of two computational statistics courses. This course is presented to address these concerns.
**Assessment:**
Coursework 100%

# MSc in Mathematics

**OBJECTIVES**
To impart a knowledge of Mathematics which would enable graduates to perform more effectively in the workplace and also enhance their research capability.

**PROGRAMME CO-ORDINATOR: DR. DONNA COMISSIONG**
**Entry Requirements**
To be admitted to the programme, a candidate should (normally) possess a BSc degree majoring in Mathematics or equivalent (minimum GPA 2.0) with at least Lower Second Class Honours. Candidates with lower qualifications may be considered but will be required to pass qualifying courses, as prescribed by the department. All candidates must have passed the following courses (or its equivalent):

| Course Code | Title |
|---|---|
| MATH 2100 | Abstract Algebra |
| MATH 2110 | Linear Algebra |
| MATH 2120 | Analysis & Mathematical Methods I |
| MATH 2160 | Analysis & Mathematical Methods II |

**Duration of study**
The course of study will extend over one year of full-time study or two years of part-time study. Part-time students will normally be required to complete the degree within two years of registration; and must complete it within three years.

**Examination**
Students will be required to pass both the coursework and the written examination. The pass mark is 50%. The grading scheme for graduate degrees is as follows: A 70 - 100%; B+ 60-69%; B 50-59%. In the case of the Research Project, evaluation will be based on the project report.

**Award of Degree**
To qualify for the award of the degree, candidates must pass all three Core courses, five/six Elective courses and the Research Project. The degree shall be awarded in two categories - Distinction and Pass. For the award of the degree with distinction, the candidate must have obtained an average mark of 70% or more, across all Core courses and Elective courses as well as 70% or more in the Research Project.

A candidate failing a course shall be ineligible for the award of distinction.

**Course of Study**
The MSc programme consists of 3 core courses **and** 5/6 electives
**Either**
(i) 5 elective courses and an 8-credit Research Project. (**MATH 6000)**
**OR**
(ii) 6 elective courses and a 4-credit Research Project. (**MATH 6001**)

A Research Project must be chosen in collaboration with at least one Lecturer in Mathematics. An 8- credit project is equivalent to two courses. A 4- credit project is equivalent to one course.

**CORE COURSES: (4 CREDITS EACH)**

| Course Code | Title |
|---|---|
| MATH 6100 | Algebra (Group Theory and Applications) |
| MATH 6110 | Real Analysis |
| MATH 6120 | Differential Equations |

**ELECTIVE COURSES: (4 CREDITS EACH)**

| Course Code | Title |
|---|---|
| MATH 6130 | Algebra (Group Actions) |
| MATH 6140 | Advanced Mathematical Methods |
| MATH 6150 | Viscous Flows |
| MATH 6160 | An Introduction to Non-Newtonian Fluid Mechanics |
| MATH 6170 | Advanced Discrete Mathematics (F-Polynomials of Graphs) |
| MATH 6180 | Probability |
| MATH 6190 | Numerical Analysis |
| MATH 6191 | Asymptotic & Perturbation Analysis |
| MATH 6192 | Advanced Mathematical Modeling |
| MATH 6193 | Numerical Methods for Partial Differential Equations |
| MATH 6310 | Complex Analysis |
| MATH 6620 | Topology |
| MATH 6630 | Functions Analysis |
| MATH 6640 | Theory of Integration |
| MATH 6194 | Discrete Mathematics |
| MATH 6195 | Finite Element Analysis |

# COURSE DESCRIPTIONS

**SEMESTER: 2**
**COURSE CODE: MATH 6100**
**COURSE TITLE: ALGEBRA (GROUP THEORY AND APPLICATIONS)**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Group Theory; Commutators, Centralisers and Nomalisers; The Homomorphism Theorems; The Sylow Theorems; The Class Equation of a Group; Theory of p-groups; Solvable Groups; The Jordan-Holder Theorem; Simple Groups; Direct Product of Groups. Applications Groups and Symmetry; Group Actions on Sets; Stabilisers Symmetry Groups in Two Dimensions; Matrix Groups; Rotations of Regular Solids; Finite Rotation Groups in Three Dimensions; Polya-Burnside Theorem and applications;.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: 1**
**COURSE CODE: MATH 6110**
**COURSE TITLE: REAL ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Topological spaces [Neighbourhood system, topological subspaces]; Interior closure, Frontier [Including dense and perfect sets]; Compactness; Connectedness; Metric Spaces; Continuity and Homeomorphism; Lesbegue Integral
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: 2**
**COURSE CODE: MATH 6120**
**COURSE TITLE: DIFFERENTIAL EQUATIONS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Existence and uniqueness of solutions. Linear Systems. Stability of linear and weakly non-linear systems. Second-order Differential equations. The boundary value problem.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6130**
**COURSE TITLE: ALGEBRA (GROUP ACTIONS)**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: MATH3430 or MATH6100**
**COURSE DESCRIPTION:** Introduction to Finite Group Theory; Groups and Homomorphism; Group Actions on Sets; Groups of Even orders; Finite p-groups; Normal Series; Direct Products and the Structures of Finitely Generated Abelian Groups; Group Actions on Groups.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6140**
**COURSE TITLE: ADVANCED MATHEMATICAL METHODS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** General Theory of Eigenvalues and Eigenfunctions, The Minimum Problem, Sequences of Eigenvalues and Eigenfunctions, Variational Properties, Eigenfunction Expansions, The Rayleigh-Ritz Approximation Method.

Green's Functions Inverses of Differential Operators, Examples of Green's Functions, The Neumann and Robin Functions, Source Functions for Parabolic Equations.

