UWI
MONA CAMPUS
JAMAICA, WEST INDIES

FACULTY OF SCIENCE AND TECHNOLOGY

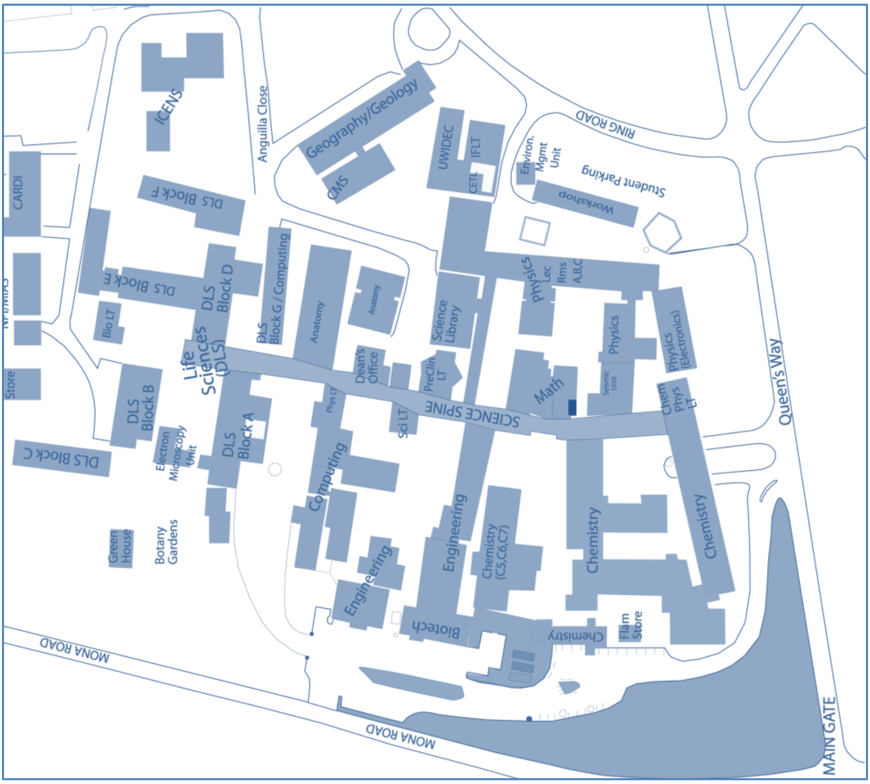
WWW.MONA.UWI.EDU/FST

GRADUATE STUDENT HANDBOOK 2021 - 2022

FST

Faculty of Science and Technology
The University of the West Indies, Mona Campus
5 Anguilla Close
Mona, Kingston 7
Tel: 876-977-1785 / 876-618-0922-3 ext: 2401 / 2962
Fax: 876-927-1566
Email: fst@uwimona.edu.jm
Web: http://www.mona.uwi.edu/fst/
Instagram: @uwimona_fst

Office Hours
Monday – Friday, 8:30 am – 4:30 pm



THE UNIVERSITY OF THE WEST INDIES
MONA CAMPUS

FACULTY OF
SCIENCE AND TECHNOLOGY

GRADUATE STUDENT HANDBOOK

ACADEMIC YEAR
2021 – 2022

www.mona.uwi.edu/fst

Disclaimer

This Graduate Student Handbook has been compiled to improve the communication between staff and students regarding postgraduate programmes, that is, both the taught and research higher degree programmes offered within the Faculty.

The programme requirements outlined are to be adhered to by 1) students enrolling in the Faculty for the 2021-2022 academic year; and 2) students who transferred into the Faculty for the 2021-2022 academic year.

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


Computing
Mathematics
Life Sciences
Chemistry
The Biotechnology Centre
Physics
Geography & Geology

Contents

ABOUT THE FACULTY

We are pleased that you are considering studying with us in the Faculty of Science and Technology (FST) at The University of the West Indies, Mona Campus. This is where the world of technology meets that of experimental and applied science. We take our students on a journey to discover and increase their knowledge and understanding of the various disciplines under the guidance of prominent lecturers and researchers.

Teaching in the FST commenced at Mona in 1949 with students in the Departments of Botany, Chemistry, Mathematics, Physics, and Zoology. The first eleven graduates appeared in 1952 and by 2000 over 9,000 graduates had been produced. Today, the Faculty is among the largest in the University, consisting of 7 departments: Biotechnology, Chemistry, Computing, Geography and Geology, Life Sciences, Mathematics and Physics.

In addition to undergraduate teaching, postgraduate teaching and research form an important aspect of the work of the Faculty. The Faculty offers a wide range of MSc programmes, and research programmes towards MPhil and PhD degrees in all Departments. If you join us next year, you will find yourself part of a 3,000-strong student body enrolled in one of over 30 graduate degree programmes including Applied Data Science, Medical Physics, Information Technology, Management Information Systems, Environmental Sciences, Geography, Geology, Food Chemistry, Renewable Energy and Zoology.

Being part of a large university means students can have access to numerous resources, internationally-recognized faculty, scholarships, student groups and research opportunities. In fact, interdisciplinary research in the FST is greatly enhanced by extensive collaborations with national and worldwide partners including faculties and campuses within The University of the West Indies, other domestic, regional and international universities, research institutions, non-governmental organizations and government ministries. Faculty and graduate students have frequent opportunities for networking and interactions with local and global cohorts by publication of research in scientific journals and presentation of abstracts at local and international conferences, consultations, meetings and discussion forums.

We now look forward to helping you make a difference in whatever field of study you decide to pursue.

GLOSSARY

TERM	MEANING
ACADEMIC YEAR	At UWI consists of three semesters: Semester 1 begins in August, Semester 2 in January and Summer semester (Semester 3) begins in May.
DEFENSE	Final requirement for a thesis and the final oral examination on a doctoral candidate's dissertation.
ETHICAL APPROVAL	Students who intend to engage in research that involves any of a number of subjects such as human or animals, radiation, biohazardous agents, etc. receive approval of their research procedures before beginning to collect data
EXAMINATION COMMITTEE	Examining committee for the doctoral (defense-of-thesis) oral examinations
FULL-TIME	Refers to enrollment in a minimum graduate-level programme per semester. At UWI the minimum graduate level courses needed to be a full-time student is XXX hours.
GRADUATE COORDINATOR	A faculty member designated to advise students and represent the Graduate School in matters pertaining to graduate study.
GRANT	Money given to the student with or without UWI work expectations. However, there may be additional guidelines to follow set forth by the granting agency
MASTER'S DEGREE	An academic qualification granted at the postgraduate level to individuals who have successfully undergone studies demonstrating a high level of expertise in a specific field of study or area of professional practice
MPHIL	Master of Philosophy. A research-focused which is the most advanced research degree before the Doctor of Philosophy (PhD or D.Phil.). In most cases thesis-only, standing between a taught Master's and a PhD. An MPhil may be awarded to graduate students after completing several years of original research and can serve as a provisional enrolment for a PhD. Usually requires one to three years of research work and a thesis as the final requirement.
OFFICE OF GRADUATE STUDIES	The office which provides record-keeping, disseminates application information, and provides professional program assistance and support for prospective and current students in all graduate degree programs.
ORAL EXAM	Exams presented verbally and usually graded by a small committee of professors who will require you to demonstrate your mastery of the concepts you have covered in your doctoral thesis Essentially final exams for graduate school, common for doctoral degrees and sometimes required for master's-level programs
PROGRAMME (OF STUDIES)	An outline or plan of coursework to be taken fulfilling the requirements of a master's degree

TERM	MEANING
PROPOSAL	A statement of the thesis topic, how the research will be conducted, what it will entail and what it will accomplish.
QUALIFYING EXAM	A qualifying examination may be oral, written, or both, and must be passed in order for the student to continue on to the graduate programme.
RESEARCH MASTERS	A research Masters generally involves far more self-directed and independent study and is narrower in focus. Programmes involve little to no in-class teaching, but guidance is provided by an appointed supervisor. This type of programme best suits students who are interested in a specific topic or are planning to undertake further academic research in a PhD programme.
SATISFACTORY PROGRESS	Demonstrating good academic standing and overall performance in program requirements, based on an approved graduate program time frame.
SPECIALIZATION	A well-developed area of study formally established within one or more major-degree programs.
STIPEND	A grant of money to a graduate student for use toward expenses. Departmental awards sometimes pay both tuition and a stipend, which can be applied toward living expenses.
SUPERVISOR	The faculty member appointed to mentor and guide a student through the completion of a graduate degree
TAUGHT MASTERS	Similar to an undergraduate degree in the way it is delivered. Involves core and optional modules delivered via lectures, seminars, and practical work. Students' work is assessed through exams, essays and group projects. This type of Master's best suits students who are looking to change career paths, boost their job prospects or expand the range of their skill set. A master's curriculum usually requires one to two years of course work and may involve a thesis or limited research project as the final requirement.
TEACHING ASSISTANT	A graduate student who is being paid 13 to 20 hours a week to assist in teaching undergraduate courses, grading, or conducting laboratory sessions.
THESIS	A thesis is a substantial master's level paper presenting independent research, which makes a contribution to the current body of knowledge in a scholarly field. A thesis usually consists of an abstract, introduction with statement of problem, literature review, methods, results, discussion, limitations, and references.
UPGRADE PROPOSAL	Before upgrading to the PhD from MPhil, students must orally present their research proposal to an upgrade committee. A proposal usually consists of an abstract, statement of problem, literature review, methods, expected results, and references.

SUPPORT STRUCTURES FOR HIGHER DEGREES

- **Useful Contacts**
- **Support Services**
- **Financing Your Degree**

GOVERNANCE STRUCTURE

Board for Graduate Studies and Research (UWI)

Pro Vice-Chancellor

Professor Stephan Gift

The Board for Graduate Studies and Research has oversight of policy and operational plans for the development, regulation, management, administration, funding, monitoring and evaluation of graduate education and research throughout The UWI.

Office of Graduate Studies and Research (Mona Campus)

Director

Professor Minerva Thame

minerva.thame@uwimona.edu.jm

The School for Graduate Studies and Research continues to foster curiosity driven, needs-related and applied research, while emphasizing the building of university-wide themes of excellence in eight focal areas:

- Biotechnology
- Culture Studies
- Education
- Health and Wellness
- Information Technology
- Social & Economic Studies
- Sustainable and Environmental Studies
- Tourism and Hospitality Management

Office of Graduate Studies and Research

Tel: (876) 935-8995 Ext 3023/ 2263

Fax: (876) 977-7427

Email: postgrad@uwimona.edu.jm

Website: www.mona.uwi.edu/postgrad

Office hours: Monday to Friday, 8:30-4:30 p.m.

Senior Assistant Registrar

Ms. Georgia Bennett

georgia.bennett@uwimona.edu.jm

The Office of Graduate Studies and Research (OGSR) at the Mona Campus is located south of the National Commercial Bank, and falls under the direction of the Office of the Campus Registrar and the School for Graduate Studies and Research.

The OGSR has responsibility for the administration of all processes relating to graduate programmes at the Mona Campus, namely:

- Admission
- Registration
- Scholarships
- Examinations (Thesis, Research Paper/Project)
- Graduation

FACULTY OFFICERS AND PERSONNEL

AT MONA CAMPUS	**Direct Line (876)**	**Extensions**
FACULTY, DEAN'S OFFICE Dean, Prof. Michael Taylor *michael.taylor@uwimona.edu.jm*	977-1785	2401 2962
Associate Dean (External Engagement & Outreach) Dr. Andre Coy *andre.coy@uwimona.edu.jm*		
Associate Dean (Student Experience) Dr. Marvadeen Singh-Wilmot *marvadeen.singhwilmot@uwimona.edu.jm*		
Associate Dean (Undergraduate) Dr. Sherene James-Williamson *sherene.james02@uwimona.edu.jm*		
Associate Dean (Graduate Studies) Dr. Curtis Busby-Earle *curtis.busbyearle@uwimona.edu.jm*	977-1828, 935-8519-21	2519-21
• Administrative Officer, Mrs. Rosalene Simmonds rosalene.simmonds@*uwimona.edu.jm* • Administrative Secretary, Mrs. Terry-Ann Collins-Fray *terryann.collins@uwimona.edu.jm* • Graduate Programme Coordinator, Mrs. Sabraham Green-Smith *sabraham.green02@uwimona.edu.jm* • Undergraduate Programme Coordinator, Mrs. Nadine McEwan *nadine.mcewan@uwimona.edu.jm*	977-1785	2401 2962

	Direct Line (876)	Extensions
DEPARTMENT OF CHEMISTRY	977-1834	3082
Head, Dr. Donna Minott Kates	927-1910	3093
Administrative Assistant, Mrs. Tracia Johnson-Blair		
DEPARTMENT OF COMPUTING		
Head, Dr. Gunjan Mansingh		2815
Senior Administrative Assistant, Mrs. Donna Burke	702-4455	2816
Administrative Assistant, Ms. Shauna Grant	970-0923	2816
DEPARTMENT OF GEOGRAPHY AND GEOLOGY	927-2728	2246
Head, Dr. Donovan Campbell		
Administrative Assistant, Miss Denese Francis		
DEPARTMENT OF LIFE SCIENCES	927-1202	2291
Head, Dr. Dwight Robinson	927-2753	
Administrative Officer, Mrs. Sophia Davis		
Senior Secretary, Ms. Debbie-Ann Brown		
DEPARTMENT OF MATHEMATICS	927-2642	2284
Head, Prof. Nagarani Ponakala		
Senior Administrative Assistant, Mrs. Orinthia Fisher-Howe	935-8621	
DEPARTMENT OF PHYSICS	927-2480	2278
Head, Dr. Tannecia Stephenson		
Administrative Assistant (Acting), Ms. Nekishea Burke		2277
Senior Secretary, Miss Margaret Little		2274
SCIENCE ENGINEERING BRANCH LIBRARY	935-8202	2202/3
Head, Dr. Sasekea Harris		
Reference Library, Mrs. Karen Tyrell		
THE BIOTECHNOLOGY CENTRE		
Director, Prof. Helen Asemota	977-1828	2518
Administrative Assistant, Mrs. Karen Stewart	977-3331	2519
CENTRE FOR MARINE SCIENCES		
Director, Prof. Mona Webber	935-8835	2835
Senior Scientific Officer, Miss Patrice Francis	935-8836	2836

GRADUATE COORDINATORS

Department/Centre	Contact
The Biotechnology Centre	Dr. Sylvia Mitchell sylvia.mitchell@uwimona.edu.jm sylviamitchell.biotech@gmail.com
Centre for Environmental Management	Dr. Vivienne Vassall environmental.management@uwimona.edu.jm
Chemistry	Dr. Paul Maragh paul.maragh@uwimona.edu.jm
Computing	Dr. Carl Beckford carl.beckford@uwimona.edu.jm
Geography & Geology	Dr. Arpita Mandal arpita.mandal@uwimona.edu.jm
Life Sciences	Dr. Tannice Hall tannice.hall02@uwimona.edu.jm
Mathematics	Dr. Mahesha Narayana mahesha.narayana@uwimona.edu.jm
Physics	Dr. Venkateswara Penugonda venkateswara.penugonda@uwimona.edu.jm Dr. Leonardo Clarke leonardo.clarke02@uwimona.edu.jm

PROGRAMME COORDINATORS

Programme	Contact
MSc Advanced Electronic System	Dr. Venkateswara Penugonda venkateswara.penugonda@uwimona.edu.jm
MSc Agricultural Entrepreneurship	Prof. Noureddine Benkeblia noureddine.benkeblia@uwimona.edu.jm
MSc Applied Data Science	Dr. Carl Beckford carl.beckford@uwimona.edu.jm
MSc Biotechnology	Dr. Sylvia Mitchell sylvia.mitchell@uwimona.edu.jm sylviamitchell.biotech@gmail.com
MSc Computer-Based Management Information Systems	Dr. Carl Beckford carl.beckford@uwimona.edu.jm

MSc Computer Science	Dr. Carl Beckford carl.beckford@uwimona.edu.jm
MSc Enterprise Risk Management (ERM)	Ms. Britta Hay britta.hay@uwimona.edu.jm
MSc Food and Agro-Processing Technology Programme (FAPT)	Dr. Andrea Goldson-Barnaby andrea.goldson03@uwimona.edu.jm
Information Technology (Diploma)	Dr. Carl Beckford carl.beckford@uwimona.edu.jm
MSc NRM-MaTE Marine and Terrestrial Ecosystems	Prof. Mona Webber mona.webber@uwimona.edu.jm
MSc Mathematics	Dr. Mahesha Narayana mahesha.narayana@uwimona.edu.jm
MSc Medical Physics	Dr. Venkateswara Penugonda venkateswara.penugonda@uwimona.edu.jm
MSc Occupational and Environmental Safety and Health (OESH)	Dr. Norbert Campbell norbert.campbell@uwimona.edu.jm
Renewable Energy Management / Renewable Energy Technology	Dr. Venkateswara Penugonda venkateswara.penugonda@uwimona.edu.jm

Graduate Council (FST)

Chairman

Ms. Jacquél Johnson
jacqueljohnson12@gmail.com

Mona Association of Postgraduate Students (MAPS)

President

Mr. Kijana Johnson
kijana.johnson@mymona.uwi.edu

REGISTRY OFFICERS AND PERSONNEL

OFFICE	Direct Line (876)	Extensions
SECRETARIAT	977-0612	
Senior Assistant Registrar, Mrs. Michelle Ashwood-Stewart	935-8317	2301
Assistant Registrar, Miss Anthea Muirhead		2200
REGISTRY INFORMATION SYSTEM	977-1202	2856
Assistant Registrar, Mr. Leighton Chambers	935-8600	2747
Business Analyst, Miss Ann-Marie Rose		
Senior Administrative Assistant, Miss Dahlia Saunders		
ADMISSIONS SECTION (STUDENT AFFAIRS)		
Senior Assistant Registrar, Mrs. Marsha Morgan-Allen	970-1002-4	2651
Faculty's Administrative Assistance, Miss Maxine Campbell	927-2272	3526
EXAMINATIONS SECTION (STUDENT AFFAIRS)		
Assistant Registrar, Mr. Kevin Tai	977-3544	7501
Administrative Assistant, Joel Shepherd	935-8855-6	7505
STUDENT ADMINISTRATIVE SERVICES (STUDENT AFFAIRS)	970-6736	3736
Supervisor, Mrs. Camille Campbell		
MARKETING RECRUITMENT AND COMMUNICATION (STUDENT AFFAIRS)		
Assistant Registrar, Mrs. Marjorie Bolero-Haughton	977-5941	2947

STUDENT SUPPORT SERVICES

ACCOMMODATIONS

Graduate Housing

The Marlene Hamilton Hall is a Post Graduate Residential complex located along the south Eastern edge of the UWI Mona Campus. It House 400 students. The Hall contains 4 six-story Blocks with 100 self-contained flats. Each Block has two (2) super studios on each floor.

Tel: (876) 977-5620 or Ext. 7995
Visit: www.mona.uwi.edu/hamilton
or
Mona Campus Lodgings
Tel: (876) 702-3493

BURSARIES, GRANTS AND SCHOLARSHIPS

Office of Student Financing

The University of the West Indies Mona, Jamaica
Tel: (876) 702-4646 | Fax: (876) 702-4647
Email: stufinc@uwimona.edu.jm
Visit: https://www.mona.uwi.edu/osf/scholarships-bursaries
Opening Hours: Monday - Friday 8:30 a.m. - 4:30 p.m.

CAREER SERVICES

Placement and Career Services

The University of the West Indies Mona, Jamaica
Tel: (876) 702-4646 | Fax: (876) 702-4647
Email: stufinc@uwimona.edu.jm
Visit: https://www.mona.uwi.edu/osf/scholarships-bursaries
Opening Hours: Monday - Friday 8:30 a.m. - 4:30 p.m.

ESCORT SERVICE

The Escort Service is provided for individuals or small groups working in the libraries, laboratories or any other on-campus centres. Persons requiring this service may call the Police Post at and a member of the Campus Security will escort you to any of the Halls or to the car park.

Tel: (876) 935-8748-9 or Ext. 2748/2749

HEALTH SERVICES

The University Health Centre (UHC) provides a wide range of primary and secondary health care services to members of the university community. The UHC is located on Gibraltar Road between the Irvine Hall and Post Office Gates.

Tel: (876) 927-2520 / 927-1660-9; Ext. 2270 & 2370
Visit: www.mona.uwi.edu/healthcentre
Opening Hours: Monday - Friday 8:30 am - 4:30 pm
Note: Please remember to take your ID & Appointment card with you.

LIBRARY SERVICES

ASKMONA Library Virtual Reference Service:
https://www.mona.uwi.edu/library/reference-0

Graduate Thesis Resources
https://www.mona.uwi.edu/library/resources-graduates

Postgraduate Learning Commons (PGLC)
Facilities and services to enable postgraduate students to work and study in a student-friendly environment. Booking form available here:
https://www.mona.uwi.edu/library/postgraduates

Main Library
Tel: (876) 935-8294-6
Email: main.library@uwimona.edu.jm
Visit: https://www.mona.uwi.edu/library/

Science and Engineering Branch Library
Tel: (876) 935-8202
Email: science.library@uwimona.edu.jm
Visit: https://www.mona.uwi.edu/library/science-engineering-branch-library-sebl

Opening Hours:
During Semester
Monday to Friday: 8:30am - 6:00am
Saturday: 8:30am - 12 Midnight
Sunday: 12 noon - 8pm

During Summer
Monday to Friday: 8:30 am - 5:00 pm
Saturday: 8:30 am - 4:00 pm
Sunday: Closed

SUPERMARKET AND GROCERY

Hi-Lo Supermarket is located by the Students' Union Complex. They offer a wide range of groceries and household items.

Opening Hours: Monday - Saturday 11:00 am - 9:00 pm

TRAVEL SERVICES

Campus Travel is located by the Students Union Complex. They offer travel and tour operation services.

Opening Hours: Monday - Friday 10:00 am - 7:00 pm

UNIVERSITY BOOKSHOP

The UWI Bookshop serves as a resource centre for the campus community; they offer a wide variety of products and services, specializing in the sale of academic and scholarly material. The Bookshop accepts cash, debit and credit cards. Institutional customers may submit purchase orders to facilitate payment.

E-mail: bookshop@uwimona.edu.jm
Tel: (876) 977-1401, (876) 702-2304-5 | **Fax:** (876) 702-2303
Visit: www.mona.uwi.edu/bookshop
Opening Hours:
Regular Opening Hours
Monday - Friday: 8:30 am – 6:00pm
Saturday: 9:00am – 2:00pm
Sunday & Holidays: Closed

Summer and Christmas Opening Hours
Monday - Friday: 8:30am – 5:00pm
Weekends and Holidays: Closed

UNIVERSITY CENTRAL LAUNDROMAT

The Laundromat is located at Irvine Hall. Tokens for washing and drying machines cost $60 per load and are sold at the Laundromat only. Students must present ID cards when purchasing tokens. Opening hours are 2:00 pm to 9:00 pm on weekdays and 6 am to 10 pm on weekends.

Office of Student Services & Development
Email: student.services@uwimona.edu.jm
Tel: (876) 977-3880 | **Fax:** (876) 927-2765
Visit: www.mona.uwi.edu/oss
Office Hours: Monday to Friday 8:30 am - 4:30 pm

UNIVERSITY POOL

The University Campus has an official Olympic sized pool with is open to staff and students.

Sports Department
Email: sports@uwimona.edu.jm
Tel: (876) 702-4473 | **Fax:** (876) 702-4480
Visit: www.mona.uwi.edu/sports
Office Hours: Sunday to Saturday 8:00 am - 6:00 pm (Closed Good Friday and Christmas day).

ONLINE SYSTEMS

Mona Information Technology Services (MITS)

http://www.mona.uwi.edu/mits/
Contact them for assistance with domain password, Microsoft Office installations, email and other IT-related issues.

Student Portal

https://mymona.uwi.edu/web/mycampus/home
Register for courses, access academic record, and update personal information

Online Learning Environment

Online course portal, OurVLE
https://ourvle.mona.uwi.edu/

Student Administration System (SAS)

https://www.mona.uwi.edu/content/student-administration-area

Bursary Online Student System (BOSS)

http://apps.mona.uwi.edu/bursary/account/login.php

Online Tuition Payment

https://eservices.mona.uwi.edu/finserv/tuition/

SCHOLARSHIPS AND GRANT FUNDING

www.mona.uwi.edu/postgrad/scholarship

UWI SCHOLARSHIPS

At present, approximately 18 UWI scholarships are available to graduates of the UWI for students pursing full-time research degrees at the Mona Campus. The value of the award is J$700,000.00 per annum.

NON-UWI SCHOLARSHIPS

A small number of other graduate scholarships are available. Applicants are invited by means of advertisements. Details are usually provided during the period March to May of every year.

RESEARCH & PUBLICATION GRANTS AND GRADUATE AWARDS

The Campus Committee provides research grants and graduate awards to Departments/Faculties and students to fund:

- research projects
- conference participation/research visits
- thesis preparation
- publications

Visit https://www.mona.uwi.edu/postgrad/forms for requisite R&P application forms. Completed forms should be submitted electronically, by the prescribed deadline, to Assistant Registrar (Graduate Studies & Research).

PROCEDURE FOR GRANT APPLICATIONS

Applications on the prescribed forms are to be submitted to the Assistant Registrar, Graduate Studies & Research, Mona, for consideration by the Campus Committee on Research & Publications and Graduate Awards:
Applications for grants are invited by means of advertisements placed on the University's websites, Mona Messaging, and on Notice Boards.
Deadline Dates for Application - Three weeks before each meeting

NOTE
The Campus Committee requires a report on the expenditure of the grant and on the progress of the research project.
Application forms available at https://www.mona.uwi.edu/postgrad/scholarship, should be submitted online by the prescribed deadline, to the Assistant Registrar (Graduate Studies & Research).

DEPARTMENTAL AWARDS

Departmental awards are offered by various departments for pursuing research in specific areas. Part-time employment may also be available, and enquiries should be made to the Head of the Department and/or Dean of Faculty in which the student is pursuing a higher degree.

Graduate students may be employed within the University for up to twelve (12) hours a week without losing their full-time student status.

TEACHING ASSISTANTSHIPS

PhD candidates, having a maximum one year to completion, can apply for Teaching Assistantships through the Head of Department.

PURSUING A HIGHER DEGREE

6 THINGS TO CONSIDER

1. Graduate Programmes Offered
2. Entry Requirements and Duration
3. Supervision
4. Ethical Issues
5. Plagiarism
6. Important Dates

GRADUATE PROGRAMMES OFFERED

Graduate studies in the FST can be undertaken in the form of taught courses or research.

Department/ Centre	**Research Masters and Doctoral Degrees** Master of Philosophy or Doctor of Philosophy
The Biotechnology Centre	▪ Biotechnology
Chemistry	▪ Chemistry ▪ Occupational and Environmental Safety and Health (OESH)
Computing	▪ Computer Science
Geography & Geology	▪ Geography ▪ Geology
Life Sciences	▪ Botany ▪ Marine Sciences ▪ Environmental Biology ▪ Zoology
Mathematics	▪ Mathematics
Physics	▪ Electronics ▪ Physics ▪ Applied Physics

Department/ Centre	**Taught Master's Degrees and Diplomas** Master of Science or Postgraduate Diploma
The Biotechnology Centre	▪ Biotechnology
Chemistry	▪ Food and Agro-Processing Technology ▪ Occupational and Environmental Safety and Health (OESH)
Computing	▪ Computer Science ▪ Computer-Based Management Information Systems ▪ Data Science ▪ Information Technology (Diploma)
Life Sciences	▪ MaTE: Marine and Terrestrial Ecosystems ▪ Agricultural Entrepreneurship
Mathematics	▪ Mathematics ▪ Enterprise Risk Management (ERM)
Physics	▪ Advanced Electronic Systems ▪ Applied Physics ▪ Medical Physics ▪ Renewable Energy Management ▪ Renewable Energy Systems

GENERAL INFORMATION

GRADUATE PROCESSES, USER MANUALS AND GUIDELINES

1. Guidelines for Students Submitting Electronic Copy of Thesis
https://www.mona.uwi.edu/postgrad/sites/default/files/postgrad/guidelines_to_students_submitting_electronic_copy_of_thesis.pdf

2. Graduate Studies Thesis Tracker User Guide
https://www.mona.uwi.edu/postgrad/sites/default/files/postgrad/uwi_graduate_studies_thesis_tracker_user_guide_-_student.pdf

3. Guidelines and FAQs for Graduate Studies Thesis Tracker Application
https://www.mona.uwi.edu/postgrad/sites/default/files/postgrad/guidelines_and_faqs_for_graduate_studies_thesis_tracker_application.pdf

4. Guidelines for Student Request – Change of Major Status
https://www.mona.uwi.edu/postgrad/sites/default/files/postgrad/guidelines_student_request_for_change_of_major_status.pdf

5. Automated Student Request System Guidelines
https://www.mona.uwi.edu/postgrad/sites/default/files/postgrad/automated_student_request_system_guidelines.pdf

6. User Manual for Change of Address
https://www.mona.uwi.edu/postgrad/sites/default/files/postgrad/user_manual_change_of_address.pdf

7. Automation of Student Requests (LOA, Withdrawals, etc)
https://www.youtube.com/watch?v=d0zZI0iqJc8

8. Online Request for Change of Major or Enrolment Status
https://www.youtube.com/watch?v=-OCL96_H5_0

9. Update Address and or Phone Number on Students' Records
https://www.youtube.com/watch?v=ZtLg_8SrgwI

10. Electronic Submission of Projects –ESPRO
https://www.youtube.com/watch?v=y9KIPuXF6tE

11. Regulations for Graduate Certificates, Diplomas and Degrees
https://www.youtube.com/watch?v=N0r97RB4SKA

GRADUATE GPA SCHEME

Table 1: Comparison of the Graduate GPA Scheme with the Undergraduate Scheme

Undergraduate Scheme			Graduate Scheme		
Grade	Grade Point	% Range	Grade	Grade Point	% Range
A+	4.30	90-100	A+	4.30	90-100
A	4.00	80-89	A	4.00	80-89
A-	3.70	75-79	A-	3.70	75-79
B+	3.30	70-74	B+	3.30	70-74
B	3.00	65-69	B	3.00	65-69
B-	2.70	60-64	B-	2.70	60-64
C+	2.30	55-59	C+	2.30	55-59
C	2.00	50-54	C	2.00	50-54
F1	1.70	40-49	F1	1.70	40-49
F2	1.30	30-39	F2	1.30	30-39
F3	0.00	0-29	F3	0.00	0-29
			FE/FC	1.70	≥50

Note: Students failing a component (coursework or exam) of a course but receiving an overall mark of 50 or more will be entitled to a grade of FC/FE. The Grade Descriptors provided clarify the standards embodied by each letter grade.

The major difference in the new graduate scheme as compared to the old is in the percentage grading bands. The current grading scheme for graduate courses is:

A = 70%+ ; B+ = 60-69% ; B = 50-59% ; F = 0-49%

Description:

1 The GPA system will apply to PG Certificates, PG Diplomas, Master's and Professional Doctorates.
2 The grade point/percentage bands as shown in the Table 1 (Graduate Scheme) above should apply. These are identical with the bands for the undergraduate GPA.
3 The descriptors which apply for the relevant range of marks are attached in Appendix 1.
4 The Minimum GPA needed for a student to graduate is 2.00 (C).
5 All coursework done for graduate credit is also computed in the GPA.

6 A student who fails any element of a course that counts towards the final grade (whether coursework or final examination) will be deemed to have failed that course and will be assigned the grade FC or FE (Fail Coursework, Fail Exam), even if they obtain an overall mark of 50% or higher. A student who passes an element of a course but does not obtain an overall mark of 50 or higher, will fall into the grade category in the grade scale in alignment with the mark achieved i.e., F1, F2. F3.

7 Academic standing will be based on the Semester GPA. If a student's Semester GPA falls below 2.0, the student will be given a warning in the first semester. If the student's GPA falls below 2.0 for two consecutive semesters, the student will be "required to withdraw".

8 **Distinction** will be awarded on the basis of a Programme GPA of 3.70 (an A- average).

9 **Merit** will be awarded if the student's GPA Average is 3.00-3.69

10 **Pass** will be awarded for students whose GPA falls below the B+ average (i.e., 2.0-2.99).

11 Research Project will be considered another course and will NOT require Distinction scores separately for the project - for the overall distinction.

12 The new GPA system will only apply to newly admitted students. All continuing students will be assessed under the existing system and will not fall under the GPA system.

13 Departmental pre-requisites should not impact on a student's GPA, and grading should be based on pass/fail. Non-GPA courses for each programme must be clearly indicated.

14 **The GPA system will come into effect from academic year 2021-2022.**

15 The Regulations requiring amendments in order to ensure conformity towards implementing GPA have been approved BGSR.

RESEARCH DEGREES

A research degree in the Faculty of Science and Technology can be placed in two categories: Master of Philosophy and Doctor of Philosophy. These are higher degrees and are mainly research-based (either laboratory- or field-based research). They span a wide range of disciplines and are awarded on the basis of original research detailed in a thesis/dissertation.

> **University Regulation 1.3**
> The ***Master of Philosophy*** (MPhil), ***Doctor of Philosophy*** (PhD) and MD shall be primarily research degrees and shall be awarded primarily on the basis of examination by thesis. Other requirements shall be as specified in the respective Faculties.

Through the MPhil and PhD programmes, students conduct research in conjunction with a supervisor, who is a faculty member and recognized scholar in a particular research field, or with a supervisory team of faculty and other experts in the relevant discipline. Original findings can be published before the award of the degree, with the publication becoming part of the final thesis, thus contributing to the dissemination of knowledge and to development.

TAUGHT MASTERS

Many of the taught Masters' Programmes also include training in research methodology and students are required to submit a Project Report or Research Paper in partial fulfillment of the requirement for the award of the Degree.

GENERAL ENTRY REQUIREMENTS

Graduate Diplomas and Taught Masters Degrees

A minimum GPA of 2.5 or a Lower Second Class Honours degree or Equivalent qualification (as determined from transcripts).

Master of Philosophy (MPhil)

> **University Regulation 1.12**
> The minimum requirement for admission to MPhil programmes shall be a minimum GPA of 3.0, or an Upper Second Class Honours degree or its equivalent, unless the Campus Committee in any particular case otherwise decides.

Typical applicants would have a bachelor's degree in the particular discipline and would have achieved at least an **upper second class honours** to be considered for this category of programmes. Applicants are also expected to write a research proposal on the area or topic of interest. Acceptance into these programmes is also subject to the availability of a supervisor.

Doctor of Philosophy (PhD)

University Regulation 1.13
The minimum requirements for admission to PhD programmes:
a) Approved graduate degrees awarded primarily for research;
b) Taught Master's degree from The UWI or another approved University, provided that the Masters programme included a research component of at least 25% of the total credit rating and the applicant achieved at least a B+ average or its equivalent;
c) Approval of upgrade application;
d) Such other qualifications and experience as the Board for Graduate Studies and Research may approve.

Applicants must have a Master of Philosophy or a Master of Science degree in the particular discipline to be considered for this category of programmes. They are expected to write a research proposal on the area or topic of interest and will only be accepted if appropriate supervisors are available. Applicants should therefore prepare a statement of proposed research, indicating their intended topic and research strategy.

PROGRAMME DURATION

Programme	Full-Time	Part-Time
Master of Science	Two (2) years	Three (3) years
Master of Philosophy	Three (3) years	Five (5) years
Doctor of Philosophy	Five (5) years	Seven (7) years

CHOOSING A RESEARCH TOPIC

If you decide to pursue a research degree, it is important that the thesis topic chosen be of genuine and sustainable interest. Investigate the current research being undertaken by members of staff of the relevant Department or Centre. Candidates may also contact possible supervisors to discuss proposed research projects. PhD applicants should prepare a statement of proposed research indicating their intended topic and research strategy.

CREDIT REQUIREMENTS AND COURSES

Master of Philosophy (MPhil)

Requires the completion of six (6) credits from postgraduate courses (determined by department and programme) in addition to a thesis documenting the results of the research carried out over a period.

Doctor of Philosophy (PhD)

Requires the completion of nine (9) credits from postgraduate courses (determined by programme and department) in addition to a thesis documenting the results of the research carried out over a period.

Course Code	Course Title
MPhil & PhD students	
RETH9005	Thesis (Science & Technology) **Register for this course every semester until you graduate**
MPhil students only	
GRSM6501	Pure and Applied Sciences MPhil Graduate Research Seminar I
GRSM6502	Pure and Applied Sciences MPhil Graduate Research Seminar II
PhD students only	
GRSM9501	Pure and Applied Sciences PhD Graduate Research Seminar I
GRSM9502	Pure and Applied Sciences PhD Graduate Research Seminar II
GRSM9503	Pure and Applied Sciences PhD Graduate Research Seminar III

Important Points to Note:

- PhD candidates are required to have **three (3) seminars** on their transcript before they can submit their thesis for examination.
- MPhil candidates are required to have **two (2) seminars** on their transcript before they can submit their thesis for examination.
- Candidates who are upgrading their registration to the PhD are required to have at least **one (1) seminar** on their transcript before their upgrade seminar can be approved by the Office of Graduate Studies and Research.

- The upgrade seminar can be considered as one of the Graduate Seminars as long as it is not the last seminar before the submission of the PhD thesis.

CONFERENCES AND PRESENTATIONS

Students are encouraged to seek opportunities to present their work. Funding is available, through grants from the Office of Graduate Studies and Research, to attend local and international conferences and other events relevant to a student's research topic/area. In addition, there is a biennial conference organised and held locally by the Faculty of Science and Technology and students are encouraged to submit posters and/or oral presentations on their work.

UPGRADING OF REGISTRATION

With the exception of holders of MPhil degrees from recognised universities, a candidate for the PhD degree is normally required to register for the MPhil degree in the first instance. Applications for transfer to a PhD programme from MPhil are encouraged where students display exceptional promise. Candidates who are upgrading their registration to the PhD are required to have presented at least one (1) seminar before their upgrade seminar can be approved by the Office of Graduate Studies and Research.

PHD TRANSFER PROCEDURE

A successful transfer to a PhD programme involves the satisfactory completion of a *transfer seminar*. The seminar includes a summary of the MPhil work to date, a presentation of results to date, and a proposal for extension of the work to PhD level.

University Regulation 1.40

29. The procedure for upgrading of registration shall be as follows:

a) The student should first consult his/her Supervisor and then write to the Senior/Assistant Registrar, through the Supervisor and the Head of Department/Unit or Director of Institute/Centre (hereafter "Head"), formally seeking an upgrade of his/her registration. The Dean of the Faculty or his/her nominee should be copied on all correspondence.

b) The Senior/Assistant Registrar will seek a recommendation from the Head of Department, advising him or her of student's eligibility for the upgrade. The Dean should be copied on all correspondence.

c) If the Head of Department is the student's Supervisor, he/she must delegate his/her responsibilities as Head in this process to a senior academic colleague in the Department/Institute/Centre/Unit.

d) If the Head of Department is in agreement with the student's request to upgrade, he/she should consult with the student's Committee of Advisors, other Departmental colleagues and the Chair of the appropriate Faculty Committee to formulate an Upgrade Assessment Committee all normally chosen from the academic staff of the University

The Upgrade Assessment Committee shall comprise:

i. the Chief Supervisor(s),
ii. at least two independent Assessors, and
iii. an independent Chair.