Cylindrical Eigenfunctions
Bessel Functions, Eigenfunctions for Finite Regions, The Fourier-Bessel Series, The Green's Function, Modified Bessell Functions.

Spherical Eigenfunctions
Legendre Functions, Eigenfunctions of the Spherical Surface, Eigenfunctions for the Solid Sphere.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6150**
**COURSE TITLE: VISCOUS FLOWS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Equations of Viscous Flow Kinematics and Dynamics of Flow, Energy Considerations, Boundary Conditions, Dimensional Analysis, Reynolds Number.

Exact Solutions
Some Exact Solutions including Flow Generated by an Oscillating Plate, Helical Flow in an Annular Region, Hamell's Problem of Flow in a Wedged-Shape Region, Flow Generated by a Rotating Disc.

Axially Symmetric Rotary Flows
Flow between Parallel Discs, Flow between Coaxial Cones, Flow between Concentric Spheres - A Secondary Flow.

Flow Past a Sphere
Creeping Flow Past a Sphere, Ossen's Criticism, Matching Techniques.

Lubrication Theory
Physical Origin of Fluid-Film Lubrication, The Mathematical foundations of Lubrication Theory, Slider Bearing, Squeeze Films, Journal Bearings.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6160**
**COURSE TITLE: AN INTRODUCTION TO NON-NEWTONIAN FLUID MECHANICS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: MATH 6150**
**COURSE DESCRIPTION:** Principles of Continuum Mechanics Basic Concepts, Material Derivative, Deformation Rates, Rivlin - Ericksen Tensors, Strain Tensors, Kinematics of Steady Shear Flows, Continuity Equation, Stress and Volume Force, Equations of Motion, Energy Equation.

Material Properties Occurring in Steady Shear Flows; Flow Function, Normal Stress Functions.

Processes that are controlled by the Flow Function; Rotational Viscometer, Pressure- Drag Flow in a Straight Channel, Radial Flow Between Two Parallel Planes, Pipe Flow, Helical Flow.

Effect of Normal Stress Differences
Cone-and Plate-Flow, Weissenberg Effect, Die-Swell, Axial Shear Flow.

**Assessment**:

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6170**
**COURSE TITLE: ADVANCED DISCRETE MATHEMATICS (F-POLYNOMIALS OF GRAPHS)**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: MATH 3290 and MATH 3400**
**COURSE DESCRIPTION:** Review of Generating Functions and Solutions of Recurrence Relations using Generating Functions. General F-polynomials of Graphs, Matching Polynomials, Circuit Polynomials, Tree Polynomials and Sub-graph Polynomials. Relationships with other Graph Polynomials.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6180**
**COURSE TITLE: PROBABILITY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Review of Distribution Theory; Poisson Process; Finite Markov Chains; Continuous time Markov Chains; Renewal Theory; Branching Process; Epidemic Theory.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6190**
**COURSE TITLE: NUMERICAL ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Review of Computer errors. Programming in MATLAB. Solution of non-linear equations.

Numerical Linear Algebra
LU and Cholesky factorizations. Pivoting. Norms and analysis of errors. Iterative methods. The matrix eigenvalue problem. The singular-value decomposition and pseudo-inverses.

Approximation of Functions
Polynomial interpolation. Hermite interpolation. Spline interpolation. Best approximation: Least squares and Chebyshev.
Trigonometric interpolation and the Fast Fourier Transform.
Numerical differentiation and integration
Gaussian and adaptive quadrature.

Numerical solution of ordinary differential equations
Existence and uniqueness of solutions. Runge-Kutta and multi-step methods. Local and global errors. Stability.
Boundary-value problems: Shooting methods. Finite-difference methods. Collocation.
Stiff equations.

Introduction to the numerical solution of partial differential equation
Elliptic, parabolic and hyperbolic partial differential equations.
**Assessment:**

| | |
|---|---|
| Coursework | 25% |
| Final Examination: One 3 hour written paper | 75% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6191**
**COURSE TITLE: ASYMPTOTIC & PERTURBATIONANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Introduction to asymptotic approximations; Regular and singular perturbation methods for ordinary and partial differential equations; Matched asymptotic expansions: Boundary layer theory, outer and inner solutions with matching principles, interior layers, corner layers; Introduction to Multiple Scales: Slowly varying coefficients, forced motion near resonance, Floquet theory, Wittaker's method; Boundary layers by multiple scales; Nonlinear oscillators; Bifurcation Theory: Hopf bifurcations, weakly non-linear analysis; Two-time and uniform expansions.
**Assessment:**

| | |
|---|---|
| Coursework | 30% |
| Final Examination | 70% |
| (Consisting of: One take home exam 35% and one 3 hour written paper 35%) | |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6192**
**COURSE TITLE: ADVANCED MATHEMATICAL MODELLING**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** Models from Newton's laws of motion: Planetary motion, energy conservation laws, resonance phenomena, surface area and minimal energy configurations; Lagrangian/Eulerian equations of motion: trajectories of particles, caustics; Linear stability analysis for oscillating systems, modelling of two-layer fluid systems, Rayleigh-Taylor instability; Heat flow problems: characteristic time of cooling, chemically reactive systems, convection-diffusion systems; Particle motion: Probability density functions, predicting particle positions, nearest neighbour interactions; Theory of Elasticity: Stress-strain relations, elastic and plastic deformation; Laws of interaction: Forces between charged particles, principle of superposition, electromagnetic forces, Faraday's law of magnetic induction; Interfaces and fronts: Modelling explosive systems with thin reaction zone kinetics - SHS, Frontal Polymerisation.
**Assessment:**