Assessors should therefore be chosen on the basis of their knowledge and experience at the appropriate level in the area of the student's research. One of the assessors may be drawn from outside the University community in the appropriate circumstances.

e) The Head of Department shall submit the recommendations for the Upgrade Assessment Committee to the Chair of the Campus Committee for approval.

f) Once approval has been given for the composition of the Upgrade Assessment Committee, the designated Chair shall ask the student to provide a copy of his/her Upgrade Proposal for each of the Assessors, and set a mutually agreed date for the oral presentation by the student of:

   i. his/her report on the work done and accomplishments to date under the MPhil registration;
   ii. his/her proposal to upgrade the work to the PhD beyond the MPhil level.

g) If the Head of Department is not in agreement with the student's request to upgrade, he/she should submit comments on the matter to the Chair, Campus Committee, copying them to the Supervisor(s). The Chair, Campus Committee, will deliberate and decide whether to allow the upgrade to take place. If approval is not granted, the Senior/Assistant Registrar shall inform the student of the decision, copying the Head of Department and Supervisor(s).

h) The precise form of material considered as part of the Upgrade Proposal will vary across Departments and disciplines so the student should draft the Upgrade Proposal in consultation with his/her Supervisor(s). The Upgrade Proposal should be no more than 100 pages. Whilst it is recognised that the exact nature of the Proposal submitted by the student will depend on the discipline, it should cover at least the following components (not necessarily as discrete items):
   i. An introduction giving the context of the work;
   ii. A literature review;
   iii. A research question and hypothesis;
   iv. A section on methodology;
   v. A substantial piece of work towards the thesis objectives;
   vi. A plan and timetable for the remainder of the work; and
   vii. A bibliography.

i) The criteria for upgrade to PhD status include:
   i. Commitment to pursuing research at The UWI leading to the PhD degree;
   ii. Satisfactory progress in the work so far;
   iii. Demonstration of sufficient awareness of the context of the work and completion of such tasks as a review of relevant literature and a bibliography;
   iv. Ability to formulate a viable hypothesis or research question that could be completed within the normal time frame of the PhD programme;
   v. Satisfactory technical and generic skills development;
   vi. Formulation of a viable plan for the work;
   vii. Consideration of the research ethics dimensions of the project, and application for ethics approval from the relevant Research Ethics Committee if appropriate;
   viii. English Language proficiency, both written and spoken.

j) The upgrade will consist of at least a 30-minute oral presentation of the work and proposal by the student, followed by questions posed to the student by the Assessors. After the presentation the Chair will meet with the Assessors to deliberate on whether the student has met the criteria as outlined.

k) The Upgrade Assessment Committee is to recommend either:
   i. Pass — upgrade of registration to PhD; or
   ii. Adequate — subject to revision of the Upgrade Proposal to the satisfaction of the Supervisor within two (2) months; or
   iii. Inadequate — Revise and resubmit the Upgrade Proposal for second and final attempt at the upgrade seminar within six (6) months; or
   iv. Fail — MPhil to be completed within a specified time.

l) The Chair of the Upgrade Assessment Committee shall prepare a written joint report on the outcome within two (2) weeks of the upgrade. This report is to be signed by all members and submitted to the Senior/Assistant Registrar for the deliberations of the Campus Committee.

m) If the Upgrade Assessment Committee cannot reach a consensus, independent written reports must be prepared by the Chair and the Assessors each with a clear recommendation about the Upgrade and submitted to the Senior/Assistant Registrar.

n) The Chair of the Campus Committee 'shall then submit the report(s) of the Upgrade Assessment Committee along with a recommendation to the Chair of the Board for consideration.

o) The Senior/Assistant Registrar shall inform student of the decision of the Board, copying the Head of Department and Supervisor(s).

AWARD OF DEGREE

For the award of the degree, the student submits a thesis or dissertation in an approved format. The essential difference between the Master and Doctoral levels, apart from the length of the registration period, lies in the quality of a successful Ph.D. thesis. This must be judged to be the result of original research, to be an addition to knowledge, and to be worthy of publication either in full or in an abridged form.

The award of a Ph.D. degree also requires that a candidate defends his/her thesis at a public oral examination.

DUTIES & RESPONSIBILITIES OF STUDENTS AND SUPERVISORS

https://www.mona.uwi.edu/postgrad

SUPERVISION

Each student receives guidance from an Advisory Committee that consists of a Supervisor, who is an expert in the area of research to be undertaken, and at least two other persons with related expertise.

The Board of Graduate Studies has issued the following guidelines for Graduate Studies regarding research. Please consult the Graduate Studies Guide for Students and Supervisors (at Office of Graduate Studies & Research website above) for further details.

RESPONSIBILITIES OF THE STUDENT

Graduate students have the following responsibilities:

- keeping the schedule of meetings agreed with the supervisor;
- taking the initiative in raising with the supervisor problems or difficulties, however elementary they may seem;
- discussing the type of guidance and comments found most helpful;
- maintaining good progress of work in accordance with the schedule agreed with the supervisor;
- presenting written material as required in sufficient time to allow for comments and discussion before proceeding to the next stage;
- making representation to the Head of Department (HOD) if an effective working relationship is not established with the supervisor or if, for reasons outside the student's control, the work is not proceeding satisfactorily.

RESPONSIBILITIES OF THE SUPERVISOR

Supervisors have the following responsibilities:

- giving guidance about the nature of research and the standard of performance expected, about the planning of the research programme, about literature and sources, about requisite techniques (including
- arranging for instruction where necessary), and about attendance at classes;
- advising the student of the nature of guidance or comments to be offered on the student's written work since comments have to be in accordance with the general principle that the work should be the student's own;

- arranging regular tutorial meetings with the student;
- being accessible to the student at other times as the need arises;
- giving detailed advice on the completion dates of successive stages of the work so that the whole may be submitted within the scheduled time;
- requesting written work as appropriate and returning such work with constructive criticism in reasonable time;
- arranging for the student to present the work to staff or graduate seminars, in oral or written form;
- arranging for the student to have practice in oral examination;
- ensuring that the student is made aware of inadequacy of progress or of standards of work below that generally accepted;
- paying particular attention to overseas students (especially those from outside the Caribbean) who may in the early stages need very frequent contact, and often advice of a seemingly elementary kind;
- submitting full annual reports to the Board for Graduate Studies, through the Campus Registrar, on the student's progress. If the student is making insufficient progress or the work is below standard, the supervisor should recommend whether the student should be allowed to continue;
- reminding the student to act in accordance with University regulations governing entry to the thesis examination (normally three months before the expected date of submission of the thesis);
- making recommendations to the Head of Department on the nomination of the examiners of the student's thesis/research paper/project report, (normally three months before the expected date of submission);
- ensuring that the final work of the student satisfies accepted standards of usage for scholarly writing and that the presentation conforms to the University's General Regulations.

RESEARCH ETHICS GUIDELINES

https://www.mona.uwi.edu/mcrec

BACKGROUND

- The guidelines are intended to assist researchers in understanding the ethics review process for the Faculty of Science and Technology (FST).

- These guidelines are not intended to be comprehensive and should not be viewed as an independent document. Faculty research ethics guidelines are subsumed under the UWI Mona Campus Research Ethics policy (https://www.mona.uwi.edu/mcrec) and based on the proposal guidelines for graduates and academic staff provided by the UWI Mona Campus Research Ethics Committee's Research Proposal Toolkit (https://www.mona.uwi.edu/mcrec).

- Ethical approval of research by the UWI Mona Campus Research Ethics Committee (MCREC) is devoted to the assessment of the research process. The review procedures will assist researchers in conducting quality research that adheres to the highest ethical standards. Ethical review is designed to promote responsible research that protects the participants, the integrity of the UWI and the researcher(s).

- Any procedures involving human subjects, that may include surveys and questionnaires, focus groups and interviews, observations etc., are to be conducted with the informed consent of participants and with protection of participants' rights and their knowledge of the level of risk involved.

- The principles of research ethics ask that researchers avoid harming participants, by respecting individuals and taking into account their needs, interests and rights. It is expected that benefits of the research outweigh the risk to participants. Furthermore, research is built on trust. There should therefore not only be trust that the findings reported by researchers are valid, representative and accurate, but also that the rights of the participants are respected and protected.

THE FST RESEARCH ETHICS COMMITTEE

- The Faculty of Sciences and Technology is mandated to establish a Research Ethics committee comprised of representatives from each Department and Centre.
- The FST Research Ethics Committee operates as a sub-committee under the UWI Mona Campus Research Ethics Committee (please see https://www.mona.uwi.edu/mcrec)

- Applications will normally be reviewed at specially scheduled meetings of the FST sub-committee following their receipt from supervisors (directly) or from the UWI Mona Campus Research Ethics Committee (low-risk expedited review).
- It is important to note that it is the responsibility of the principal investigator or supervisor to submit proposals directly to the main committee after review by the faculty sub-committee; thus assuming full responsibility for the ethical approval of their research.

REVIEW OF PROPOSAL

There are three possible levels of review (details available online at https://www.mona.uwi.edu/mcrec) and researchers may indicate in the cover letter under which their proposal would fall. **N.B. All moderate, high risk and PhD proposals require full committee review.**

a. Full/Convened Committee Review
b. Minimal risk proposal (which include expedited)
c. Review for Exemption Status

ROLE OF THE COMMITTEE

The expanded role of the FST Research Ethics Committee includes the following:

1. To review proposals generated by FST Faculty and Graduate Students so as to provide feedback and ensure that the submission to the UWI Mona Campus Research Ethics committee (MCREC) is as seamless as possible.
2. To review minimal risk proposals which are directed to the FST Ethics Committee by the UWI Mona Campus Research Ethics Committee (MCREC) and give approval/feedback to the UWI MCREC.
3. In cases where the UWI MCREC provides feedback on a proposal and the researchers require clarifications, the FST sub-committee is available to meet and discuss the concerns by appointment.
4. The subcommittee is also available for consultation with any staff or student, by appointment.

OBTAINING ETHICAL APPROVAL

All persons conducting research involving humans and other animals **MUST** seek ethical approval **PRIOR** to the start of field work or data collection.

Students whose research requires ethical approval are advised to initiate the process **as soon as they have written their research proposal and at least 3 months before they plan to start data collection/surveys.** The **application is actually made by the Supervisor** (with the student named as co-applicant) or by the Principal Investigator where there is no graduate student involvement.

THE ETHICS REVIEW PROCESS

1. Complete a research proposal to the satisfaction of supervisor/supervisory committee/Principal Investigator. This must be inclusive of questionnaire(s), list of focus group questions or other documents to be used to gather data from human subjects. **N.B. copyrighted instruments must be accompanied by a letter/e-mail granting permission for use.**
2. Download the Research Ethics Toolkit (Ethics proposal requirements) from link #3 below.
3. Provide all documents as guided by the toolkit, that is:
    a. Cover letter
    b. Summary/abstract
    c. Proposal
    d. Checklist
    e. Consent forms
    f. Letters of support from partner agencies/departments (where needed)
    g. Project budget
    h. Appendices (questionnaires etc.)
4. Proposal must be submitted online following the instructions in the applicant manual (see link below).

IMPORTANT LINKS

It is important that all members of the FST are acquainted with the following documents, available online:

1. The University of the West Indies: Policy and Procedures on Research Ethics
   https://www.mona.uwi.edu/fst/sites/default/files/fpas/uploads/uwi_policy_on_research_ethics_oct_2010_2_1.pdf
2. Policy and Code on Research Ethics for the University of the West Indies
   http://www.mona.uwi.edu/fms/sites/default/files/fms/uploads/Ethics%20Policy%20and%20Code%5B1%5D.pdf
3. Guidelines for Preparing Research Proposals, A Handbook by the UWI Ethics Committee
   https://www.mona.uwi.edu/mcrec/sites/default/files/mcrec/guidelines_for_preparing_research_proposals_toolkit_june_2020_final_1-1.pdf
4. 4 step guide for submitting online
   https://www.mona.uwi.edu/mcrec/node/13
5. Applicant Manual
   https://www.mona.uwi.edu/mcrec/sites/default/files/mcrec/applicants_manual_oct_13_2020.pdf

UNIVERSITY REGULATIONS ON PLAGIARISM

DEFINITION *of plagiarism* (in these Regulations)
"Plagiarism" means the unacknowledged and unjustified use of the words, ideas or creations of another, including unjustified unacknowledged quotation and unjustified unattributed borrowing.

CATEGORIES OF PLAGIARISM AND ASSOCIATED PENALTIES

- ***Level One cases*** are those in which only small quantities of the work is affected, and in which the breaches are minor. They therefore include borderline situations, cosmetic paraphrasing, negligent referencing or a few incorrect or missing citations.
    - In the case of written papers and project reports, Level One Plagiarism, if substantiated, shall result in a deduction of marks. Resubmission after appropriate correction, as an educational opportunity for the student, may be required.
    - In the case of theses, Level One Plagiarism, if substantiated, shall result in return of the submitted work to the student for revision and resubmission. Resubmission in this situation will not be regarded as a failure.
- ***Level Two cases are*** those which involve extensive plagiarism, with clear indication of academic dishonesty. They include situations where a significant amount of material is borrowed or directly quoted or cosmetically paraphrased with no attribution at all, or attribution insufficient to indicate that the borrowed material is not the work of the student.
    - For written papers and project reports, a student found guilty of Level Two Plagiarism shall, at a minimum, receive a grade of zero. Depending on the severity of the offense, such a student could also receive a grade of zero for the course or could be expelled from the University, with or without the possibility of re-entry.
    - Theses in which Level Two Plagiarism has been substantiated shall be treated as "inadequate" (see Regulations for Graduate Diplomas and Degrees, Section 3, Reg. 26), which permits resubmission of the revised thesis for examination within eighteen months of the date of notification; or, if the offense is particularly severe shall result in expulsion.

For full details consult the University Regulation on Plagiarism (Graduate Diplomas and Degrees) and Policy on Graduate Student Plagiarism document available on the Office of Graduate Studies & Research website at: http://www.mona.uwi.edu/postgrad/

TURNITIN

www.turnitin.com

Graduate Students submitting theses, research papers or project reports for examination, must submit an electronic copy of the Turnitin report showing the similarity index.

The University has created an account to allow you to check your papers for plagiarism.

Instructions for **creating a new student account:**

1: Please visit Turnitin's website at **www.turnitin.com** then click on create account.

2: Under ***New Students Start Here*** click on Create a User Profile.

3: Below ***Have you Ever Used Turnitin?*** Scroll down until you see ***Create A New Account*** click on ***Student***

(Please note the credentials will not work in any other instance).

4: Under ***Create A New Student Account***, please insert the credentials (i.e. Class ID and enrolment password), complete the rest of the form and follow the instructions.

In order to obtain the credentials necessary to create your new student account, please visit the Office of Graduate Studies and Research.

For more information on Turnitin, please visit http://www.turnitin.com/en_us/training/getting-started or www.turnitin.com/help and submit an e-mail

Related link

Analyzing Turnitin Originality Reports
https://www.mona.uwi.edu/library/sites/default/files/library/uploads/analyzing_turnitin_originality_reports_UWI_milu_2012.pdf

THESIS SUBMISSION GUIDELINES

www.mona.uwi.edu/postgrad/GRIP

The Graduate Studies Thesis Tracker, GSTT is an online application portal used by graduate research students to apply for examination of thesis and to monitor the progress of their thesis examination. The student initiates the process by completing and submitting the Application for Examination Form online. To access GSTT, log into the Student Administration System (SAS) using your Student ID# and Password). Select *Student Services* from the menu, then click the *Graduate Studies Thesis Tracker* option; select *Submit Application* and complete all fields.

ACTIVITY	RESEARCH MASTERS & DOCTORAL DEGREES Master of Philosophy/Doctor of Philosophy
3 MONTHS BEFORE SUBMISSION **Apply for Examination of Thesis**	▪ Completed Research Paper/Project Form (see GRIP) ▪ Receipt showing payment of applicable examination fee from the Bursary
Submit Thesis Title and Recommended Examiners	▪ Department submits Recommendation for Titles and Examiners of Theses and Research Papers to OGSR
Check you have registered for the semester	▪ Registration up-to-date ▪ Register for each semester until the award of the degree
Check you have the required credits and seminars	▪ PhD requirements: 9 credits and 3 seminars ▪ MPhil requirements: 6 credits and 2 seminars
Check research paper through plagiarism detection software	▪ Visit www.turnitin.com to sign up and submit thesis ▪ UWI GRIP (Graduate Studies Research and Information Portal) offers a useful resource.
Consult a Librarian	▪ Consult with the librarian in the Mona Information Literacy Unit to ensure format and references meet requirements
ON THE DAY OF SUBMISSION	Submit: ▪ Signed Certificate of Completion Form ▪ Turnitin receipt ▪ Required bound hard copies of research paper plus one (1) electronic copy of research paper (MS Word Document) ▪ Proof of payment of Examination Fee (where not previously submitted)

ACADEMIC CALENDAR 2021/2022

Semester I Dates 2021/2022

- Semester I begins August 29, 2021
- Teaching begins September 6, 2021
- Teaching ends November 26, 2021
- Review Week November 28 – December 4, 2021
- Examinations December 06 – December 22, 2021
- Semester I ends December 22, 2021

Semester II Dates 2021/2022

- Semester II begins January 16, 2022
- Teaching begins January 17, 2022
- Teaching ends April 8, 2022
- Review Week April 10 – April 15, 2022
- Examinations April 19 – May 13, 2022
- Semester II ends May 13, 2022

Seminars/Colloquia are held weekly.
Stay connected and get details of these and other upcoming events via our website and social media sites.

www.mona.uwi.edu/fst
Instagram
Facebook
Youtube

The Biotechnology Centre

www.mona.uwi.edu/biotech

1

Taught Master's Degree

MSc. in Biotechnology

Research Degrees

MPhil in Biotechnology
PhD in Biotechnology

Director: Prof. Helen Asemota
Graduate Coordinator: Dr. Sylvia Mitchell
Contact: 2 St. John's Close
The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: biotechcentre@uwimona.edu.jm
Tel: (876) 977-1828 / (876) 977-6661
Ext: 2519 / 2520 / 2521

MASTER OF SCIENCE IN BIOTECHNOLOGY

PROGRAMME OVERVIEW

The MSc in Biotechnology is intended to meet the needs of a broad range of professionals whose basic learning and knowledge are in medical, agricultural and life sciences. The potential users of the MSc Biotechnology would be natural and applied scientists, teachers, agriculturists, medical, paramedical and technical professionals.

The programme is designed to provide the necessary skill sets, knowledge and hands-on experience in contemporary biotechnology which would ultimately contribute to the higher learning, capacity building and career advancement.

Programme Objectives

- Demonstrate a comprehensive understanding of the theories 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;
- Develop practical industrial applications within existing industries or new venture (entrepreneurship) activities;
- Exercise individual judgment and initiative in biotechnological principles and applications;
- Analyse the social & environmental impacts 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 (PG) programme.

Entry Requirements

- First degree from a recognized University in biology/ biochemistry/agriculture or other natural sciences, medicine and veterinary science,
- Candidates applying for the programme should have completed and secured a minimum “B” grade in at least three (3) of the following undergraduate courses or their equivalents,
    - Genetics * Microbiology

- Molecular biology * Microbial Biotechnology
- Plant Biotechnology
- Agriculture, or Botany/Geography

- Persons without adequate coverage of these areas may be required to pursue and pass appropriate qualifying courses (as mentioned above) before admission into the MSc or diploma programme;
- Students enrolled in the 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.
- The MSc research project can be either 9 or 12 credits, the latter being a more extensive detailed research project. For students choosing the 9-credit project, the difference in 3 credits must be made up with an elective. Although students may opt to do either research project, only those that complete the 12-credit research project will be eligible for consideration for entry into the PhD program.

Duration of Programme

- Full-time study: 1.5 years (18 hrs/wk)
- Part-time study: 2.5 years (9 hrs/wk)

Areas of Research

1. Plant Biotechnology
2. Molecular Genetics
3. Plant Molecular Biology
4. Plant Tissue Culture
5. Molecular Plant Virology
6. Bioengineering of tuber crops
7. Management of Diabetes through the use of Glycemic Indices of Indigenous Caribbean Food

Programme Structure

The design is face-to-face lectures and laboratory sessions taught in the evenings and weekends. The entire programme is 45 credits: 8 core courses, 3 electives and a research project.