| | |
|---|---|
| Research Project (written report and oral presentation | 40% |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6193**
**COURSE TITLE: NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
Computer literacy is expected. Prior knowledge of mathematical software packages such as MATLAB would be an asset.
**COURSE DESCRIPTION:** Preliminaries: classification of partial differential equations; Well-posedness; Spatial differences: central differences; Fourier analysis; Higher order difference approximations; One-sided differencing; Temporal errors: Concepts of stability and accuracy; analysis of dispersive and dissipative error; Mostly explicit difference schemes: Forward Euler in time, Central difference in space; Lax-Friedrichs; Leap-frog (2-2) and (2-4); Concept of artificial dissipation; Lax-Wendroff; MacCormack's scheme; Runge-Kutta time stepping; Systems of equations: Decoupling; disparate speeds; Implicit schemes: Backward Euler; Crank-Nicholson; compact $4^{th}$ order approximation for spatial derivatives; implicit schemes for systems; Semi-implicit schemes: Adams-Bashforth multi-step method; Parabolic equations and methods for their numerical solution; Numerical approximation of boundary conditions (for parabolic and hyperbolic equations): Extrapolating boundary conditions; one sided differences; linear systems; Two-dimensional problems: Operator splitting; Alternating directions implicit method; Anisotropic errors, 2-D boundary conditions.
**Assessment:**

| | |
|---|---|
| Coursework | 40% |
| (4 Computer Lab Group Assignments) | |
| Final Examination: One 3 hour written paper | 60% |

**SEMESTER: 1**
**COURSE CODE: MATH 6194**
**COURSE TITLE: DISCRETE MATHEMATICS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** In this course, the principles of basic Combinatorics, Graph Theory and Algebra will be developed to the more general setting of enumerative Combinatorics and Graph Theory. Students will be introduced to the notion of combinatorial identities via an exquisite blend of multinomial expansions, generating functions and recurrence relations. They will have the opportunity to utilize the Principle of Inclusion and Exclusion as well as their associated inversion formulas. More advanced properties and applications of counting numbers such as Stirling, Bell, Fibonacci and Catalan sequences will be discussed. Particular attention will be paid to the recurrence relations involved in counting systems. Generating functions will be utilized to solve the more significant graphical enumeration problems. Important results such as the enumeration of rooted and unrooted trees will be derived. A few important topics in Graph Theory that are not covered in the undergraduate course MATH 3400 (Graph Theory) will also be explored. Tutte's Theorem in planarity and the more recent developments by Thomassen leading to a proof of Kuratowski's Theorem will be incorporated. Fundamental ideas, such as the use of Kempe chains (used in proving the Four Colour Theorem) will also be introduced.
**Assessment**
Coursework: 40%
Final Examination: One 3-hour written paper 60%

**SEMESTER: NOT OFFERED IN 2014/2015**
**COURSE CODE: MATH 6195**
**COURSE TITLE: FINITE ELEMENT ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** The main objective of this course is to clarify and explain the basic ideas on which finite element methods are founded. The focus throughout will be on the nature of the finite element method, how it works, why it makes sense, and how to use it to solve problems of interest.
Throughout the course, students will be required to develop and implement numerical algorithms. Special emphasis will be placed on the efficiency and accuracy of these methods for problem solving. As this course is a practical one, students will be evaluated by their performance in coursework assignments, computer lab exams and on a final research project.
Students taking this course must have a thorough understanding of undergraduate calculus and ordinary differential equations. A solid foundation in undergraduate matrix algebra will also be assumed. As students will be required to implement the algorithms on a computer, prior knowledge of elementary computer programming will be a definite asset, although this is not a prerequisite.
Algorithms will be presented during lectures in pseudo code format to facilitate the creation of well-structured programs in a variety of programming languages. The numerical software package Matlab will the chosen programming tool for in-course assignments. An introductory tutorial will be organized at the beginning of the course for students with no prior knowledge of Matlab.
**Assessment**
Coursework: 100%

**SEMESTER: 1**
**COURSE CODE: MATH 6310**
**COURSE TITLE: COMPLEX ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COUSE DESCRIPTION:** The course develops the properties of the complex number system, treated as a generalization of the real number system. We explore the parallel analysis that results, with a particular emphasis on differentiability, analyticity, contour integrals, Cauchy's theorem, Laurent series representation, and residue calculus.
Core topics include: complex numbers, analytic functions and their properties, derivatives, integrals, series representations, residues, and conformal mappings. Application of the calculus of residues and mapping techniques to the solution of common boundary value problems encountered in physics and engineering applications is a major part of the course. Students are expected to have a strong background in advanced undergraduate calculus of real variables. An earlier or concurrent course in differential equations is an asset, but is not a prerequisite for this course.
**Assessment:**
- Coursework : 40%
  (Two 15% Coursework examinations and
  10% Assignments based on four assignments
  given during the semester)
- Final Examination: One 3-hour written paper 60%

**SEMESTER: 2**
**COURSE CODE: MATH 6620**
**COURSE TITLE: TOPOLOGY**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course serves as a broad introduction to the basic notions of General Topology, Metric spaces, Continuity and Homeomorphism, Compactness, connectedness and separation axioms. Students taking this course must therefore have a thorough understanding of undergraduate level real analysis.
**Assessment**
- Coursework: 40%
  (Two 15% Coursework examinations and
  10% Assignments, based on four assignments
  given during the semester)
- Final Examination: One 3-hour written paper 60%