Core courses must be completed before attempts at electives and the research project. Electives are usually declared after the first year for the part-time and after the second semester for full-time students.

A Diploma will be awarded if the research project is not completed.

Credit Requirements

MASTER OF SCIENCE	
8 core courses	24
Any 3 optional courses	9
Research Project A (can go towards PhD) or	12
Research Project B	9
Total compulsory credits	**45**
POSTGRADUATE DIPLOMA	
8 core courses	24
Any 2 optional courses	6
Total compulsory credits	**30**

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
	CORE COURSES	
BTEC6001	Molecular biology and R-DNA technology	3
BTEC6002	Microbial and Environmental Biotechnology	3
BTEC6004	Medical and Veterinary Biotechnology	3
BTEC6005	Industrial Biotechnology and Bioprocessing	3
BTEC6006	Bioinformatics	3
BTEC6008	Bioethics, Biosafety and Intellectual Property Rights (IPR) in Biotechnology	3
BTEC6007	Immunotechnology and Molecular Therapy	3
BTEC6003	Advances in Plant Genetic Engineering and Plant Biotechnology	3
TBD	Two Electives	3+3
TBD	Third Elective	3
	ELECTIVES	
BTEC6009	Molecular Diagnostics	3
BTEC6010	Molecular Plant Breeding	3
BTEC6011	Genomics and Proteomics Technologies	3
BTEC6012	Nutraceutical Biotechnology	3

COURSE CODE	COURSE TITLE	CREDITS
BTEC6013	Applied Bioinformatics	3
BTEC6014	Directed Reading and Seminar	3
BTEC****	Entrepreneurship in Biotechnology	3
	RESEARCH PROJECT	
BTEC6018	Research Project A	9
BTEC6019	Research Project B (1 semester research work + Presentation and Report)	12

COURSE DESCRIPTIONS

BTEC6001 MOLECULAR BIOLOGY AND R-DNA TECHNOLOGY
(Core course) (3 credits) (Semester 1)

Eligibility
Enrolled in MSc Biotechnology course/Graduate Diploma in Biotechnology or permission from Head of Department

Prerequisites
Molecular Biology or Principles of Molecular Biology or equivalent

Course Description
This course is a techniques-based course that seeks to provide students with the knowledge which serves as a basis for experimental, applied and industrial biotechnology.

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

- explain the recombinant DNA techniques using prokaryotic and eukaryotic organisms and the manipulation of DNA.
- apply techniques to generate clones, examine gene regulation, and express proteins.
- analyze the choice of techniques for experiments in Biotechnology.
- explain, illustrate and interpret the principle, mechanism and steps of various biotechnological techniques and methods.
- review specific field and laboratory approaches, instrumentation and methodologies used in research in selected problems in biotechnology.

Course Content

1. Gene Regulation
2. Recombinant DNA Technology
3. Gene synthesis, Sequencing and Amplification of DNA
4. Manipulation of Gene Expression in Prokaryotes
5. Heterologous Protein Production in Eukaryotic cells
6. Directed Mutagenesis and Protein Engineering
7. Molecular Diagnostics
8. Therapeutic Agents
9. Large-Scale Production of Proteins from Recombinant Microorganisms
10. Transgenic Animals
11. Regulating use of Biotechnology

Assessment

- **Coursework** **50 %**
  - Lab report 10%
  - Term paper & journal paper discussion 20%
  - Two mid-sessional tests 20%
- **Final Exam** **50 %**
  - 3-hour written exam

BTEC6002 MICROBIAL AND ENVIRONMENTAL BIOTECHNOLOGY

(Core Course) (3 Credits) (Semester 1)

Eligibility

Enrolled in the MSc Biotechnology course/Graduate Diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisites

Molecular Biology/Principles of Molecular Biology or equivalent

Course Description

This course examines current applications of microbial organisms for industrial and environmental applications and also illustrates specific applications of biotechnology to solve environmental 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.

Learning Outcomes

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.

Course Content

Introduction to microbial growth kinetics; generating products from genetically modified microorganisms; using applications of biotechnology to address important environmental issues such as environmental quality evaluation, monitoring, remediation of contaminated environments; energy production, production of biofuels (biogas, bioethanol, biohydrogen); applications in the paper and plastic industry; uses in other industrial processes to minimize environmental deterioration.

Assessment

- **Coursework** **50 %**
  - Lab report 10%
  - Term paper & journal paper discussion 20%
  - Two mid-sessional tests 20%
- **Final Exam** **50 %**
  - 3-hour written exam

BTEC6003 ADVANCES IN PLANT GENETIC ENGINEERING AND PLANT BIOTECHNOLOGY

(Core Course) (3 Credits) (Semester 2)

Eligibility

Enrolled in the MSc Biotechnology course/Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisites

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.

Learning Outcomes

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.

Course Content

Topics include: 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.

Assessment

- **Coursework** **50 %**
  - Lab report 10%
  - Term paper & journal paper discussion 20%
  - Two mid-sessional tests 20%
- **Final Exam** **50 %**
  - 3-hour written exam

BTEC6004 MEDICAL AND VETERINARY BIOTECHNOLOGY

(Core Course) (3 Credits) (Semester 1)

Eligibility

Enrolled on the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

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.

Learning Outcomes

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.

Course Content

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.

Assessment

- **Coursework** **50 %**
  - Lab report 10%
  - Term paper & journal paper discussion 20%
  - Two mid-sessional tests 20%
- **Final Exam** **50 %**
  - 3-hour written exam

BTEC6005 INDUSTRIAL BIOTECHNOLOGY AND BIOPROCESSING

(Core Course) (3 Credits) (Semester 1)

Eligibility

Enrolled on the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

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.

Learning Outcomes

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.

Course Content

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

- **Coursework** **50 %**
  - Lab report 5%
  - Term paper & journal paper discussion 25%
  - Two mid-sessional tests 20%
- **Final Exam** **50 %**
  - 3-hour written exam

BTEC6006 BIOINFORMATICS

(Core course) (3 Credits) (Semester 1)

Eligibility

Enrolled in the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisite

Molecular Biology/Principles of Molecular Biology or equivalent

Course Description

Bioinformatics reveals the science of analyzing and deducing the structure and function of genes and proteins through computational methods and software and statistical tools.

Learning Outcomes

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.

Course Content

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.

Assessment

Coursework		**60 %**
• Course work assignment	10%	
• Lab report and project	20%	
• Journal paper discussion	10%	
• Two mid-sessional tests	20%	
Final Exam		**40 %**
• Final written exam (3-hour duration)		

BTEC6007 IMMUNOTECHNOLOGY AND MOLECULAR THERAPY

(Core Course) (3 Credits) (Semester 2)

Eligibility

Enrolled on the MSc Biotechnology course/ Graduate Diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisite

Molecular Biology/Principles of Molecular Biology or equivalent

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.

Learning Outcomes

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.

Course Content

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 inflammatory disorders and contemporary targeted molecular therapies for such disease with examples; Medical Nanobiotechnology, Nanotherapeutics: Cancer treatment, Wound care products, Implantable materials and devices, Nanosurgery.

Assessment

Coursework		**60 %**
• Course work assignment	10%	
• Term paper	10%	
• Lab report	5%	
• Journal paper discussion	15%	
• Two mid-sessional tests	20%	
Final Exam		**40 %**
• Final written exam (3-hour duration)		

BTEC6008 BIOETHICS, BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (IPR) IN BIOTECHNOLOGY
(Core Course) (3 Credits) (Semester 2)

Eligibility
Enrolled in the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

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.

Learning Outcomes
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.

Course Content
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.

Assessment

- **Coursework** **60 %**
  - Course work assignment 10%
  - Term paper 15%
  - Journal article discussion 15%
  - Two mid-sessional tests 20%
- **Final Exam** **40 %**
  - Final written exam (3-hour duration)

BTEC6009 MOLECULAR DIAGNOSTICS
(Elective) (3Credits) (Semester 2)

Eligibility
Enrolled in the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisites
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.

Learning Outcomes
Upon successful completion of this course, students should 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.
- explain the diagnostic tools available for plant disease diagnosis and pathogen detection.

Course Content

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.

Assessment

- **Coursework** **60 %**
  - Course work assignment 10%
  - Lab report 10%
  - Term paper and Journal article discussion 20%
  - Two mid-sessional tests 20%
- **Final Exam** **40 %**
  - Final written exam (3-hour duration)

BTEC6010 MOLECULAR PLANT BREEDING

(Elective) (3 Credits) (Semester 2)

Eligibility

Enrolled in the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisites

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.

Learning Outcomes

Upon successful completion of this course, students should 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.

Course Content

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.

Assessment

- **Coursework** **60 %**
  - Course work assignment 10%
  - Term paper 15%
  - Journal article discussion 15%
  - Two mid-sessional tests 20%
- **Final Exam** **40 %**
  - Final written exam (3-hour duration)

BTEC6011 GENOMICS AND PROTEOMICS TECHNOLOGIES

(Elective) (3 Credits) (Semester 2)

Eligibility

Enrolled in the MSc Biotechnology course/Post Graduate diploma in Biotechnology or permission from Coordinator and Head of Department

Prerequisite

Molecular biology and R-DNA technology or equivalent

Course Description

Genomics and proteomics are central to modern biotechnology and are key to a range of research areas in the bio-sciences including medical, plant, microbial and environmental biotechnology. Genomics is the study of the functions and interactions of the genes in a genome whereas proteomics is defined as the study of all the proteins expressed by the genome. Both genomics and proteomics incorporate areas of biotechnology, bioinformatics and biology, and utilize a multitude of methods and techniques to study gene and protein expression profiles of cells and whole biological systems.

Learning Outcomes

Upon successful completion of this course, students should 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.

Course Content

The covered topics include: Structural genomics; Classical ways of genome analysis; Physical mapping of genomes; Genome sequencing, SNP analysis and association mapping; Sequence assembly and annotation; Comparative genomics; Functional genomics: DNA chips, transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways; Epigenomics and beyond the Mendalian genetics; Proteomics - Protein structure and folding; function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis; Applications of genomics and proteomics in agriculture; Human genome sequencing and implication in health industry; Proteomics research in drug design and delivery and Pharmacogenomics.

Assessment

- **Coursework** **60 %**
  - Course work assignment 10%
  - Term paper 15%
  - Journal article discussion 15%
  - Two mid-sessional tests 20%
- **Final Exam** **40 %**
  - Final written exam (3-hour duration)

MPHIL/PHD BIOTECHNOLOGY

PROGRAMME OBJECTIVES

1. To provide a strong understanding of the foundation, principles, and application of the substantive areas of biotechnology, with emphasis on plant biotechnology and plant molecular biology.
2. To train students with modern scientific equipment, tools, techniques and methodologies used in genetic engineering and biotechnology research and development.
3. To encourage the development of problem-solving skills in the students area of specialization in biotechnology.

Entry Requirements

- A Bachelor's degree from the University of the West Indies, or other recognized universities, with at least an upper second class honours.
- Students must demonstrate aptitude in independent research and have passed the core undergraduate biotechnology and biochemistry courses, including molecular biology courses at the UWI.

Areas of Research

1. Plant Biotechnology
2. Molecular Genetics
3. Plant Molecular Biology
4. Plant Tissue Culture
5. Molecular Plant Virology
6. Bioengineering of tuber crops
7. Management of Diabetes through the use of Glycemic Indices of Indigenous Caribbean Food

Duration of Programme

MPhil Degrees: 5 years part-time / 3 years full-time
PhD Degrees: 7 years part-time / 5 years full-time

Seminars

Each candidate is required to give 1-2 seminars per academic year.

Centre for Environmental Management

2

www.uwi.edu/cem

Taught Master's Degrees & Diplomas

MSc. and Diploma in Natural Resource Management

Specializations:

Integrated Urban and Rural Environmental Management (IUREM)

Disaster Risk Management (DRM)

Marine and Terrestrial Ecosystems (MaTE)
(offered in conjunction with the Department of Life Sciences)

Director: Dr David Smith
Programme Coordinator: Dr Vivienne Vassall
Contact: 13 Gibraltar Camp Way
The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: environmental.management@uwimona.edu.jm
Tel/Fax: (876) 702-4152
Ext: 2519 / 2520 / 2521

MASTER OF SCIENCE: NATURAL RESOURCE MANAGEMENT

PROGRAMME OVERVIEW

There are three M.Sc. Degree and Diploma streams in the NRM:

- Integrated Urban and Rural Environmental Management (IUREM)
- Disaster Risk Management (DRM) and
- Marine and Terrestrial Ecosystems (MaTE).

The M.Sc. degree consists of a common core of six courses, plus specific specialization courses for each stream, and a major Research Project.

Programme Objectives

The M.Sc. NRM-IUREM commenced in September 1998. It is coordinated by the Centre for Environmental Management and was initially supported by funds from the European Union. The primary objective of the programme is to contribute to an integrated approach in the Caribbean region by training professionals in environmental and natural resource management.

The M.Sc. NRM-DRM commenced in September 2009. The focus of this programme is on the training of disaster management personnel from different disciplines, and the development of policy to address regional disaster management.

The M.Sc. NRM-MaTE is the result of a 2008 merger of the Aquatic Sciences and Tropical Ecosystem Assessment and Management M.Sc. programmes, and is coordinated in conjunction with the Department of Life Sciences. The programme investigates selected aspects of the biodiversity associated with Jamaican aquatic and terrestrial environments, with a greater emphasis on their management, conservation and sustainable use.

Entry Requirements

- For the M.Sc. IUREM and DRM
  BSc. Honours degree in earth sciences, geography, geology, environmental science, social sciences or a relevant or analogous area from a recognized university.
- For the M. Sc. MaTE
  BSc. Honours degree in biological sciences from a recognized university.

Duration of Programme

- Two years and two summer periods. This excludes time taken for examination of the project.
- Candidates will be required to register **Research Project "incomplete"** (Exams Only) in September (Semester 1) following submission of the project in August (Summer Semester); and in January (Semester 2) after submitting the project in November (Semester 1).

PROGRAMME STRUCTURE

The programme is delivered using a variety of mechanisms including face-to-face lectures, seminars, tutorials, field trips and a research project. It also includes project and scenario-based workshops, case studies and assignments in which group work and student-centred learning approaches will be used. Students will be encouraged to take responsibility and control of their own learning. This will culminate in the final research project in which students will be responsible for the conduction and reporting of a project with the assistance of a supervisor who is an expert in the chosen area.

The programme is taught full-time with the delivery of lectures/tutorials and seminars (two evenings per week) from 5:30 to 8:30p.m. Laboratory sessions and Field trips occur on a Friday or Saturday.

Credit Requirements

MASTER OF SCIENCE	
6 core courses	18
Specialization courses	18
Research Project A or Research Project B	12 or 9
Total compulsory credits	**45**
POSTGRADUATE DIPLOMA	
Any 3 core courses	9
Specialization courses	15
Total compulsory credits	**24**

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
	NRM CORE COURSES	
	YEAR I, SEMESTER I	
ENVR6401	Environmental Law and Multilateral Environmental Agreements	3
ENVR6402	Research Methods and Project Management	3
ENVR6406	Socio-ecology and Natural Resource Management	3
	YEAR I, SEMESTER 2	
ENVR6403	Environmental Impact Assessment	3
ENVR6404	Principles and Practice of Geoinformatics	3
ENVR6405	Management and Analysis of Environmental Data	3
ENVR6407	Environmental Economics*	3
* Applies only to students in IUREM stream and students in MaTE who elect to do the ENVR 6500 Research project. ENVR6407 is done in the Summer Term of Year 1.		
	DRM SPECIALISATION	
ENVR6410	Environmental Hazards and their Impacts	3
ENVR7100	Principles of Disaster Risk Management	3
ENVR7130	Hazard Vulnerability and Risk Analysis	3
ENVR7140	Techniques and Tools in Disaster Risk Management	3
ENVR7170	Disaster Information and Communication	3
ENVR6500	Research Project	9
	IUREM SPECIALISATION	
ENVR6400	Waste Management Systems	3
ENVR6410	Environmental Hazards and their Impacts	3
ENVR6420	Health and the Environment	3
ENVR6430	National Parks, Tourism and Recreational Amenities	3
ENVR6440	Land and Water	3
ENVR6500	Research Project	9
	MaTE SPECIALISATION	
BIOL6421	Coastal Habitat Restoration and Rehabilitation (done in the summer term of Year 1 at the Discovery Bay Marine Lab)	3
BIOL6412	Conservation & Management of Biodiversity	3
BIOL6413	Sustainable Use and Management of Natural Resources	3
BIOL6414	Integrated Coastal Zone Management	3
BIOL6415/ ENVR6430	National Parks, Tourism and Recreational Amenities	3
ENVR6500	Environmental Project **OR**	9
BIOL6550	Environmental Research project	12**

** Access to BIOL6550 is contingent on student performance in Year 1 courses (No failures and B+ or better in all courses).

The NRM Diploma

A Postgraduate Diploma in Integrated Urban and Rural Environmental Management, Disaster Risk Management or in Marine and Terrestrial Ecosystems will be awarded to persons completing 15 credits of the specialization courses for the IUREM, DRM or MaTE streams, and any three of the core courses (9 credits) from the programme, a total of **24 credits**.

COURSE DESCRIPTIONS

BIOL6412 CONSERVATION & MANAGEMENT OF BIODIVERSITY

(3 Credits) (Semester 2)

Course Description

This course will provide an advanced and detailed review of the theoretical basis for conservation practice and review issues relevant to tropical biodiversity conservation. It is structured to provide the critical biological underpinning for other courses in the MSc programme.

Learning Outcomes

The student who successfully completes this course will be able to:

- Describe and demonstrate an understanding of the underlying population biology and key genetic and molecular biology issues of importance to conservation science;
- Explain the energetic, nutrients and ecosystem level patterns and processes found in Neotropical ecosystems;
- Describe and discuss the methods used to select, design and manage protected natural areas, and the discuss their importance as tools for biodiversity conservation;
- Discuss the role of human communities in protected areas management and sustainable natural resource use;
- Demonstrate an understanding of the approaches used in coastal, marine and freshwater protected areas management
- Demonstrate an understanding of the tools and techniques used in ex situ conservation and ecological restoration

Course Content

- review of the key elements of ecology and biology relevant to conservation of biological diversity; from molecular to ecosystem (including demography and population dynamics); landscape ecology; measurement of biological diversity; ecosystem patterns and processes.

- brief introduction to the historical and socio-economic factors leading to current biodiversity crisis; outline approaches currently taken by conservation biologists to address threats; international treaties including the Convention on Biological Diversity.
- Molecular genetics: concepts of molecular genetics, intra-specific variation, inter and intra-specific genetic diversity, processes of evolution, allopatric and sympatric speciation; overviews of modern molecular methods for detecting genetic species/heterozygosity; importance of intra-specific heterozygosity in relation to evolution and adaptation, with specific reference to the Caribbean.
- species diversity; explore the cline in diversity between the tropics and the poles; define endemicity and keystone species; identification of unique elements of Caribbean biodiversity; processes that maintain diversity of regional ecosystems.
- tropical ecosystems including forest, savannah, riverine, lake, wetland, mangrove and coastal systems of the region; holistical consideration of each system in relation to their diversity, ecology, ecosystem function, goods and services.

Assessment

- **Coursework** **50 %**
    - Project and presentation 25%
    - Essay 25%
- **Final Exam** **50 %**
    - One 2-hour written examination

BIOL6413 SUSTAINABLE USE AND MANAGEMENT OF NATURAL RESOURCES
(3 Credits) (Semester 1)

Course Description
The aim of this course is to familiarize students with contemporary issues regarding sustainable use of tropical resources and sustainable development. The main-streaming of biodiversity within development is a priority for the Conference of the Parties of the Convention on Biological Diversity (CBD) and this course will explore some of the key issues and problems associated with this process. It will introduce students to renewable ecosystem-based industries and the environmental issues

historically associated with their operation and consider what is required of these sectors as they move toward sustainability.

Learning Outcomes

The student who successfully completes this course will be able to:

- Explain the underlying concepts for sustainable use of natural resources;
- Describe the properties of Neotropical soils and how these properties affect sustainable land-use, water conservation and land capability;
- Explain the characteristics of Neotropical agro-ecological and agro-forestry systems and discuss the properties of sustainable models for such systems;
- Demonstrate an appreciation of the techniques and principles associated with sustainable timber, NTFP, wildlife, and capture fisheries management and the role of these management strategies in carbon sequestration (soil based & REDD+);
- Describe the current status of development and exploitation of biodiversity-based sources of renewable energy in the wider Caribbean, including biofuels;
- Discuss the role of aquaculture in sustainability of marine and freshwater fisheries;
- Explain the role of ecotourism and other non-consumptive uses of biodiversity in achieving sustainable use of natural resources.

Course Content

This course will address important tropical ecosystem-based industries including forestry, agriculture, fisheries, energy, the pharmaceutical industry and tourism. Topics covered will include an analysis and determination of land capability and optimal land use; social aspects of land use and land degradation; participatory approaches in sustainable development; integration of soil and water conservation into farming systems; integrating water needs in agriculture with industrial and potable supply requirements.

Agro-ecological systems: sustainable mono-cropping, multiple cropping and agro-forestry systems for tropical environments; sustainable forestry and timber production; development and exploitation of alternative energy sources including solar energy, hydroelectric, wind power, turbines and farms, wave power, deep water wave devices in response to anticipated climate change issues.

Finally, current issues of fishery management in achieving sustainability in tropical capture fisheries; management of freshwater environments for fisheries production; integration of aquaculture production systems into agricultural and water conservation practices.

Assessment

- **Coursework** **50 %**
  - Project and presentation 25%
  - Essay 25%
- **Final Exam** **50 %**
  - One 2-hour written examination

BIOL6414 INTEGRATED COASTAL ZONE MANAGEMENT
(3 Credits) (Semester 1)

Course Description

- To promote best practices in the field of integrated coastal management in order to address environmental issues and conflicts associated with exploitation of coastal resources.
- To facilitate the application of social analysis, economic evaluation, EIA, GIS and alternative dispute resolution techniques to resolve coastal issues.
- To analyze the composition of stakeholders involved in any issue and evaluate the coastal resources management in the region towards the formulation of a regional strategy for ICM.

Learning Outcomes

On successful completion of the course, students will be able to:

- Articulate basic concepts in ICM
- Discuss international agreements and global issues related to ICM
- Describe institutional arrangements in ICM
- Describe the Caribbean coastal environment and the tools and processes applied in ICM
- Articulate the major coastal problems in the Caribbean
- Describe regional management regime and policies in operation in the Caribbean.

Course Content

- Integrated coastal management concepts and practices
- Instructional arrangements in integrated coastal management
- Economic valuation

- Environmental Impact Assessment and Strategic Environmental Assessments
- Social Analysis
- The Caribbean Coastal Environment
- Major coastal problems in the Caribbean
- Integrated Coastal Management in the Caribbean Region
- Integrated Coastal Management Studies in the Caribbean
- Practical exercises will be conducted on the above-mentioned topics

Assessment

▪ **Coursework**		**50 %**
• Project and presentation	25%	
• Essay	25%	
▪ **Final Exam**		**50 %**
• One 2-hour written examination		

BIOL6421 COASTAL HABITAT RESTORATION AND REHABILITATION
(3 Credits) (Semester 1 or 3 (Summer))

Course Description
This course will expose students to the causes of coastal habitat degradation and loss, the loss in associated ecosystem services and therefore the need for effective options and approaches to generate real habitat rehabilitation or restoration. It will assist students to conduct field and desk-top assessments to diagnose these impacts and design effective interventions. Environmental professionals and practitioners who seek to design effective rehabilitation plans for coastal habitats to mitigate loss will learn what works through actual hands-on rehabilitation exercises. Furthermore, there has been ongoing research and continued development of alternative restoration techniques, applicable to small island developing states like Jamaica.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Differentiate between coastal habitat rehabilitation and restoration
2. Identify and evaluate ecosystem services and associated value of the individual and interacting habitats.
3. Understand the desirability of conservation as an alternative to restoration.
4. For corals/coral reefs:
   a. Identify and diagnose reasons for habitat loss in coral reef ecosystems
   b. Triage potential donor and recipient sites, assessing suitability for either purpose

   c. Establish the objective of the restoration activity (structural integrity vs topographic complexity vs. species diversity and abundance levels)
   d. Evaluate and propose appropriate restoration/replantation techniques (incl. coral gardening and u/w or *ex-situ* nurseries, transplanting techniques) for local (Jamaican/Caribbean) applications
   e. Design appropriate restoration/rehabilitation techniques and monitor to establish success / failure of the activity
5. For mangroves:
   a. Demonstrate an understanding of the various biological and physical parameters that affect mangrove forest loss and decline.
   b. Apply the different tools, equipment and techniques used to collect associated biological and physical data to diagnose coastal forest changes, anomalies, loss and degradation.
   c. Analyse ecological mangrove restoration and adaptive management approaches by reviewing global and regional case studies of mangrove restorations or restoration attempts.
   d. Apply various techniques used to manipulate the physical factors that need to be considered to achieve ecological mangrove restoration.
   e. Apply appropriate monitoring protocols to evaluate the r success/failure of mangrove restoration sites
6. For seagrasses:
   a. Analyse the various methods employed globally in seagrass restoration and their suitability for local (Jamaican/Caribbean) application.
   b. Design and prescribe rehabilitation methods/interventions based on different factors causing loss
   c. Evaluate the factors which will affect success or failure at potential restoration sites
   d. Determine appropriate techniques to establish success/failure of the activity
   e. Apply appropriate monitoring protocols to evaluate the success/failure of seagrass restoration sites

Course Content

This course will cover the following:

1. Principles and best practices of degraded habitat assessment (reefs, mangroves, seagrasses)
2. Principles of environmental conservation, mitigation, retribution and restoration (including case studies)
3. The causes of habitat degradation and loss (reefs, mangroves, seagrasses)
4. Collecting/measuring and analysing relevant data related to ecosystem health or degradation-including types of tools and equipment used, and their operation.
5. Ecosystem restoration/rehabilitation techniques (natural and artificial reefs, mangroves, seagrasses, e.g. Modifying landscapes, compaction, nursery seedlings vs. wildings, monitoring plots

6. Assessing the success of habitat restoration (reefs, mangroves, seagrasses) efforts (lessons learned)
7. Aesthetic considerations
8. Economic consideration (ecosystem services and their value vs. cost of rehabilitation)
9. Ethical dilemmas in ecological restoration

Assessment

- **Coursework** **50 %**
  - Oral Presentation (x2) 20%
  - Field Report (x2) 20%
  - Management Protocol for 1 habitat (x1) 10%
- **Final Examination** **50 %**
  - One 2-hour written paper

BIOL6550 ENVIRONMENTAL RESEARCH PROJECT

(12 Credits) (Semesters 3&4: 20 weeks commencing in the Summer)

Anti-requisite: May not be taken with ENVR6500

Course Description

Students will prepare potential topics for their Research project during the first semester of the M.Sc., based on initial ideas for their research project. Potential projects may be suggested for those students who do not have a specific topic in mind. During the first two semesters, the student will further develop the research project idea and clear aims and objectives. This will enable supervisors to be identified for respective projects and to guide the progress of the research thereafter.

The research project may cover any feasible aspect of environmental management (IUREM) and management of tropical biodiversity (MaTE). It may involve a pure research study toward a fundamental aspect of Waste Management, for example, or of tropical biodiversity or address more applied issues. It may involve field or laboratory-based work or may be a desk study involving data analysis or interrogation of legal documents. It may underpin studies being undertaken by staff within UWI or it may address an issue related to a student's employer.

The project should, however, give the student a chance to further develop skills from the toolbox and a more detailed understanding of some component of the course.

Learning Outcomes

The student who successfully completes the Research Project will:

- Demonstrate an advanced knowledge and understanding of a practical or technical aspect of environmental monitoring or management of tropical biodiversity
- Demonstrate knowledge and understanding of the underlying philosophies to project preparation and reporting
- Demonstrate an ability to analyse scientific information and literature critically
- Summarise and present on a topic relevant to an aspect of tropical biodiversity
- Demonstrate the possession of skills in self-management
- Demonstrate the possession of skills in numerical techniques
- Demonstrate the possession of oral presentation skills
- Summarise and present on a topic relevant to an aspect environmental management (IUREM) or tropical biodiversity (MaTE)
- Demonstrate the possession of skills in self-management Demonstrate the possession of skills in numerical techniques
- Demonstrate the possession of oral presentation skills

Assessment

- Oral Presentation of Research Project **30** %
- Research Paper (15,000 word maximum) **70** %

ENVR6401 ENVIRONMENTAL LAW AND INTERNATIONAL ENVIRONMENTAL AGREEMENTS

(3 Credits) (Semester 1)

Course Description

This course will provide students with a working knowledge of the philosophical bases and key principles of environmental management, general foundations/sources of environmental law, and an introduction to the history, structure and function of current international environmental agreements (IEAs) specifically related to biodiversity conservation. It will describe specific sector regimes, enforcement of environmental laws and international and regional environmental law. The course will provide students with a clear understanding of the current regional legislative models for biodiversity conservation, and critical international agreements on biodiversity protection.

Learning Outcomes

The student who successfully completes this course will be able to:

- Describe the basic components of environmental law
- Describe the application and enforcement of environmental law
- Explain the existing regional legal frameworks for environmental protection
- Describe the current suite of IEAs and discuss relevant issues related to their regional implementation
- Summarise and present on a topic relevant to environmental law and IEAs
- Demonstrate the possession of interpersonal and teamwork skills
- Demonstrate the possession of skills in self-management

Course Content

- Background to existing environmental laws;
- Framework for regulation of the environment in the Caribbean region.
- Ways in which human behaviour with respect to the environment is regulated at the international level, using key biodiversity-related IEAs;
- Existing legal environmental regimes of selected Caribbean countries;
- factors that surround and influence the negotiation and implementation of international environmental law;
- Key IEAs: including Convention on Biological Diversity, the Biosafety Protocol, the UN Convention on Climate Change, Cartagena Convention, RAMSAR, CITES and Principle on Forests;
- Key regional environmental agreements, including the Cartagena Convention, SPAW Protocol;
- 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** **50 %**
  - Project and presentation 35%
  - Essay 15%
- **Final Exam** **50 %**
  - 3-hour written exam

ENVR6402 RESEARCH METHODS AND PROJECT MANAGEMENT

(3 Credits) (Semester 1)

Course Description

The goal of this course is to provide students with a strong foundation in the conduct of research and the principles and elements of research design. They will be introduced to the conceptual and practical aspects of research proposal writing, including the essentials for writing a good research proposal and the pitfalls in proposal writing. Students will be exposed to principles governing research ethics and will also be familiarized with issues relating to plagiarism in research and methods for referencing in research. The Project Management module is designed to expose students to essential knowledge in current methodologies and skills to guide a project to its successful completion.

The course modules will provide the student with a solid foundation for conducting research and managing projects, which can be utilized both for the specific Master's project and as a basis for more long-term projects. The course will also assist in enhancing students' skills in oral and written technical, scientific and other presentations.

Learning Outcomes

On successful completion of the course, the student will be able to:

- Understand the purposes served by research
- Understand the fundamentals of selecting research topics and defining and articulating research problems, aims and objectives
- Formulate research questions and hypotheses
- Conceptualize the framework for the research
- Understand the elements of a well written research proposal
- Have an awareness of issues relating to plagiarism
- Integrate and present information in a coherent and logical form with correctly cited references
- Understand the principles of project management and the steps in guiding a project from beginning to completion.

Course Content

Module 1: Research Foundations, Part 1

- The purpose of Research
- Essentials of choosing a good Research topic
- Defining the Research Problem
- Research Ethics

Module 2: Research Foundations, Part 2

- Developing a Conceptual Framework
- Research Aims and Objectives
- Research Questions and/or Hypotheses

Module 3: Research Foundations, Part 3

- fundamentals of thesis/research paper writing
- technical report writing
- presentation and writing styles
- pitfalls in thesis/research paper writing

Module 4: Project Management
Designed to build the capacity among students to guide a project to its successful completion by using project management methods and skills. Projects related to resource management and development (as it relates to the environment) are the principal focus of the course. The objectives of the module are to enable students to internalize key concepts and issues in project management, develop skills in the preparation of detailed project implementation plans, project scheduling, budgeting, monitoring and control using Microsoft Project, and the procurement of goods, works and services.

Seminar on Plagiarism and Referencing: organized in collaboration with the Main Library.

Assessment

- **Coursework** **50 %**
    - Research Project-related assignments
    - Project Plan
- **Final Exam** **50 %**
    - One two-hour examination

ENVR6403 ENVIRONMENTAL IMPACT ASSESSMENT
(3 Credits) (Semester 1)

Course Description
This course provides an overview of the variety of environmental assessment tools available with the selection of the EIA for in depth treatment. It aims to help students understand what impact assessment is attempting to achieve and what constitutes a good EIA and EIS. The course will introduce participants to the fundamental principles and philosophy of EIA, including practical demonstrations

for illustrative purposes. The course will expect students to reflect deeply on the limitations and key issues of EIA as it is currently practiced, and suggest creative solutions to advance the effectiveness of EIA as an environmental management tool.

Learning Outcomes

The student who successfully completes this course will be able to:

- Understand the variety of environmental assessment tools available and their key functions
- Describe the role and intentions of EIA in environmental management for sustainable development
- Explain processes, principles and supporting legislation
- Define the objectives of EIA
- Critically assess the quality of EIA processes and EIA documents, especially TORs and EIS
- Explain the limitations of EIA in environmental management and issues that require further development to improve the contribution of EIA to sustainable development

Course Content

- General overview environmental assessment tools currently available; introduction to Environmental Impact Assessment (EIA) including definition, goals, objectives and purpose; definition of key terms, history of the EIA; legislative, policy and institutional framework for EIA.

- Description of the EIA process, with emphasis on biodiversity conservation and sustainable use; development of Terms of Reference (TOR) including screening, scoping and public participation; and assessment of project impacts, including understanding the ecosystem, assessment of significant impacts of the project and impact management.

- EIS reporting and Environmental Management Plans, review of the EIS, linked to the TOR; and follow-up monitoring, auditing, adaptive management and enforcement; public participation, EIA standards, EIA for islands, and Strategic Environmental Assessments.

Assessment

- **Coursework** **50 %**
  - Project 25%
  - Essay 25%
- **Final Exam** **50 %**
  - One two-hour examination

ENVR6404 PRINCIPLES AND PRACTICE OF GEOINFORMATICS
(3 Credits) (Semester 2)

Course Description
The aim of this course is to provide an overview of the main concepts associated with the discipline of geoinformatics. This will include an overview of the various concepts and technologies and techniques available for spatial decision making. Students will benefit significantly from this because the information provides a foundation for spatial decision-making.

Learning Outcomes
The student who successfully completes this course will be able to:

- Examine the nature of GIS and its information technology, cartographic and geographic basis
- Explain the basic principles underpinning GIS
- Critically examine the advantages and shortcomings of the major GIS approaches and their suitability for different applications
- Discuss the main issues surrounding data requirements, quality, analysis and management

Course Content

- Overview of the principles of geoinformatics including an introduction to geographic information systems, Global Positioning Systems and field survey techniques.
- Introduction to geoinformatics and key definitions
- Spatial data acquisition using GPS and field survey techniques, GIS data structures and capabilities; GIS and network analysis and spatial data analysis, and GIS functionality
- Hardware and software systems and the design and implementation of GIS.

Assessment

- **Coursework** **50 %**
  - Project 25%
  - Essay 25%
- **Final Exam** **50 %**
  - One two-hour examination

ENVR6405 MANAGEMENT AND ANALYSIS OF ENVIRONMENTAL DATA
(3 Credits) (Semester 2)

Course Description
The course aims to provide students with a fundamental understanding of the importance of storage, retrieval and analysis of environmental data. It will provide practical training in statistical analysis of environmental data and demonstrate the storage and retrieval of biodiversity information using national and international databases. The course will show how data, through appropriate management and analysis, becomes information which then informs the decision-making process. In addition, it will provide the student with fundamental skills which may underpin many elements of their future research project and career.

Learning Outcomes
The student who successfully completes this course will be able to:

- Describe the process of good experimental design in ecological studies
- Select appropriate statistical analyses to examine various datasets
- Apply appropriate parametric/non-parametric statistical analyses to data
- Analyse univariate data using software for quantitative analysis and interpret the results of such analyses
- Explain the uses and application of various multivariate statistical analyses to ecological data
- Summarise and present on an application of data analysis
- Demonstrate the possession of group and team-working skills
- Explain the differences between qualitative and quantitative research.
- Select and apply appropriate qualitative methodologies to research

Course Content

- Quantitative and qualitative approaches to data management.
- Conceptual and practical aspects of qualitative and quantitative research; differences in the two approaches.

- Quantitative and qualitative analytical methods: participant observation, participatory action research, media and textual analysis as well as software for data analysis.

Quantitative analysis component

- Statistical analysis of environmental data.
- Fundamental univariate numerical techniques, including basic parametric and non-parametric statistics.
- Application of appropriate tests to datasets using task sheets and statistical software;
- Use of multivariate statistical techniques to analyse detailed environmental datasets;
- Bayesian statistics, and biodiversity specific data analysis software.

Qualitative analysis component

- Examine the differences between qualitative and quantitative research;
- Strengths and weaknesses of the qualitative approach;
- Overview of qualitative methods: Ethnography, Grounded Theory, Projective techniques, Observation, Focus groups and Interviewing;
- Qualitative Analysis: content analysis, visual analysis and practical applications of content analysis and visual methodologies;
- Software for qualitative analysis such as NVivo.

Assessment

▪ **Coursework**		**50 %**
• Project	25%	
• Essay	25%	
▪ **Final Exam**		**50 %**
• One two-hour examination		

ENVR6406 SOCIO-ECOLOGY AND NATURAL RESOURCES MANAGEMENT
(3 Credits) (Semester 1)

Course Description

The Convention on Biological Diversity expressly recognizes the importance of rural, indigenous and traditional users of biodiversity. The primary purpose of this course is to provide students with an introduction to the cultural, socio-economic and traditional beliefs, values and attitudes that affect the way rural, tribal and other indigenous users of natural resources interface with these resources. It also introduces the students to the approaches available to natural resource managers to integrate these users in sustainable management of biodiversity. The course will serve as an introduction for those students who have had little exposure to the disciplines of economics, social psychology, demography, and social organization to the issues surrounding the use of natural resources by rural and indigenous peoples.

Course Content

- Current sociological thinking on the nature of, and relationships between, human values, beliefs, and attitudes to nature.
- Western scientific approaches to renewable resources management in the context of traditional economically driven resource production.
- Review (using case studies) of regional examples of natural resources use by rural, tribal indigenous peoples; compare and contrast the bases for these interactions with western, science-based natural resources management.
- 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.

Learning Outcomes

The student who successfully completes this course will be able to:

- Explain how beliefs, values and attitudes are currently understood to shape human behaviours towards natural resources.
- Describe the interrelationships between capitalism, science and western-style forestry, wildlife management and fisheries management;
- Explain and discuss, using named regional examples, the historical and current economic and cultural relationships between indigenous users and natural resources.
- Understand and describe the challenges faced by natural resource managers responsible for integrating rural and indigenous people in sustainable forestry, wildlife and fisheries management.
- Describe and understand the use of social impact assessment tools in management of natural resources utilized by rural, indigenous and traditional users of biodiversity.