**SEMESTER: 1**
**COURSE CODE: MATH 6630**
**COURSE TITLE: FUNCTIONAL ANALYSIS**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** This course aims at familiarizing the student with the basic concepts, principles and methods of functional analysis and its applications. The principles learnt from basic calculus and linear algebra will be developed further to the more general setting of abstract infinite-dimensional vector spaces. Students will therefore be expected to have a solid background in undergraduate calculus, real analysis, and liner algebra.
Students will be introduced to the notion of vector spaces and the distance between vectors, as well as to continuous maps between such vector spaces. This interplay between the algebraic and analytic setting gives rise to many interesting and useful results, which have a wide range of applicability to diverse mathematical problems, such as from numerical analysis, differential and integral equations, optimization and approximation theory.
The first part of the course is devoted to a short introduction in the theory of metric spaces and to a detailed study of normed and Banach spaces and in particular to the analysis of linear operators acting upon them. The second part of the course deals with Hilbert spaces and linear operators upon them, since they play a fundamental role in applied mathematics. Finally, we look at some fundamental theorems for normed and Banach spaces such as the Hahn-Banach theorem for complex vector spaces and normed spaces and its application to bounded linear functionals; the uniform boundedness theorem, and the closed Graph theorem.
**Assessment**
- Coursework: 40%
  Two 15% Coursework examinations and
  10% Assignments based on four assignments given during the semester
- Final Examination: One 3-hour written paper 60%

**SEMESTER: 1**
**COURSE CODE: MATH 6640**
**COURSE TITLE: THEORY OF INTEGRATION**
**NUMBER OF CREDITS: 4**
**PREREQUISITE: NONE**
**COURSE DESCRIPTION:** In this course, we consider the limitations of the Riemann integral, and show that it is necessary to develop a precise mathematical notion of 'length' and 'area' in order to overcome these deficiencies. In so doing, we create a precise concept of measure, and use it to construct the more powerful Lebesgue integral. Finally we look at applications of measure and Lebesgue integration in modern probability theory. Students will be expected to have a solid background in undergraduate calculus and real analysis.
**Assessment**
Coursework: 40%
Two 15% Coursework examinations and
10% Assignments based on four assignments given during the semester)
Final Examination: One 3-hour written paper 60%

# DEPARTMENT OF PHYSICS

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# ABOUT THE DEPARTMENT OF PHYSICS

The Department of Physics at St. Augustine offers opportunities for postgraduate studies leading to MPhil and PhD degrees by research and thesis.

Normally all students register for an MPhil degree but after a year it is possible to upgrade one's registration to a PhD degree on the recommendation of the supervisor and the approval of the Board for Higher degrees.

The minimum qualification for admission to the MPhil programme is a BSc General Honours degree in Physics (minimum GPA 3.0) or its equivalent from an approved University.

A candidate admitted for postgraduate studies with a **Pass** or a **Lower Second Bachelor's** degree or equivalent is normally required to take a qualifying examination by the end of the first year. Passing of the qualifying examination is a pre-requisite for the continuation of postgraduate studies and submission of thesis.

# RESEARCH INTERESTS AND FACILITIES

The current research in progress or research areas where activities are planned include:

**(1) FUEL CELL AND LITHIUM BATTERY RESEARCH**
The Fuel Cell and Lithium Battery Research is carried out at Caribbean's First Fuel Cell Materials Research Lab (FCMRL) at Dept. of Physics and broad areas are as follows:

a. Development of Membranes for Fuel Cells:
The main area of research is to develop new and novel electrolyte membranes for applications in Polymer Electrolyte Membrane Fuel Cells (PEMFC) and Direct Methanol Fuel Cells (DMFC's). Various chemical and physical techniques are used to develop these membranes. The membranes developed are then evaluated using various characterization techniques and later tested in fuel cells. Research on materials for Solid Oxide Fuel Cells (SOFC's) will be started shortly.

b. Development of Catalysts for Fuel Cells:
New and novel catalysts are under process of development at FCMRL. The goal is to develop new non platinum based catalysts to work with the developed membranes. Research is also carried out on the nano tubular support for the catalysts and their testing in fuel cells.

c. Modelling of Fuel Cells:
Modelling is a very important aspect of fuel cell development and is done to evaluate various parameters related to fuel cell in order to use top to bottom approach in fuel cell development. Various models for different phenomenon are developed using various software's like Matlab etc.

d. Development of Dye sensitized Solar Cells:
Materials for application in Dye sensitized solar cells are also synthesized and dyes are made in collaboration with Chemistry Department. Solar cells will be synthesized and tested in future.

e. Development of Electrolytes for Lithium Batteries:
Non-aqueous polymer electrolytes in gel as well as film form are developed under this area of research for application in lithium batteries. Various techniques are used including acid-base approach, ternary system approach, polymer-in-salt approach etc. The materials developed are tested for their suitability in lithium batteries using different characterization techniques.

**(2) CERAMICS AND REFRACTORIES**

a. Development of ceramics and refractories based on regional materials for a wide range of applications. Current research includes:
- Chemical and mineralogical characterisation of raw materials, compositional studies, synthesis, high-temperature solid-state reactions,
- Physical and mechanical testing, x-ray and electron microscopy. Analyses, micro-structure/ property relationships.

**(3) MEDICAL PHYSICS AND BIOENGINEERING**

- Recordings of mass potentials as well as signals from neurons to determine the manner in which the brain interacts with its neural network functions. EEG studies.
- Blood flow studies for photoplethysmography
- Magnetocardiography using superconducting quantum interference device (SQUID).
- Objective assessment of the scoliotic spine.
- Anthropometrics and ergonomics.
- Assessment of human movement, fitness testing
- Radiation biology and Medicine
- Low doses and Non-Targeted effects of ionizing radiation

**(4) ASTRONOMY**

a. Theoretical Astronomy
- The area of focus in theoretical astronomy is with statistical analyses on the large scale structure of the Universe as well as quasars.

b. Observational Astronomy
- Observational astronomy offers opportunities to study variable stars and other objects such as quasars and BL lac objects. This is done with the 16' L X 200 Meade Telescope equipped with CCD camera.

c. Astrobiology
- Mud volcanoes and the pitch lake are studied as analog sites for Mars and Titan respectively as conditions for extremophiles.

**(5) SOLAR ENERGY STUDIES**

The design, construction and testing of low and high temperature flat plate collectors for use with
(i) Solar crop dryers and
(ii) Solar air conditioners, refrigerators and solar powered heat engines,
(iii) Solar timber dryers.
(iv) Solar water decontamination methods for rural areas.
(v) Solar Distillation
(vi) Materials for Photovoltaics
This area of research may be done as a joint effort with other departments.

**(6) GEOTHERMAL ENERGY STUDIES**

- Geophysical surveys - Resistivity and Seismic
- Methods of identification of fractured reservoirs
- Geothermal Heat Pumps

**(7) EARTH MATERIALS STUDIES**

- Various aspects of Mineralogy and Petrology of Trinidad and Tobago, including resources of the continental shelf.

**(8) ENVIRONMENTAL PHYSICS**

- Environmental monitoring with respect to sound and aerosols in certain work environment.
- Implications of sea surface temperatures for the Caribbean region in environmental studies.
- Climate change studies/modeling.
- Air pollution modeling (with respect to the regional industries).
- Solar water decontamination methods for rural areas.
- Lava flow problems (in collaboration with the Department of Mathematics and Seismic Research Unit).
- Wind potential assessments for Trinidad and Tobago.
- Rain erosivity determination.

**(9) QUANTUM OPTICS**

Quantum physics and solar energy technologies and medical technologies.

**(10) FIBRE-OPTICS, OPTOELECTRONICS**

Optoelectronics, fibre-optics and solar energy technologies and medical technologies.

**(11) ELECTRONICS**

- VLSI (Very Large Scale Integration) Implementation of Digital Signal Processing (DSP) Algorithms.
- Simulation and Design of Communication Systems.
- Design of Speech Recognition Systems.
- Design of Spectrum Analyzer
- Digital system Design using FPGA (Field Programmable Gate Array)

# POSTGRADUATE COURSES IN PHYSICS

## COURSE DESCRIPTIONS

**SEMESTER: 2 (NOT OFFERED IN 2014/2015)**
**COURSE CODE: PHYS 6294**
**COURSE TITLE: NOVEL MATERIALS**
**NUMBER OF CREDITS: 3**
**PREREQUISTE: BSc (Physics, Chemistry, Chemical Engineering and/or permission of HOD, Physics)**
**COURSE DESCRIPTION:** Superconductivity phenomenon, magnetic properties of superconductors, theories of high $T_C$ superconductors, preparation techniques and composition features, applications of high $T_C$ superconductors.

Fundamentals of nanotechnology, Nanotechnology in materials, ceramic nanomaterials, metal nanomaterials, polymeric nanomaterials, composite nanomaterials, synthesis of nanomaterials, nanotechnology in biomaterials, soft biomaterials, nanotubes, nanowires, applications of nanomaterials

Geometry of Nanoscale Carbon; Bonding, Dimensionality, Topology, Energetics, Fullerenes; Single and double walled Carbon Nanotubes, Synthesis of Single Wall Carbon Nanotubes; Diameter and Orientation Control and growth mechanisms, Selective Covalent Chemistry, applications of carbon nanotubes

Piezoelectric, Shape memory alloys and shape memory polymers, Magnetic shape memory alloys, pH-sensitive polymers, Temperature-responsive polymers, Halochromic materials, Chromogenic systems, Non-Newtonian fluid, applications of smart materials.

**Assessment:**

| | |
|---|---|
| Coursework: | 30% |
| Research Project: | 70% |

**SEMESTER: 2**
**COURSE CODE: PHYS 6492**
**COURSE TITLE: DIGITAL SYSTEM DESIGN**
**NUMBER OF CREDITS: 3**
**PREREQUISTE: BSc Physics with Minors in Electronics/ Medical Physics and Bioengineering, BSc in Electrical and Computer Engineering, BSc in Computer Science / Math with PHYS2291 / PHYS3391 or permission of Head of Department.**
**COURSE DESCRIPTION:** Various implementation technologies for digital systems and their comparison. Introduction to computer-aided design (CAD) tools for digital systems. Hardware description languages (HDLs). Custom and Semi-custom design flow. Xilinx's ISE Design Suite. Mentor Graphic's Design, Test and Verification Package, Matlab.

VHDL: Data objects. Classes and data types. Operators. Overloading. Entity and architecture declaration. Introduction to behavioral, dataflow and structural models. VHDL Statements: concurrent, sequential, assignment, process, conditional and case statements. Array and loops. Packages & libraries. Delays.

VHDL modeling and simulation of basic and advance combinational & sequential circuits. Design of Microcomputer: Basic components of a Microcomputer, Specifications, Architecture of a simple Microcomputer system, Design of a simple Microcomputer system using VHDL. Synthesis and optimization for cost, speed, power and chip recourse utilization tradeoffs.

Programmable logic devices: PROM (Programmable Read Only Memory), PAL (Programmable Array Logic), PLA (Programmable Logic Array), CPLD (***Complex Programmable Logic Device***) and FPGA (***Field Programmable Gate Array***). Xilinx's FPGA Design Flow. Digital system implementations using CPLDs and FPGAs. FPGA based implementation of various digital signal processing algorithms.