Assessment

- **Coursework** **50 %**
  - Project 25%
  - Essay 25%
- **Final Exam** **50 %**
  - Final written exam (2-hour duration)

ENVR6407 ENVIRONMENTAL ECONOMICS
(3 Credits) (Semester 2 or 3 (Summer))

Course Description
The primary purpose of this course is to provide students with an introduction to environmental and natural resource economics. The secondary purpose is to give students insight into how economists think about the environment and how they approach environmental problems. It will provide an introduction to economic value of environmental assets and costs of environmental problems. It will provide students with the basic theory in environmental and natural resource economics and how this underpins environmental management policy and decision making.

Learning Outcomes
The student who successfully completes this course will be able to:

- Define and describe key concepts in environmental economics.
- Empirically solve problems of natural resource distribution.
- Evaluate the feasibility of policies and their theoretical expected outcomes for solving environmental problems, in a Caribbean context.
- Differentiate and defend the choice of policies to solve specific environmental problems
- Demonstrate the critical analysis of academic information and literature

Course Content
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** 50 %
  - Project 20%
  - Essay 30%
- **Final Examination** 50 %
  - One 2-hour examination

ENVR6430 NATIONAL PARKS, TOURISM AND RECREATIONAL AMENITIES (or **BIOL6415**)
(3 Credits) (Semester 2)

Course Description

This course will examine the tourism and leisure industry with particular emphasis on its impacts, the sustainable management of tourism and recreation amenities, in particular, the mitigation of negative impacts, the management of National Parks and other protected areas with particular respect to recreational use. It will also examine environmental education and communication and the interrelationship with and application to tourism and the management of national parks and recreational amenities.

Learning Outcomes

The student who successfully completes this course will be able to:

- Understand the relationship between tourism, recreation and natural resource management
- Explain core concepts in tourism and understand their relevance in the wider contexts of sustainable development
- Summarize and present on topics such as sustainable tourism, ecotourism and community-based tourism
- Compare and contrast different case studies and specific projects addressing issues relating to tourism and recreation policy development, planning and management of natural resources.

Course Content

- Concepts such as sustainable tourism, greening of tourism, nature tourism, ecotourism and community-based tourism
- Ecosystem and human health to provide a sound basis for practical work in policy development, planning and management of natural resources
- Responsible Environmental Behaviour (predictors; categories)
- Environmental Literacy
- Ecological Identity

- Antecedents of Environmental Education
- Implementation Tools for Environmental Education & Communication

Assessment

- **Coursework** **50 %**
  - Continuous assessment (oral and written presentations)
- **Final Examination** **50 %**
  - One 2-hour examination

ENVR6500 RESEARCH PROJECT

(9 Credits) (Semester 3: 12 weeks commencing in the Summer)

Course Description

To plan and carry out a research project on a topic relevant to the MSc specialization.

Learning Outcomes

Upon successful completion of this course students will be able to:

- Identify research needs within a chosen field
- Plan and carry out a research project answering identified needs.

Course Content

The research programme will be identified by a qualified supervisor.

Assessment

- Oral Presentation of Research Project **25 %**
- Research Paper (15,000 word maximum) **75 %**

Department of Chemistry

www.mona.uwi.edu/chemistry

3

Certificate

Certificate in Food and Agro-Processing Technology (FAPT)

Taught Master's Degrees & Diplomas

MSc in Food and Agro-Processing Technology (FAPT)
MSc in Occupational and Environmental Safety and Health (OESH)

Research Degrees

MPhil and PhD in Chemistry
MPhil and PhD in Occupational and Environmental Safety & Health

Head of Department: Dr Donna Minott Kates
Graduate Coordinator: Dr Paul Maragh
Contact: 2 Plymouth Crescent
The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: hodchemistry@uwimona.edu.jm
Tel: (876) 977-1910 | (876) 977-1834
Fax: (876) 977-1835
Ext:

MASTER OF SCIENCE: FOOD AND AGRO-PROCESSING TECHNOLOGY (FAPT)

PROGRAMME OVERVIEW

This course of study aims to effectively train students in the science and technology involved in the processing of food and other agricultural commodities.

On completion of the M.Sc. Food and Agro-Processing Technology programme, graduates will be able to develop a career in industry (including the development of their own commercial operations), public sector agencies or academia. Students who successfully complete this course will be skilled in the principles of ensuring the safety, quality and nutritional value of food products from the farm to the table at economical prices. This is done by incorporating active and cooperative learning experiences into the core and elective courses and the research programme.

Students will be exposed to courses in food chemistry, safety, product development, processing, packaging and problem solving. Specific commodities to be studied include cereals, animal and fish products, fats and oils, dairy, fruits, vegetables, root crops and specialty products.

The classroom learning experience will be supplemented by laboratory exercises and trips to relevant processing facilities. This combined learning effort will produce highly knowledgeable graduates, who will be competitive for employment in the public or private sectors, thus building technological capacity and strengthening human resource capabilities.

Entry Requirements

- Bachelor of Science degree in the natural sciences, Agriculture or Engineering with at least a lower second honours; professional experience is an advantage.
- Some candidates may be required to complete a practical course in the analysis of food components.

Programme Duration

- Master of Science (Full-time): 16 months
- Master of Science (Part-time): 28 months
- Postgraduate Diploma (Full-time only): 12 months

PROGRAMME STRUCTURE

Full-Time

Credit Requirements: 45 credits (minimum) to include credits from all nine (9) core courses and a research project. A minimum of six credits from elective process specialization courses is also required.

Level	Semester	Course	Credits
Year 1	1	• 4 core courses	15
	2	• 3 core courses	11
		• **plus** 1 of 2 elective process specialization courses	3 or 4
	3 (Summer)	• 2 core courses	7
		• **plus** 1 of 2 elective process specialization courses	2 or 3
Year 2	1	• Research Project I or • Research Project II	6 or 12

Part-time

Credit Requirement: 45 credits (minimum) to include credits from all nine (9) core courses and a research project. A minimum of six credits from elective process specialization courses is also required.

Level	Semester	Course	Credits
Year 1	1	• 2 core courses	8
	2	• 2 core courses	6
	3 (Summer)	• 1 core course	4
Year 2	1	• 2 core courses	7
	2	• 1 core course **plus** the first of 2 elective process specialization courses	7-8
	3 (Summer)	• 1 core course **plus** the second of 2 elective process specialization courses	7
		• 2 core courses	7
Year 3	1	• Research Project I or • Research Project II	6 or 12

Certificate in Food and Agro-Processing Technology (FAPT)

The Certificate programme is offered over 2 semesters and consists of 3 courses. Two (2) in semester 1 and One (1) in semester 2 with a total credit load of twelve (12)

COURSE CODE	COURSE TITLE	SEMESTER	CREDITS
FAPT6101	Agro-Processing Technologies	I	4
FAPT6202	Food Microbiology and Biotechnology	I	4
FAPT6302	Product Development	II	4

Post-Graduate Diploma: Food & Agro-Processing Technology

(Full-time only)

Credit Requirement

Minimum of 22 credits selected from core courses, and must include Agro-Processing Technology, Food Chemistry, Food Microbiology and Biotechnology, and Food Safety and Quality Standards.

Course	Credits
Semester 1	
• Minimum of 3 core courses	11 minimum
Semester 2	
• Minimum of 2 core courses	7 minimum
Semester 3 (Summer)	
• 1 core course	3 or 4

Programme Content

COURSE CODE	COURSE TITLE	SEMESTER	CREDITS
	CORE COURSES		
FAPT6101	Agro-Processing Technologies	I	4
FAPT6102	Packaging: Materials and Applications	II	4
FAPT6201	Food Safety and Quality Standards	II	3
FAPT6202	Food Microbiology and Biotechnology	I	4
FAPT6301	Research Methods: Principles and Practice in the Food and Agro-processing Sectors	I	4

FAPT6302	Product Development	II	4
FAPT6303	Agro-Processing Problem Solving	III	4
FAPT6401	Agri-Business Management	III	3
FOST6003	Food Chemistry	I	3
ELECTIVE COURSES			
FAPT6103	Edible Oils, Fats & Biofuels Processing	III	3
FAPT6104	Meat, Poultry and Seafood Processing	II	4
FAPT6105	Fruits, Vegetables, Root Crops and Tubers Processing	II	4
FAPT6106	Cereal and Grain Processing	III	2
FAPT6107	Herbs, Spices, Essential Oils, Nutraceuticals and Fine Chemicals	II	3
FOST6010	Dairy Chemistry and Dairy Products Technology	III	3
QUALIFYING COURSE			
FAPT3511	Food Chemistry Practical	I	1
RESEARCH PROJECT			
FAPT6304	Research Project I	II-IV	6
FAPT6305	Research Project II	II-IV	12

COURSE DESCRIPTIONS

FAPT3511 FOOD CHEMISTRY LABORATORY
(1 Credit) (Semester 3) (Qualifying Course)

Prerequisites: None

Course Description
This practical course is designed to strengthen the knowledge base and technical competency of students who do not have a strong background in the fundamental laboratory techniques employed in the analysis of basic food components. This course will equip students with the skills to conduct analytical techniques and methodologies commonly used for the analysis of macro and micro food components including fats, carbohydrates, proteins, water, vitamins, minerals and toxicants. The principles governing the various techniques will be emphasized.

Learning Outcomes
On completion of this course, students will be able to:
1. Describe the principles governing the various techniques used to determine macro and micro food components;

2. Apply current analytical laboratory techniques (e.g, HPLC and spectrophotometry, polarimetry, atomic absorption spectroscopy) to the analysis of selected food components;
3. Explain the reactions that are involved in the chemical analysis of a given food component;
2. Effectively plan and safely conduct appropriate chemical investigations of foods and record relevant observations and data;
3. Apply chemical analysis of foods to solving problems in food industry;
4. Effectively and ethically communicate scientific data orally and in writing using appropriate technical language.

Course Content

1. Carbohydrates analysis
    a. Crude fiber
    b. Lactose
    c. Pectin
2. Protein analysis
    a. Kjeldahl titration
    b. Formol titration
    c. Biuret method
3. Fat analysis
    a. Crude fat
    b. Degree of unsaturation
    c. Degree of rancidity
4. Analysis of Vitamins
    a. Titrimetric determination of Vitamin C in fruits
    b. HPLC determination of vitamins A, D and E
    c. Determination of minerals via ashing and acid extraction
5. Analysis of other compounds in foods
    a. HPLC determination of anthocyanins in fruits
    b. GC determination of cholesterol in foods
    c. Spectrophotometric determination of nitrites in processed meat
    d. Determination of endogenous toxins in foods (hypoglycin A in ackees and cyanide in cassava)

Assessment

- **Coursework** **100%**
    - Laboratory reports(x6) 80%
    - One Term paper 10%
    - One Presentation 10%

FAPT6101 AGRO-PROCESSING TECHNOLOGIES

(4 Credits) (Semester 1)

Prerequisite: NONE

Course Description

The effective application of agro-processing technologies is vital to the sustainable growth and development of the food and agricultural industries. This course will introduce students to the agro-processing industry, and provide details about the techniques involved in the processing and preservation of agricultural products. Thermal processing, refrigeration/freezing, irradiation, and dehydration are among the techniques that will be covered. The processing techniques applied to specific food groups as well as the application of microorganism in agro-processing will be discussed in detail. The effects of processing on product quality and the environment are included. This course has a strong practical component designed to provide students with the hands on experience necessary to prepare different types of food products in a pilot plant setting.

This course (along with Food Chemistry, and Food Safety and Quality Standards) forms the central planks around which all other courses in the programme are organized.

Learning Outcomes

On completion of this course, students will be able to:

1. Discuss the source and variability of raw food material and their impact on agro-processing operations;
2. Describe and explain the different operations and techniques employed in agro-processing;
3. Discuss the effects of selected processing techniques on the different aspects of product quality;
4. Generate a process flow diagram for the production of processed foods from specified agricultural raw materials;
5. Justify the choice of processing techniques applied to a particular product;
6. Evaluate and select appropriate equipment for the processing of a given product;
7. Operate basic equipment used to process agricultural materials;
8. Classify processes based on their energy consumption, and devise/suggest methods to achieve conservation;
9. Evaluate issues concerning product safety, labelling, and compliance with regulatory requirements;
10. Develop measures to reduce and treat waste in an environmentally friendly manner.
11. Evaluate and provide solutions for problems related to processing/preservation of agricultural products.

Course Content

1. Characteristics of Agro-processing Industry
2. Unit Operations in Agro-processing
3. Quality Factors in Foods
4. Food Deterioration and its Control
5. Heat Preservation and Processing
6. Irradiation, Microwave and Ohmic Processing
7. Chilling, Freezing and Modified Atmospheres
8. Freeze Drying and Freeze Concentration
9. Application of Microorganisms
10. Coating
11. Filling and Sealing of Containers
12. Processing of Different Food Material
13. Safety, labelling and other regulatory issues
14. Environmental Considerations

Assessment

- **Coursework** **40%**
    - Practical reports 15%
    - One term paper 10%
    - In-course test 10%
    - Presentation 5%
- **Final Exam** **60%**
    - 3-hour final written exam

FAPT6102 PACKAGING: MATERIALS AND APPLICATIONS

(4 Credits) (Semester 2)

Prerequisite

NONE

Course Description

This course will review the manufacture of glass, plastic, metal and paper and the processes which prepare these materials for food packaging. The properties of various polymers, their advantages and disadvantages and the equipment used to convert them to containers will be covered. Laboratory sessions will allow the students to better understand closing methods, defects identification, quality testing and material characterization. Visit to a factory that fabricate and use food packaging will also be utilized in the learning process. Selected topics for food packaging applications will include aseptic packaging, retorting, package/product interactions, active and smart packaging, shelf-life studies, handling of packages, and modified atmosphere packaging.

This course demonstrates the dependence of packaging on the chemistry of the packaged product as well as the technologies used for processing and illustrates the inter-relationship with food safety and quality. It is thus critical to any modern programme in food and agro-processing.

Learning Outcomes

On completion of this course, students will be able to:

1. Describe the methods by which glass, plastic, metal and paper materials are manufactured;
2. Illustrate the techniques by which food packaging materials are fabricated from glass, plastic, metal and paper;
3. Compare the properties of various packaging types for raw materials as well as the final package;
4. Assess the benefits and disadvantages of types of food packaging;
5. Explain the principal methods of packaging foods and the criteria for selecting and testing packaging materials;
6. Construct flow diagrams/models of processes for packaging fabrication, filling and closing equipment in food packaging plants;
7. Evaluate recent advances in food packaging techniques, systems and applications.

Course Content

1. Introduction and overview.
2. Plastic packaging.
3. Metal packaging
4. Glass packaging
5. Paper and wood packaging
6. Packaging closures
7. Food product shelf life
8. Package/product interaction
9. Permeability and shelf life
10. Mass transfer in packaging

Assessment:

- **Coursework** **40%**
  - Practical reports 10%
  - One term paper 10%
  - In-course test 10%
  - Field Trip Report 10%
- **Final Exam** **60%**
  - 3-hour final written exam

FAPT6103 EDIBLE OILS, FATS & BIOFUELS PROCESSING
(3 Credits) (Semester 2)

Prerequisites
FAPT6101, FAPT6201, FOST6003

Course description
Oils and fats comprise one of the major food groups, and are therefore a very important component in the diet. A good understanding of their physiochemical and functional properties, and the different technologies employed for their processing and quality assurance is therefore essential. The relationship between fats and health is significant, and it is imperative that workers in the agro-processing industry are sufficiently knowledgeable about this topic. The production of biofuels from biomass including oils is becoming increasingly significant. This is in part due to the global trend of increasing energy consumption along with concerns about energy security in the face of dwindling crude oil reserves. The production of biofuels would provide better energy security and improve the local and regional economies, as well as the environmental benefits that come from using this renewable source of energy. Alternative energy production involving biofuels is an emerging world trend, and is a very relevant component of this course.

This course introduces the different classifications of lipids, their physical and chemical properties and common chemical reactions, which are related to the effects of processing on fats and oils. Students will be exposed to various methods used for processing fats into specified products. Issues relating to deterioration, preservation, product quality and analysis, by-product utilization, and health aspects will be included. Students will also be introduced to biofuels processing, with the production of biodiesel, natural gas and alcohol, as well as other emerging technologies, being explored. Environmental issues will be discussed.

Learning Outcomes
On completion of this course, students will be able to:

1. Distinguish among the different classes of compounds comprising lipids;
2. Describe the physiochemical properties of fats and oils and explain their chemical reactions;
3. Describe methods used for processing selected fats and oils for use in food industry, and discuss the effects of processing on fats and oils;
4. Relate the roles and effects of lipids in nutrition and health;
5. Explain processing, quality assurance and analytical techniques that are used to produce high quality fat and oil products;
6. Illustrate chemical, instrumental and enzymatic tests for lipids;

7. Explain the production of biodiesel, natural gas, and selected alcohols from biomass and discuss the energy balance related to biofuels production;
8. Compare the current technologies used in biofuels processing;
9. Discuss the effects of biofuels production on the environment, and the regulations that apply;
10. Evaluate current issues related to lipids, their production, and use as food and as fuel.

Course Content

Part A: Edible Oils and Fats

1. Physical and chemical properties of fats and oils
2. Common chemical reactions
3. Processing of fats and oils for food use (vegetable oil, margarine and spreads, etc.)
4. Effects of processing on fats
5. Lipid oxidation
6. Role of fats in nutrition and health
7. Quality control
8. Analysis of lipids
9. Regulation and safety
10. By-products
11. Environmental considerations

Part B: Biofuels

1. Biodiesel production
2. Biomass conversion to ethanol and butanol
3. Biomass conversion to natural gas
4. Other technologies
5. Energy balance of biofuels production
6. Value-added processing of biofuels residues
7. Environmental impacts of production and products
8. Regulations and the environment

Assessment:

- **Coursework** **40%**
  - Field trip reports 10%
  - One Term Paper 15%
  - In-Course test 10%
  - One Presentation 5%
- **Final Exam** **60%**
  - 3-hour written exam

FAPT6104 MEAT, POULTRY & SEAFOOD PROCESSING
(4 Credits) (Semester 2)

Prerequisites
FAPT6101, FAPT6201, FOST6003

Course Description
This course introduces the biochemical, chemical and nutritional aspects of different muscle foods (meat, poultry and seafood), as well as the methods of producing value-added food items from these sources. Students will be exposed to safety concerns surrounding the preservation and processing of these foods and measures for addressing these issues. Advanced and environmentally friendly processing technologies for muscle foods and new uses of by-products will also be examined.

Learning Outcomes
On completion of this course, students will be able to:

1. Categorize muscle foods according to their origin, structure and composition;
2. Explain the biology of muscle and its biochemical conversion to meat;
3. Relate the chemistry of meat to its nutritive value in the diet;
4. Describe and apply measures to ensure safety during processing and of the processed product;
5. Assess factors that contribute to a good quality muscle food product;
6. Devise solutions to quality and health problems that can occur with selected muscle food products;
7. Select equipment and additives for the processing of specific types of muscle foods;
8. Illustrate selected, conventional methods in the processing of specific muscle foods.
9. Evaluate at least two advanced technologies for muscle food processing;
10. Assess strategies/programmes/procedures for treating muscle food waste in terms of environmental effects and economic cost/value;
11. Describe the production of at least two examples of muscle food by-products.

Course Content

1. Importance of animal protein production
2. Differentiation of muscle foods
3. Factors affecting the quality of muscle food
4. Biochemical, chemical, and physical aspects of muscle conversion to meat

5. Muscle composition
6. Muscle food safety concerns
7. Preservation and processing
8. New approaches for the development of meat products (advanced technologies, in-vitro meat production etc.)
9. Meat by-products
10. Treatment & Disposal of Waste

Assessment

- **Coursework** **40%**
  - Practical reports 15%
  - Field trip reports 15%
  - One In-Course test 10%
- **Final Exam** **60%**
  - 3-hour final written exam

FAPT6105 PROCESSING OF FRUITS, VEGETABLES, ROOT CROPS AND TUBERS
(4 Credits) (Semester 2)

Prerequisites
FAPT6101, FAPT6201, FOST6003

Course Description
This course will, among other things, equip students with the requisite knowledge to successfully produce high-quality products from these food sources. The content will encompass the processing of fruits, vegetables, root crops and tubers, from farm to fork. Students will be introduced to the composition and quality indices of these foods, in addition to the principles and applications of thermal processing, dehydration, refrigeration, freezing, minimal processing, and specialized techniques for fruits, vegetables, root crops and tubers. Effects of post-harvest handling and processing on product quality, product safety, quality assurance and international trade issues, the potential for product development and by-product utilization will also be covered.