**Assessment:**

| | |
|---|---|
| Theory Coursework | 30% |
| Four Laboratory reports (equal weighting) | 20% |
| One Major Design Project | 50% |

**SEMESTER: 2**
**COURSE CODE: PHYS 6295**
**COURSE TITLE: SOLAR ENERGY CONVERSION**
**NUMBER OF CREDIT: 3**
**PREREQUISITES: BSC PHYSICS OR PERMISSION FROM HEAD OF DEPARTMENT.**
**RENEWABLE ENERGY**
Solar Energy; Photovoltaics; Wind Energy; Hydroelectricity; Geothermal Energy; Ocean Thermal Energy Conversion; Wave Energy; Hydrogen; Fuel Cells; Biomass.

**SOLAR ENERGY**
Solar energy utilization; Solar radiation – Basic concepts, Geometric effects, Atmospheric effects, Solar spectrum, Solar insolation, Air mass; Solar; spectra, Spectral Energy distribution, Planck's formula, Spectral distribution of the solar constant, Wien's law, Stefan Boltzmann law; Flat plate collectors, selective surfaces; Design, construction and operating principles of a solar collector; Optical characteristics - Optics of collectors, Fresnel equations, Overall transmittance and reflectance for two polarization states, multiple glazings; Heat transfer across building walls; Heat transfer; characteristics; Efficiency of glazing/absorber system; Angular dependence of Solar Absorptance; Transmittance-Absorptance product; Radiation; exchange between surfaces; Mathematical analysis of a solar collector as applied to a selected unit; Concentrating Solar Power (CSP); Solar Cooling

**PHOTOVOLTAICS (PV)**
Photoelectric effect; Semi-conductor Physics; Materials used for PV cells; Photovoltaic cell, module, array; PV characteristics, characteristic curves; Factors influencing performance of PV cells; PV energy systems: components–generator, charge controller, battery and inverter; PV design, including Electrical and Mechanical design; Categories of PV modules: Cell types, Encapsulation materials, Substrate and Frame structure; Thin Films; Quantum Dot Nanotechnology; PV Grid connection; Modeling techniques: RETScreen Analysis; Economic analysis and applications; Socio-economic impacts of renewable energy education, dissemination and applications.
**Assessment:**
35 Hours of practical work, including Project. (Students must pass practical coursework).

| | |
|---|---|
| Theory Coursework: | 15% |
| Practical Coursework: | 35% |
| (Practical experiments & Field Trip: 15% Research Project 20%) | |
| Final Examination: One 2 hour final paper | 50% |

# MSc in Renewable Energy Technology (RET)

This master's programme is the result of an urgent need for the Caribbean region to become equipped in terms of building capacity in technologies which will support protection of the environment and also meet the challenges of escalating price and availability of fossil fuels and their use. The emphasis in this master's programme is on providing new graduates and persons already working in various sectors of the economy, with professional training and education in renewable energy technologies. The programme will provide expertise in these areas which will help to build capacity in the region and open possibilities for further study and research.

**Aims and Objectives**
This programme is intended to meet the needs of a broad range of professionals whose occupations are related to science and energy, and sustainable development. Included will be natural scientists, engineers and technical-related professionals, as well as those from the social sciences such as administrators. This programme is an entirely new programme, consisting of new and existing courses.

**Admissions Criteria**
B.Sc. Science degree.
Students normally would be required to have an Upper Second Class Honours degree in Physics, Mathematics or Engineering. Other qualifying students with a first degree would be required to undergo the Preliminary Study. Students must complete and pass this not-for-credit preparatory course prior to the first semester.

**Course of Study**
All students must take 8 compulsory courses worth 24 credits, 4 elective courses worth 12 credits, and a 9-credit Final Research Project – for a total of 45 credits.

**Programme Content**
The courses for the programme are listed below, with the eight (8) compulsory courses. Students will also be required to complete four (4) courses from the list of six (6) Elective courses, as well as the 9-credit Research Project course. The Core and Elective courses, together with the Research Project, total 45 credits.

## COURSE LISTING

**Core Compulsory (8 courses – 24 credits)**

**Semester I**

| | | |
|---|---|---|
| RENT 6001 | Energy Economics | 3 credits |
| RENT 6002 | Shaping Sustainable Energy Systems | 3 credits |
| RENT 6004 | Solar Energy Conversion | 3 credits |
| RENT 6005 | Wind Energy I | 3 credits |
| RENT 6006 | Bioenergy I | 3 credits |
| RENT 6007 | Energy Use and Energy Auditing | 3 credits |

**Semester II**

| | | |
|---|---|---|
| RENT 6003 | Programme and Project Management | 3 credits |
| RENT 6008 | Electrical Integration of Renewables | 3 credits |

**Electives (4 courses – 12 credits)**

**Semester II**

| | | |
|---|---|---|
| RENT 6009 | Hydro and Marine Power | 3 credits |
| RENT 6010 | Geothermal Energy | 3 credits |
| RENT 6011 | Energy Storage | 3 credits |
| RENT 6012 | Advanced Solar Energy | 3 credits |
| RENT 6013 | Wind Energy II | 3 credits |
| RENT 6014 | Bioenergy II | 3 credits |
| RENT 6000 | Research Project | 9 credits |
| | Three months work + Presentation and Report | |

## COURSE DESCRIPTIONS

**SEMESTER: 1**
**COURSE CODE: RENT 6001**
**COURSE TITLE: ENERGY ECONOMICS**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** Students will receive basic insights into the field of energy economics. They will learn about the different markets supplying energy and the different sectors demanding energy. An understanding of the limitations of non-renewable energy sources and the problems of their substitution by renewable energy sources will be gained. The special aspects of grid based energy markets will be discussed. At the end of the course each student should be able to understand the basic concepts of the different energy markets and the possible contributions of the different energy sources to a sustainable energy supply.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 1**
**COURSE CODE: RENT 6002**
**COURSE TITLE: SHAPING SUSTAINABLE ENERGY SYSTEMS**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** Sustainable Development is the framework within which RenewableEnergy Management must be placed. The long-term goal of the MSc Renewable Energy Technology is to equip participants with the technical expertise so they can implement projects which promote self-sufficiency and sustainable development of the region.