Learning Outcomes
On completion of this course, students will be able to:
1. Describe the structure and composition of FVRT;
2. Explain the different techniques employed in the processing of FVRT;
3. Discuss the effects of post-harvest handling and processing on the quality of FVRT;
4. Generate a process flow for the production of specified agricultural

products from FVRT;
5. Illustrate selected processing techniques for specified FVRT products;
6. Evaluate the production, utilization and disposal of waste & by-products from food processing of FVRTs;
7. Relate environmental effects and their solutions to the production and disposal of waste in food processing of FVRTs;
8. Discuss quality control/assurance regulations, systems and strategies (Jamaica and International) used in the processing of FVRTs;

Course Content

1. Post-harvest handling and maintenance of post-harvest quality of FVRT
2. Deterioration of FVRT and their processed products
3. Principles of preservation methods for FVRT
4. Packaging technology for FVRT products
5. Specific products from FVRT
7. FVRT processing units
8. Sensory analysis of FVRT and their products
9. Bioprocessing for value-addition and waste-treatment
10. Quality control/assurance: HACCP, ISO Quality management, GMPs
11. By-product utilization
12. Potential for product development

Assessment

- **Coursework** **40%**
  - Field trip reports 15%
  - One term paper 10%
  - One In-Course test 10%
  - One Presentation 5%
- **Final Exam** **60%**
  - 3-hour final written exam

FAPT6106 CEREAL AND GRAIN PROCESSING
(2 Credits) (Semester 3)

Prerequisites
FAPT6101, FAPT6201, FOST6003

Course Description
Students taking this course will become familiar with the main types of crops that are harvested for processing into commonly known cereal products. The course will cover the grading, quality attributed, common processing technologies and end use of most cereals consumed in the Caribbean, North America, and

European regions. Hazards associated with the storage and consumption of certain cereals will also be taught during the course. These include fungal infestation and aflotoxins, lipid oxidation of seeds and grains, and allergenic reactions to cereals such as wheat, soy, peanut and certain tree nuts.

Learning Outcomes

On completion of this course, students will be able to:

1. Describe the types and general farming and storage practices of cereal grains;
2. Discuss the nutrient content of major cereal grain types;
3. Explain the methods of processing cereal grains
4. Compare the advantages and disadvantages of the current methods of extending storage and shelf life of selected cereals;
5. Relate cereal quality and its influence on the quality of cereal based foods;
6. Evaluate the safety issues associated with processing, storage and use of raw and processed cereal products;
7. Assess the current use of specialty foods prepared from cereals for their nutrient value, safety and economics;
8. Illustrate at least three methods of testing for safety and quality of selected cereal products.

Course Content

1. Farming of cereal crops
2. Introduction to cereal science
3. Cereal processing methods
4. Nutrient content of cereals
5. Cereal shelf life
7. Specific end use products
8. Safety of cereal processing and end use
9. Specialties and non-cereal products
10. Methods of testing the quality and safety of cereals and cereal end products

Assessment

- **Coursework** **20%**
  - Field trip reports 10%
  - One In-Course test 10%
- **Final Exam** **80%**
  - 3-hour final written exam

FAPT6107 HERBS, SPICES, ESSENTIAL OILS, NUTRACEUTICALS & FINE CHEMICALS

(3 Credits) (Semester 3)

Prerequisites

FAPT6101, FAPT6201, FOST6003

Course Description

Methods of classification and standardization of herbs and spices are introduced in this course. Additionally, it investigates the methods in which these materials may be used with minimal processing or processed extensively into value-added products, based on an appreciation of the folk-medicinal and science-based properties. The potential of the functional food, nutraceutical and fine chemical industries arising from the use of herbs and spices will be explored.

Learning Outcomes

On completion of this course, students will be able to:

1. Outline botanical classification of select herbs and spices;
2. Describe the applications and functions of important herbs, spices and essential oils;
3. Relate the chemical components/structures of herbs and spices to their properties and their biological activity;
4. Describe methods used to determine biological activity;
5. Discuss efficient and effective agricultural practices for the cultivation, harvesting and storage of botanicals;
6. Evaluate sourcing practices for herbs and spices;
7. Report on methods utilized in extraction of value added products from Caribbean flora;
8. Discuss techniques employed in processing of herbal plant material;
9. Evaluate the scientific and technical feasibility of producing value-added products from local botanical sources;
10. Formulate value added products on the basis of knowledge of the biological activity of various herbs and spices;
11. Evaluate quality control measures used in the processing of herbal plant materials;
12. Describe adverse effects of selected botanicals (herbs, spices);
13. Discuss utility and effectiveness of local and international regulations as it relates to marketing and trade in selected botanicals.

Course Content

1. History, origin and applications of natural plant products
2. Taxonomy and botanical authentication of plants; plant genetic resources and diversity

3. Bio-prospecting
4. Cultivation, harvesting, processing and storage of botanicals (GAP and GSP)
5. Introduction to chemistry and biochemistry of natural products
6. Characterization and methods of analysis
7. Bio-activity screening of botanicals
8. Herbs and spices as functional ingredients
9. Fine chemicals from botanicals
10. Adverse effects
11. Extraction and processing methods
12. Quality control
13. Marketing, trade and regulations of relevant industries

Assessment

- **Coursework** **30%**
  - Field trip reports 10%
  - One term paper 10%
  - One In-Course test 10%
- **Final Exam** **70%**
  - 3-hour final written exam

FAPT6201 FOOD SAFETY AND QUALITY STANDARDS
(3 Credits) (Semester 2)

Prerequisites
NONE

Course description
This course allows the students to become familiar with microbial and chemical risk factors that are associated with food safety. The microbial factors include bacteria, fungi, viruses and protozoa. The chemical factors include both organic and inorganic compounds that are from plant, animal, packaging, agricultural and industrial sources. Various techniques to minimize the risks to food safety are discussed, including temperature control (heating and cooling), irradiation, chemical, pH, pressure and dehydration. Processing methods that use these techniques to ensure food safety are presented in this course. The students will also be engaged with methods of identification of microbial and chemical contamination of foods. The role of governmental agencies and food laws aimed at minimizing food related illnesses will be considered. To assist the students in these aspects, visits will be organized to governmental agencies responsible for food safety and to quality control testing facilities managed by private companies.

Food safety and quality standards forms an integral part of adding value to agricultural products meant for consumption and as such this course represents one of the pillars supporting the programme.

Learning Outcomes

Students completing this course will be able to:

1. Discuss current issues relating to food safety and efforts that are being made to solve them;
2. Identify microbial and chemical hazards of public health concern;
3. Evaluate the efficacy of food processing methods and technologies used to minimize food safety issues;
4. Discuss risk assessment, HACCP, GMPs and ISO 9000 principles and how they could be used to minimize food safety hazards;
5. Assess the various techniques that are used in the identification of food safety risks;
6. Explain the role of regulatory agencies in minimizing food safety issues;
7. Compare government regulations re food plant operations in Jamaica (e.g., BSJ) and in other countries (e.g. USA - USFDA, USDA);
8. Work as a team to evaluate food safety issues, risks, and determine solutions.

Course Content

1. Introduction and overview
2. Microbial risks and food safety
3. Chemical risk and food safety
4. The safety of processed foods
5. Methods of minimizing food safety risk
6. Food processing and safety #1
7. Food processing and safety #2
8. Review of methods of identifying microbial food safety risks
9. Methods of identification of chemical food safety risks
10. Governmental regulations aimed at reducing outbreaks
11. Public health issues

Assessment

- **Coursework** **40%**
    - Practical reports 10%
    - Field Trip Report 10%
    - In-course test 10%
    - Term Paper 10%
- **Final Exam** **60%**
    - 3-hour Final written exam

FAPT6202 FOOD MICROBIOLOGY & BIOTECHNOLOGY

(4 Credits) (Semester 2)

Prerequisite

NONE

Course description

Modern food processing technologies demand a thorough understanding of the challenges that micro-organisms present in the production of nutritious and safe foods. The preservation techniques employed are often directly related to the characteristics of the micro-organisms of public health significance, and the strategies adopted in food production are geared towards minimising the risks of food borne illnesses. With an increase in our knowledge and control of micro-organisms, and an ability to manipulate their chemical processes (biochemistry), biotechnology will continue to have a tremendous impact on the production of foods and food additives into the foreseeable future.

This course is therefore designed to provide the student with the knowledge and understanding of the attributes of micro-organisms and the application of modern techniques in the applied science of food microbiology. Students will also develop an advanced understanding of the microbiology of foods, food-borne diseases, food spoilage and modern microbial analytical techniques. The course will also introduce students to diverse techniques in genetic engineering and biotechnology (for example: identifying food genes, genetically modified micro-organisms, transgenic crops and livestock, bioinformatics, food-omics, industrial microbiology, fermentation technology and bioreactors, food enzymes, etc.) and ethics in biotechnology.

Learning Outcomes

On completion of this course, students will be able to:

1. Discuss the microbial ecology of foods;
2. Enumerate and explain standard and new methods for the isolation and identification of micro-organisms in foods;
3. Discuss the application of molecular techniques to the microbial analysis of food;
2. Describe how micro-organisms can be used in food production;
3. Explain the incidents and causes of food-borne diseases and food spoilage;
4. Perform basic and advanced microbiological investigation of foods;
5. Describe traditional and modern applications of biotechnology in food production;
6. Discuss the principles relating to the production of named fermented foods;

7. Analyse and evaluate data, from practical reports and group projects, to solve real world problems in food processing and biotechnology;
8. Demonstrate the ability to undertake independent learning by self-directed assignments;
9. Explain and discuss the roles and responsibilities of biotechnologist in contributing to food production and security;
10. Discuss the ethical issues in genetic engineering and biotechnology;

Course Content

Microbiology

1. Growth of Bacteria
2. Foodborne Illnesses
3. Grouping of Micro-organisms
4. Microbial Defects in Specific Foods
5. General Principles Underlying Spoilage

Biotechnology

1. Introduction to Food Biotechnology
2. Application of biotechnological strategies in food industry
3. Plant Biotechnology
4. Animal Biotechnology
5. Microbial Biotechnology
6. Specific requirement in using molecular technology for food industry
7. Biochemistry and Biotechnology of food
8. Production of recombinant proteins and enzymes for food industry
9. Carbohydrate Biotechnology
10. Fat and Lipid Biotechnology
11. Production of flavours, vitamins and other ingredients
12. In situ improvement of nutritional quality for plants and animals as food products
13. Biotechnology and food borne diseases
14. Diagnosis and Preventive systems
15. Regulatory, Social and Ethical Aspects of Biotechnology

Assessment

- **Coursework** **40%**
  - Practical reports 15%
  - In-course test 10%
  - Field Trip Report 5%
  - Term Paper 10%
- **Final Exam** **60%**
  - 3-hour final written exam

FAPT6301 RESEARCH METHODS: PRINCIPLES AND PRACTICE IN THE FOOD AND AGRO-PROCESSING SECTORS

(4 Credits) (Semester 2)

Prerequisite
None

Course description
The course is designed to prepare students for a meaningful research project in the food and agro-processing sectors. Students will be introduced to the philosophy and principles of scientific research methodology, including the planning, design and conduct of research projects. Students will be guided in developing their research question (from existing and/or perceived problems in the sector) and instructed on the conduct of extensive literature review through the use of abstracting and indexing resources. The importance of ethics in the conduct of research will be emphasized.

Students will develop their research project scope and objectives and will consider the appropriate methodologies to be utilised. Students are expected to present an independently prepared research proposal (written and oral) at the end of the course. Additional learning modules include an introduction to the principles of strategic market research which may be used to develop market intelligence and competitive advantage, and the use of statistical tools in decision making, through data collection, analysis and interpretation.

Learning Outcomes
Upon successful completion of the course students will be able to:

1. Discuss ethical and technical principles which underpin scientific research;
2. Plan and Design research projects by:
3. Develop and design a study to assess opportunities in a market (market intelligence) for food products, by applying market surveillance techniques
4. Analyze both quantitative and qualitative data using statistical tools
5. Apply research skills to prepare and present a project.

.

Course Content

1. The Fundamentals of Research:
2. Focusing your Research Efforts:
3. Research Methodologies
4. Preparing the Research Report / Presenting Research Outcomes
5. Introduction to Statistics and use of Statistical tools (SPSS) in Research
6. Strategic Research

Assessment

- **Coursework** **40%**
  - Practical reports (Case studies/statistics) 15%
  - In-course test 10%
  - MSc Project Proposal 15%
  - Oral Seminar 5%
- **Final Exam** **60%**
  - 3-hour final written exam

FAPT6302 PRODUCT DEVELOPMENT
(4 Credits) (Semester 2)

Prerequisites
FAPT6101, FAPT6201, FOST6003

Course description
The course will introduce students to the importance of Food Product development both to the individual product owner and to the market economy. The theoretical background provided should enrich student thinking about the major issues in development of new food products There will be a significant amount of time spent on acquiring an understanding of the planning, processes and operational strategies necessary for successful marketing of a food product The infusion of current practice into the course in the form of case studies, guest speakers and visits to factories is also a useful aid to enhance the understanding of future entrepreneurs.

Learning Outcomes
On completing this course, students will be able to:

1. Discuss the scientific and technical information needed to commence the development of a food product;
2. Identify the steps involved in moving a food product from the conception stage to commercialization;
3. Evaluate food product developmental methods, formulation and processing specifications;
4. Describe the roles of marketing and regulatory personnel in product development;
5. Explain the significance, function and interrelations of a product development team;
6. Work with a team to plan for the development of a new product;
7. Apply skills to develop a prototype food product (with commercial potential) in the laboratory;
8. Prepare a report on the development process for the prototype product and present same to peers and others.

Course Content

1. Introduction and overview.
2. Development of the product's specifications.
3. The significance of concept testing
4. The significance of ingredients and packaging in defining the product attributes
5. Process optimization
8. Market optimization
9. Important factors to consider in product development
10. Real world experience

Assessment

- **Coursework** — **50%**
    - Practical reports — 25%
    - One Term Paper — 10%
    - In-course test — 10%
    - Presentation — 5%
- **Final Exam** — **50%**
    - 3-hour final written exam

FAPT6303 AGRO-PROCESSING PROBLEM SOLVING

(4 Credits) (Semester 2)

Prerequisites

FAPT6102, FAPT6302

Course description

In this course, principles and practices of problem-solving in relation to food processing and food products will be modelled. Students will be exposed to simple and complex issues related to specific food processing and products and will engage in discussions, laboratory analysis and collaborative decision-making to solve these problems. They will have the opportunity to prepare scientific reports and to present these in order to share their findings.

Learning Outcomes

On completion of this course, students will be able to:

1. Discuss the principles involved in solving problems with selected processed food products/food processing;
2. Scientifically analyze food products/food processing in specified ways;
3. Compare methods of analysis of selected food products;
4. Assess findings of scientific analysis and come to logical conclusions based on the results obtained, by working within a small group;

5. Prepare and present reports of findings in relation to problems with selected food products, by working with a small group.

Course Content

The course will consist of the following elements:

1. Identification and analysis of simple problems with selected processed foods/food processing.
2. Report and discussion of findings and suggested solutions to problems.
3. Identification and analysis of complex problems with selected processed foods/food processing (long term research).
4. Report, presentation of findings and discussion of long term research results.

Assessment

- **Coursework** **100%**
    - Group short term reports 15%
    - Group long term report 20%
    - Oral presentations 10%
    - Attendance and class/group participation 5%
    - Individual short term report 20%
    - Individual long-term report 30%

FAPT6304 RESEARCH PROJECT I

(6 Credits) (Semester 3)

Prerequisites

FAPT6101, FAPT6201, FAPT6301, FOST6003

Course Description

This course is intended to develop critical thinking skills by having students conduct research to generate reliable data. Technical decisions must be based on the sound evaluation and analysis of objective data. The course is thus designed to introduce students to the conduct of research and should ideally be the execution of the research proposal developed in the Research Methods course [FAPT 6301] completed in Semester I. Research on the project may begin in Semester II, or shortly thereafter.

Students pursuing Research Project I may undertake an original project which seeks to test their hypothesis regarding an identified research problem. Alternately, they may conduct research which seeks to assess the validity of data from a pre-existing research project, or collect data associated with the performance of a process, or consumer product in the market. The work must

demonstrate critical thinking, thorough analysis and/or new interpretation of results which provides credible insights towards solving a wider problem.
A project report shall be prepared and submitted for examination. Students are required to prepare an abstract and a poster based on the research project for presentation to a peer-review panel.

Learning Outcomes

On completing this course students will be able to:

1. Execute a planned research project in a timely manner;
2. Employ experimental techniques to generate reliable data;
3. Evaluate, analyse and interpret data;
2. Propose a solution to problems identified;
3. Prepare a project report based on the research findings;
4. Summarise the project results in the form of a conference abstract;
5. Present research findings as a poster for review by peers;
6. Demonstrate the attitudes required to work collaboratively in a research team.

Course Content

Actual content and structure will vary depending on the subject matter of the research project but it could consist of independent laboratory and/or process and/or consumer directed research. This should be agreed to by the student's academic supervisor. The project could be initiated as a result of industrial collaboration with UWI, an investigation originating from a governmental concern, a sponsored research question from UWI and or an external funding agency or from one suggested by the student's supervisor. The project could be carried out at UWI and or at an external site agreed to by the student and the academic supervisor. If an external site is to be used an agreement for use of the facilities must be reached with the relevant parties at that site prior to beginning the research project. At all times, the research project will be under the supervision of the academic supervisor, however an industrial supervisor may also be appointed to co-supervise the project.

Assessment

- Project Report 85%
- Poster 15%

FAPT6305 RESEARCH PROJECT II
(12 Credits) (Semester 3)

Prerequisites
FAPT6101, FAPT6201, FAPT6301, FOST6003

Course Description
This course is intended to develop the critical thinking skills necessary to conduct higher order research and will facilitate a better understanding of factors that influence an identified problem. Research project II is designed to prepare students for rigorous scientific enquiry and requires the student to develop a research project after consultation with his/her academic supervisor. Research on the project should begin in Semester II.

Students pursuing Research Project II may undertake a more in-depth original project which seeks to test a hypothesis regarding an identified research problem. Alternately, they may conduct research which seeks to assess the validity of data generated from a pre-existing research project, or collect and analyse data associated with the performance of a process, or consumer product in the market. The work must demonstrate critical thinking, thorough analysis and/or new interpretation of results which provides credible insights towards solving a wider problem.

A report of the project shall be submitted as a thesis according to the relevant University regulations and shall be externally examined. Students are expected to draft a research paper for submission to an appropriate peer-reviewed scientific journal.

Learning Outcomes
On completing this course students will be able to:

1. Design and execute a research project in a timely manner;
2. Conduct an original research or present original interpretation of existing research;
3. Employ experimental techniques to generate reliable data;
2. Evaluate, analyse and interpret data;
3. Propose solutions to problems identified;
4. Prepare a thesis based on their research;
5. Draft a paper based on the research project for submission to an appropriate peer-reviewed scientific journal;
6. Demonstrate the attitudes required to work collaboratively in a research team.

Course Content

Actual content and structure will vary depending on the subject matter of the research project but could consist of independent laboratory and/or process and/or consumer directed research. This should be agreed to by the student's academic supervisor. The project could be initiated as a result of industrial collaboration with the UWI, an investigation originating from a governmental concern, a sponsored research question from the UWI and or an external funding agency or from one suggested by the student's supervisor. The project could be carried out at the UWI and or at an external site agreed to by the student and the academic supervisor. If an external site is to be used an agreement for use of the facilities must be reached with the relevant parties at that site prior to beginning the research project. At all times, the research project will be under the supervision of the academic supervisor, however an industrial supervisor may also be appointed to co-supervise the project.