In this course, students will learn to differentiate between the competing models of sustainable development and to identify the major requirements and barriers to sustainable development of the energy system.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6003**
**COURSE TITLE: PROGRAMME AND PROJECT MANAGEMENT**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION**: The course is aligned to International Standards with the concepts and terminology as prescribed by Project Management Institute (PMI) Guide to Project Management Body of Knowledge (PMBOK) Guide. It covers the five essential project management process groups of initiating, planning, executing, controlling and closing projects. Participants will gain an understanding of the tools and techniques that can be applied to each phase of a project.

In both public and private sectors, there is an increased focus on managing projects to achieve a product/service of requisite quality, and to deliver that product/service within the approved budget and schedule. This course will provide a broad overview of the concepts and practices used managing projects in today's business environment.

**Assessment**

| | |
|---|---|
| Coursework | 40% |
| Final Exam | 60% |

**SEMESTER: 1**
**COURSE CODE: RENT 6005**
**COURSE TITLE: WIND ENERGY I**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** This course explores the fundamental aspects of the wind resource, wind turbine aerodynamics and control, along with institutional and environmental aspects (including planning issues). An integral part of the course is a computer-based laboratory to provide hands-on experience in the design and optimisation of a wind farm. This course will also include a field trip to wind turbine site to allow the student to appreciate wind power in the real world.

Development of indigenous, renewable energy resources is critical in the drive to reduce energy cost and achieve energy security in the region. Wind power plays an important role in this movement since the wind resource in many parts of the Caribbean is favourable for wind energy development. Whether large, medium or small-scale, wind power is set to play a major part in the future energy mix of the Caribbean. Wind power technology is an interdisciplinary subject which must complement the other electricity generation methods.
**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 1**
**COURSE CODE: RENT 6006**
**COURSE TITLE: BIOENERGY I**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** Humans have used Bioenergy for thousands of years. It is still the most widely used form of renewable energy. In this course students will be introduced to the fundamental concepts of what biomass is, its role in nature and for human societies, in which way it is used sustainably, how it can be converted to energy and how certain biofuel technologies can help with waste management. Bioenergy encompasses many different sources including energy crops, agricultural waste, domestic waste and animal waste, all of which are plentiful across the Caribbean region. Case studies are presented that show current practices across the Caribbean.
**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6007**
**COURSE TITLE: ENERGY USE AND ENERGY AUDITING**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** This course is designed to enable students to assess the energy efficiency of small and medium premises, carry out energy audits and propose appropriate energy saving measures. The course comprises lectures, moderated working sessions and group exercises designed to allow the students to put the knowledge gained into practice. The whole development of Renewable Energy stems from the need to develop renewable indigenous resources and to eliminate or reduce the use of fossil fuels in the generation of electricity. This thrust can be enhanced by the efficient use of energy. An initial step is the assessment of existing systems and the introduction of energy efficient schemes. This alone can significantly reduce the electricity demand, and this must be a first step towards self sufficiency and energy security
**Assessment**:

| | |
|---|---|
| Coursework | 100% |

**SEMESTER: 2**
**COURSE CODE: RENT 6008**
**COURSE TITLE: ELECTRICAL INTEGRATION OF RENEWABLES**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** The integration of generators powered from renewable energy sources is fundamentally similar to that of fossil-fuelled generators and is based on the same principles; but, renewable energy sources are often intermittent and dispersed (large numbers of relatively small generators) and these factors must be considered. This module applies the well-established principles of electrical engineering to the subject of integrating generators powered from renewable energy sources into electrical power systems, small and large.

Electrical integration of renewable energy is often the overlooked, but is a crucial aspect of the renewable energy field. It is very common to convert energy from a renewable source into electricity. The same, of course, is true of energy from fossil fuels and the simple reason is that electricity is very convenient both to transport and to utilise. That said the design of the electrical system is rarely trivial. The proper integration of any electrical generator into an electrical power system requires knowledge of the well-established principles of electrical engineering. This course provides this very important aspect of the development of renewable energy.
**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6009**
**COURSE TITLE: HYDRO AND MARINE POWER**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION**: In this module the principles surrounding the generation of electricity from water will be examined. River, wave and ocean thermal resources are studied, as well as planning and environmental issues. Turbine and generator system design forms a major theme in this module as well as the thermal dynamics of ocean thermal technologies.

The Caribbean has unexplored potential for hydropower and various forms of marine power (wave and ocean thermal in particular). However there are few persons in the region with the necessary knowledge and skills to engage in the development of these resources. This course will provide the initial knowledge and skills base to help jump-start the development of the resources.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6010**
**COURSE TITLE: GEOTHERMAL ENERGY**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** This course provides an overview of geothermal energy systems. An integral part of the course is the Field Trip where students gain first hand information about different methods of measuring resistivity using equipment such as the MiniSting or the SuperSting. Field trips to specific Geothermal sites would help reinforce student understanding of the dynamic interaction of hydrothermal systems.

Many of the Caribbean islands have significant geothermal energy potential but limited technical resources in terms of trained personnel. It is therefore necessary to train persons in this area to satisfy the demands of the region in developing the science and technology of geothermal energy. This course will provide initially the necessary knowledge and skills to engage in the development of geothermal energy.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6011**
**COURSE TITLE: ENERGY STORAGE**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** A major part of this course will involve investigation of the hydrogen economy and hydrogen fuel cells. Inter-island energy transportation through a Caribbean wide super grid will also be discussed as well as small-scale energy storage options.

In order for renewable energy to meet consumer demand, energy storage will become more important as grid penetration increases. Therefore this course will explore the functioning, properties, and application of physical-chemical energy storage systems.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6014**
**COURSE TITLE: BIOENERGY II**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** Building on from knowledge gained in Bioenergy I, this module aims to cover in detail the production of energy from waste, of alcohols from micro-organisms and micro-algal systems and to cover in detail the topic of advanced conversion technologies such as pyrolysis and gasification and of special heat engines suited to the use of fuels derived from biomass/waste. A closer look at anaerobic biodigesters is performed, an area of potential benefit to the treatment of human and agricultural wastes. The principles underlying: alcohol production, energy extraction from waste, gasification, pyrolysis and the cycles of engines designed to run on fuels from biomass are covered in depth throughout this module. Students wishing to further specialize in this area will have the option of taking this course which further develops some of the topics in the first Bioenergy course and goes in-depth into the science of waste-to-energy production.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6013**
**COURSE TITLE: WIND ENERGY II**
**CREDITS: 3**
**PREREQUISITE: RENT 6005**
**COURSE DESCRIPTION:** Building on wind energy I, this module aims to cover in depth (a) the advanced statistics and modeling of the resource necessary for precise assessment, (b) the aerodynamics and mechanics necessary for the design and stressing of wind turbines. Small-scale systems, electrical aspects, noise generation and offshore systems are also covered. The highlight of this course will be a wind tunnel based laboratory investigating the loading of a small-scale wind turbine.

Students who wish to further specialize in Wind Energy technology will have the option of taking this course which expands and delves further into the technology, and modeling and setting up of a wind farm.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 1**
**COURSE CODE: RENT 6004**
**COURSE TITLE: SOLAR ENERGY CONVERSION**
**CREDITS: 3**
**PREREQUISITE:**
**COURSE DESCRIPTION:** Solar Energy is the basis for other forms of renewable energy. This course therefore starts by briefly describing the main forms of renewable energy and then delves into solar energy radiation and utilisation. It describes the solar spectra and active and passive solar systems. The heat transfer characteristics are investigated and methods of estimating efficiency are outlined.

The course introduces photovoltaics (PV) and the science of the photoelectric effect. PV characteristics are defined and PV design, categories of PV modules, grid connection issues and economic analysis are explained.

**Assessment**

| | |
|---|---|
| Coursework | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6012**
**COURSE TITLE: ADVANCED SOLAR ENERGY**
**CREDITS: 3**
**PREREQUISITE: RENT 6004**
**COURSE DESCRIPTION:** Building on Solar Energy Conversion, this module aims to cover in considerable depth (a) the semiconductor physics and technology involved in the design and manufacture of state of the art photovoltaic devices, (b) the design of photovoltaic components and systems, (c) advanced solar energy applications.

This will enable students to design simple PV systems, incorporating power tracking, and solar thermal systems. The module will also enable students to gain an understanding of the technology and economics of the manufacturing processes associated with the production of PV cells. One of the highlights of the course will be the design and analysis of a PV system by students via a software based laboratory.

**Assessment**

| | |
|---|---|
| Course-work | 50% |
| Final Exam | 50% |

**SEMESTER: 2**
**COURSE CODE: RENT 6000**
**COURSE TITLE: RESEARCH PROJECT**
**CREDITS: 9**
**PREREQUISITE:**
**COURSE DESCRIPTION:** The aim of the research project is to allow the student to synthesise and articulate several aspects of the taught programme within a single themed research topic. In addition, it will provide the opportunity for further detailed skills training in aspects of renewable energy technology. It will also allow the student to pursue an individual course of study on a particular research topic or issue of interest to the student and will incorporate technical skills training specific to the individual student. As such, the research project will provide the opportunity to develop a specific set of practical and reporting skills that will be invaluable to the student in his/her future career.

A Research Project is a fundamental component of the MSc programme and this is reflected, not only in the credit weighting, but by the fact that the research project runs for a six-month period so that the student may have the necessary time to produce a project of a high standard.

**Assessment**

| | |
|---|---|
| Oral Presentation of Research Project | 10% |
| Research Proposal and Methodology | 30% |
| Research Thesis Report | 60% |

# APPENDIX X – Information Resources at the Alma Jordan Library

A crucial part of your postgraduate training is learning to use data and information resources for academic purposes. In this world of too much information – knowing when you need information, what kind of information you need, what information is available and how to search for, select and obtain relevant information are crucial information literacy skills required for your assignments, research and career.

Our wide-ranging collection spans several subject areas relevant to the Faculty of Science and Technology, including Agricultural Sciences, Astronomy, Chemistry, Computer Science, Information Technology, Life Sciences, Mathematics, Physics and Statistics.

Aside from holding over 400,000 books and 800 journal titles, we offer access to more than 60,000 electronic journals, 30,000 e-books and 240 databases – much of this material is not available freely on the Internet.

Moreover, a sizeable body of Caribbean research may be accessed from maps, newspapers, theses and over 130 special collections in the West Indiana and Special Collections Division. The Institutional Repository (UWISpace) contains not only abstracts of UWI theses, but also publications of our own faculty members. Online resources can be accessed on and off-campus.

In addition to providing resources you may consult and borrow, the Library offers audio-visual, computing, photocopying and printing facilities, as well as areas for quiet study and seminars.

Other services include our Reference Service and our Interlibrary Loan/Document Delivery service, which helps you to obtain books and articles that we do not hold.

You may attend specialist information literacy training on using the Library's resources, finding information resources beyond Google and arrange for consultation sessions that will help you to improve your research and citation skills, the latter being a crucial academic competency.

My staff and I will be pleased to assist you. You can visit us on Floor 2 of the Alma Jordan Library or contact me:

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