Assessment

Students will be expected to draft at least one paper based on the research project for submission to an appropriate peer-reviewed scientific journal in keeping with the journal's guidelines for authors. This draft shall be reviewed by the project supervisor and supervisory committee.

- Thesis 90%
- Research article draft 10%

FAPT6401 AGRI-BUSINESS MANAGEMENT

(3 Credits) (Semester 2)

Prerequisites

FAPT6102, FAPT6302

Course description

This course will provide an overview of the abilities required of business professionals working within the agro-food processing industry. Students will gain an understanding of the unique and changing structural, legal and regulatory aspects of food markets (chains), as well as basic business management theories and concepts necessary to fully understand and appreciate the skills needed to manage organizations effectively and efficiently within this agro-processing industry.

Learning Outcomes

Upon successful completion of the course, students will be able to:

1. Explain the importance of the food and agro-processing sector to the economy;
2. Assess the effectiveness of the six primary functions of management;
3. Describe the expertise required for effective food processing plant operation
4. Design strategies for successful food commercialization (from final prototype to innovative commercial product).

Course Content

1. Introduction: importance of the agri-food system (overview); value chain (input, production, processing, distribution, consumer); emerging trends and challenges in the agri-business industry
2. Functions of Management
3. Operations and Production Planning
4. Human Resource Management
5. Financial Analysis and Planning
6. Marketing Mix & Plans
7. Food Commercialization

Assessment

- **Coursework** **40%**
    - Two Course tests 20%
    - Term Paper & Poster 20%
- **Final Exam** **60%**
    - 3-hour final written exam

FOST6003 FOOD CHEMISTRY

(3 Credits) (Semester 2)

Prerequisites

CHEM3501, FAPT3511 or equivalent course

Course description

In order for practitioners in the field to effectively apply and exploit agro-processing techniques, it is essential that they possess sound knowledge and understanding of the chemical composition and structure of foods. This course exposes students to the chemistry of the major (water, proteins, lipids, carbohydrates and lipids) and minor (vitamins and minerals, enzymes, colourants) food components. Students will be exposed to the effects of processing and storage on the chemical, nutritional, functional properties and quality of the food product. Issues related to functionality, bioavailability, toxicity, and dietary recommendations of vitamins and minerals will also be presented. The students will be made aware of undesirable components of foods, and the means to reduce them. Analytical methods employed for the determination of different food components and food quality will be presented.

Learning Outcomes

On completion of this course, students will be able to:

1. Describe the chemistry of the major and minor food components;
2. Explain how the structures of these components affect their functional properties;
3. Discuss the chemical changes and interactions in foods during processing and storage;
4. Explain how these changes affect the texture, colour, flavour, stability, and nutritive qualities of the food;
5. Assess the sources of undesirable components in foods, and evaluate their effects on health;
6. Design methods and techniques to reduce/eliminate undesirable food components from the diet;
7. Propose appropriate analytical methods for analysis of food components.

Course Content

1. Water
2. Carbohydrates
3. Proteins
4. Enzymes
5. Lipids
6. Vitamins and Minerals
7. Colourants
8. Flavours
9. Food Additives
10. Undesirables in Foods (Toxicants and Contaminants)
11. Dispersed Systems

Assessment

- **Coursework** **40%**
  - Two Course tests 20%
  - One Term Paper 15%
  - One Presentation 5%
- **Final Exam** **60%**
  - 3- hour final written exam

FOST6010 DAIRY CHEMISTRY & DAIRY PRODUCTS TECHNOLOGY

(3 Credits) (Semester 3)

Prerequisites

FAPT6101, FAPT6201, FOST6003

Course Description

Students will learn about the composition of milk and its physical, chemical, and functional properties. Current and cutting edge technologies applied to the production of dairy products will be covered. The production of different dairy products, the effects of processing on various characteristics of the finished product and on the environment will also be discussed. Other topics that will be covered include: preservation, management systems for safety and quality, and labelling, regulatory and energy conservation issues. Students will be exposed to the practical aspects of dairy processing via field trips to processing plants.

Learning Outcomes

On completion of this course, students will be able to:

1. Describe the composition of milk and its physical, chemical, and functional properties;
2. Explain the different techniques employed in the processing of dairy products, and discuss the effects of processing on various aspects of product quality;
2. Describe the methods used and construct process flows for the production of specified dairy products;
3. Evaluate the factors that contribute to the degradation of dairy products and describe measures that be applied in the extension of shelf life of dairy products;
4. Solve problems related to processing/preservation of dairy products, in relation to quality, safety, environmental effects;
5. Illustrate the methods used to test and evaluate product quality of dairy products;
6. Discuss issues concerning product quality, safety, labeling, and other regulatory issues;
7. Discuss the role of dairy products in nutrition and health;
8. Apply knowledge and skills gained to the development of new dairy products.

Course Content

1. Composition of milk
2. Physical and chemical properties of milk
4. Processing methods for dairy products
5. Effects of heating

6. Dairy products
7. Role of dairy products in nutrition and health
8. Degradation of milk and milk products
9. Shelf-life extension
10. Management systems for safety and quality
11. Safety issues
12. Regulations for dairy products
13. Evaluation of product quality
14. Environmental considerations

Assessment

- **Coursework** **40%**
    - Field trip reports 10%
    - One term paper 15%
    - One In-Course test 10%
    - One presentation 5%
- **Final Exam** **60%**
    - 3-hour final written exam

MASTER OF SCIENCE: OCCUPATIONAL ENVIRONMENTAL SAFETY AND HEALTH (OESH)

PROGRAMME OBJECTIVES

- To develop advanced understanding of concepts and issues of Occupational & Environmental safety and Health.
- To provide training in the recognition, evaluation and control of occupational and environmental safety and health challenges.
- To address the urgent and growing need for the development of a cadre of professionals with competencies in Occupational and Environmental Safety and Health (OESH).
- To enhance the development, design implementation and management of complex OESH issues both in the private and public sector.
- To encourage functional awareness of the key issues related to environmental and occupational safety and the development of a proactive attitude to the expectations and demands of occupational and environmental safety and health on governments, environmental management, business enterprises, educational institutions, trade unions, workers and the public.
- To ensure that issues of cultural and individual diversity that are relevant to the Caribbean experience are fully integrated into training and practice.

Entry Requirements

- Either a First Degree or its equivalent in basic or applied sciences or related areas.
- Advanced placement for applicants with prior training in health and safety and suitable work experience.
- Applicants without prior OESH training or experience: arrangements will be made to bring their knowledge base up to the required level.

Areas of Research

Industrial hygiene, workplace safety, all aspects of environment, ergonomics, toxicology, standards and policy development.

Programme Duration

Full-time: 1 year
Part-time: 2 years

Courses are taught weekday evenings, weekends, holidays and the occasional weekday as required.

PROGRAMME STRUCTURE

Credit Requirements

The MSc. in OESH requires a minimum of 43 credits: eight (8) 4-credit taught courses and two (2) one-credit seminars over two semesters for full-time students and over four semesters for part-time students. A 9-credit Research paper is required to complete the programme.

Seminars

All students are required to attend all seminars arranged by the programme.

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
	SEMESTER I	
OESH6000	OESH and Public Policy	4
OESH6100	Advanced Environmental Health	4
OESH6200	Advanced Occupational Safety and Health	4
OESH6300	Seminar	1
OESH6600	Independent Study and Research Methods	4
	SEMESTER II	
OESH6010	Advanced Topics in OESH-A (Measurement Methods and Ventilation)	4
OESH6030	Advanced Topics in OESH-B (OESH Disorders)	4
OESH6040	Advanced OESH Management Systems	4
OESH6050	Advanced Topics in OESH-C (Ergonomics)	4
OESH6320	Seminar	1
	SUMMER (CORE COURSE)	
OESH6700	Research Project	9
	ELECTIVES	
OESH60X	Advanced Topics in OESH	4

COURSE DESCRIPTIONS

OESH6000 OESH AND PUBLIC POLICY
(4 Credits) (Semester 1)

Course Description

To develop an understanding of the complex, dynamic and delicate relationship between business pursuits, public interests and public policy. Students will:

1. Explore and analyze the process of public policy development, formulation and implementation
2. Explore and assess the impact of public policies on business pursuits, trade and human rights etc.
3. Analyze the cost-benefit of OESH public policies
4. Explore, analyze and evaluate OESH business ownership and consultancy opportunities and challenges
5. Explore, analyze, evaluate and communicate complex OESH risk issues to the public and specialized audiences

Learning Outcomes

On completion of this course the graduates should be able to:

1. Understand the principal inputs to public policy decisions
2. Communicate the local, national and international responsibilities for risk management to an organization
3. Communicate the results of risk assessments to workers and surrounding communities
4. Understand the legal basis for OESH litigation, and be able to serve as expert witnesses
5. Develop a viable business model for OESH consulting and ownership

Course Content

- Fundamentals of public policy-definition, goals and objectives of public policies (regulations, legislation)
- Initiation, mobilization of public support for, promulgation, implementation and enforcement of public policies
- The role of data, psychosocial factors in society, politics, religion and other cultural factors in public policy
- Cost-benefit analyses of OESH public policies
- Other public policies (national and global) that impact OESH policies and programmes (trade and market access/barriers
- Risk assessment and communication
- Negotiation skills/principles
- The process of innovation in OESH – science-technology-innovation connectivity, market, economic and cultural factors

- International legal systems as a context for OESH litigation
- The national legal system as a context for OESH litigation and the legal basis for OESH complaints
- Expert witness on OESH
- Business management skills
- Entrepreneurship in OESH-establishing an OESH business, consultancy, promoting OESH cultures
- Contractor's and sub-contractor's responsibilities in OESH
- Ethical principles of OESH work and the precautionary principal

Assessment

- **Coursework** **50%**
  - In-course test
- **Final Examination** **50%**
  - 3-hour final written exam

OESH6010 ADVANCED TOPICS IN OESH-A
(Measurement Methods and Ventilation)
(4 Credits) (Semester 2)

Course Description
The course is designed to provide students with extensive knowledge of the principles involved in air monitoring for toxic exposures. This will include the type of air contaminants, routes of exposure and the potential hazards they pose to people in the workplace. This course is designed to explore the use of engineering controls, such as building design and ventilation systems, to reduce the potential risks, while providing hands-on experience with the equipment used in air monitoring and the interpretation of results from the monitoring.

OESH6030 ADVANCED TOPICS IN OESH-B
(OESH Disorders)
(4 Credits) (Semester 2)

Course Description
The course will provide students with working knowledge of the principles of Occupational Toxicology, the impact of select toxicants on organ systems and how this knowledge may be used to protect workers, the general public, and the environment. The course will look at the nature of the toxicity of various chemicals, the regulatory framework in which these may be managed and the

existing standards which may guide how these chemicals are handled. The course will also look at the significance of HIV/AIDS as a workplace issue.

Assessment

- **Coursework** **50%**
    - In-course test
- **Final Examination** **50%**
    - 3-hour final written exam

OESH6040 ADVANCED OESH MANAGEMENT SYSTEM

(4 Credits) (Semester 2)

Course Description

To prepare OESH professionals to assist senior management in loss control measures by being proactive in preventing losses of OESH origin before they occur. Students will:

1. Employ the most modern and advanced technologies to assess exposure to occupational and environmental hazards
2. Explore and evaluate suitable occupational and environmental health care services
3. Identify and assess sources and management procedures for OESH risks in simple and complex organizations
4. Discuss coordination of OESH data, standards, policies, legislation and harmonize them with company activities
5. Assess and appreciate of contemporary governance models and practices

Learning Outcomes

On completion of this course the graduates should be able to:

1. Select and apply modern and advanced methods of exposure assessment
2. Understand the limitations of workplace and environmental exposure assessment
3. Apply the principles of organizational loss control
4. Audit an organization to determine the presence of occupational and environmental risks
5. Develop strategies for determining the relative risk of activities within an organization
6. Assess the cost/benefit of strategies for managing risk
7. Audit an organization for readiness and capability to respond to occupational and environmental incidents and disasters
8. Manage, evaluate and report on incident and disaster responses

Course Content

- 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
- Advanced risk assessment techniques
- Surveillance and geographical information systems
- Principles of cost accounting
- Management and leadership skills
- ISO series, other national, regional and international standards
- 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** **50%**
    - Laboratory reports and in-course test
- **Final Examination)** **50%**
    - 3-hour final written exam

OESH6050 ADVANCED TOPICS IN OESH-C
(OESH Disorders - Ergonomics)
(4 Credits) (Semester 2)

Course Description

The course will review the principles of Ergonomics or Human Factors, discuss the interaction between people and physical and psychological aspects of the work environment and illustrate the application of ergonomics in the prevention of accidents job induced fatigue and work-related musculoskeletal disorders. The course will incorporate a working knowledge of specifics aspects of human anatomy as it relates to musculo-skeletal disorders, which will allow students to apply that knowledge to the improvement of people's interaction with products systems, and workplace environments. Students should understand the concepts of designing for human use, optimizing working and living conditions to enhance effectiveness and efficiency of work.

Assessment

This course will be fully evaluated by coursework:

a) Lab report on fitness evaluations	20%
b) Hand tool assignment	10%
c) Analysis of an employee in a seated environment. And preparation of a 10 to 15-minute PowerPoint presentation on the case which will be shared on the class site	30%
d) Video Analysis of manual task using REBA, NIOSH and other tools from the course to complete this evaluation	20%
e) Case study involving psychosocial aspects of work-related injuries	20%

OESH6100 ADVANCED ENVIRONMENTAL HEALTH

(4 Credits) (Semester 1)

Course Description

To develop advanced understanding of concepts and issues of environmental health. Students will:

1. Explore and analyze the roles of environmental health professionals
2. Discuss and analyze in detail contemporary environmental health issues
3. Discuss and analyze in detail principles governing operations of equipment and technologies in environmental health
4. Comprehensively explore, discuss and evaluate resources available to environmental professionals
5. Explore and evaluate the environmental health impact of key industries in the region – tourism, mining, oils/gas, agriculture

Learning Outcomes

On completion of this course the graduates should be able to:

1. Articulate and appreciate the roles of the environmental professional, and know the resources available to assist them
2. Understand the concepts of environmental toxicity, hazard, exposure and risk and apply them to specific situations
3. Recognize and assess the magnitude of environmental hazards
4. Select and evaluate control technologies and processes
5. Source and use national and international guidelines, standards and regulations

Course Content

- The environmental professional, and the resources available to assist them

- Environmental toxicology and risk assessment
- Ecology and the biosphere
- 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** **50%**
    - Laboratory and field studies
- **Final Examination** **50%**
    - 3-hour final written exam

OESH6200 ADVANCED OCCUPATIONAL SAFETY AND HEALTH

(4 Credits) (Semester 1)

Course Description

To develop a deep understanding of advanced concepts of occupational safety and hygiene. Students will:

1. Discuss and evaluate the role of OSH professional and the resources available for their work
2. Use contemporary literature to explore, analyze and discuss ergonomic, chemical and physical hazards at the work place
3. Explore and select new technologies for assessing, evaluating and controlling workplace hazards
4. Source, analyze and discuss national, regional and global policy issues relevant to OSH

Learning Outcomes

On completion of this course graduates should be able to:

1. Articulate and appreciate the roles of OSH professionals and the resources available to assist them

2. Recognize, select and apply concepts of toxicity, hazard, exposure and risk to specific situations
3. Recognize and assess the nature and magnitude of the safety and health threat posed by occupational hazards
4. Evaluate and select control technologies to optimize occupational safety and health
5. Source, assess and employ national and international guidelines, standards and regulations to improve OSH conditions

Course Content

- 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
- Contemporary issues on physical hazards in the workplace
- Hazards of healthcare settings
- OSH programs
- Hazards of the skin and introduction to biological monitoring
- Measurement of chemical and physical hazards in the workplace
- Surveying the workplace
- Control technologies in the workplace – advances in engineering controls and personal protective equipment
- Safety
- Ergonomics
- Occupational epidemiology
- National and regional guidelines, standards and regulations
- International guidelines, standards and regulations

Assessment

- **Coursework** **50%**
  - Laboratory studies 20%
  - Field survey and report 30%
- **Final Examination** **50%**
  - 3-hour final written exam

OESH6300 SEMINAR

(1 Credit) (Semester 1)

Course Description

Students will attend seminars once a week and will be required to prepare and make presentations on their research topic or journal articles relevant to OESH at least once per semester.

OESH6320 SEMINAR

(1 Credit) (Semester 2)

Course Description

Students will attend seminars once a week and will be required to prepare and make presentations at least once per semester.

OESH6600 INDEPENDENT STUDY AND RESEARCH METHODS IN OESH

(4 Credits) (Semester 1)

Course Description

This is a very intensive course involving one module of Research Methods (18 hours); one module of Epidemiology (12 hours) and one module of Biostatistics (24 Hours). This course is intended to prepare students to successfully undertake their 9-credit research project.

Learning outcomes:

On completion of the course students should be able to:

- Conduct critical and extensive literature review, use of library and electronic sources of information
- Define research questions and determine the relevant aims/goals and objectives, anticipated results of study and their significance
- Describe and distinguish between study designs and research methodologies including instrumentation where applicable
- Write a research proposal
- Conduct research projects in diverse aspects of OESH and present the results using appropriate biostatistics measures
- Discuss the results and conclusions

Course content:

Research Methods

- Introduction to Research Methods
- Conducting literature review
- Study design (Goals and objectives)
- Sampling and other design issues
- Variable selection, scales of measurement

- Questionnaire design, pre-testing and data collection
- Data management/quality control; coding

Epidemiology
- Descriptive epidemiology and demography
- Analytic epidemiology
- Concepts of association and causation

Biostatistics
- Summarising data
- Basic principles of probability; sample distribution and Central limit theorem; z-and t-distributions
- Introduction to SPSS; confidence intervals, hypothesis testing; concepts of p-value
- Statistical inference
- Chi-square tests; Fisher's Exact test
- Analysis of variance -ANOVA
- Correlation and Regression
- Sample size determination

Assessment
- **Coursework** **50%**
    - In-course examination 20%
    - Laboratory studies and reports 30%
- **Final Examination** **50%**
    - 3-hour final written exam

OESH6700 RESEARCH PROJECT
(9 Credit) (Summer)

This is an independent research programme supervised by academic staff.

OESH60X ADVANCED TOPICS IN OESH
(Elective)

OESH topics and course content will be presented by academic staff and approved prior to being offered. The topics will explore in detail, quantitative aspects, current issues, phenomena and subjects in any area of scholarship that is important to OESH. Active student participation, hands on experience and other forms of participatory leaning will be encouraged. Formal examinations or a series of essays may be used to examine the students.

Examples of advanced topics:

- Building and assessing ventilation systems
- Land use planning and environmental conservation
- Emissions modeling and control
- Advanced topics on Asbestos management and biological effects
- Advanced occupational and environmental measurement, epidemiology and geographical information systems
- Understanding the role of vectors in the transmission of disease
- Critically evaluate different geographical disease information systems
- Understanding the geographical and temporal progression of disease, given modern social interaction and transportation systems
- Use of surveillance techniques to detect the presence of disease outbreaks
- Apply practical systems for the management of infectious disease transmission
- Introductory OESH Medicine
- Understand the advantages and limitations of the various techniques available for diagnosing occupational disease
- Recognize occupational diseases and distinguish them from diseases resulting from non-occupational exposures
- Evaluate patients presenting occupational disease symptoms for disability
- Understand the etiology of occupational diseases
- Understand treatment regimens for common occupational disorders

MPHIL/PHD IN CHEMISTRY

PROGRAMME OBJECTIVES

- To produce a cadre of leaders in science for academia (research and teaching), government and quasi-governmental organizations and industry: exponents of science and technology and conduits for S & T driven change and development.
- To generate new knowledge and publishable results
- To produce graduates with:
  - thorough knowledge of their specific areas of research (current state, trends, prospects) and good familiarity with allied high levels of technical and analytical skill; ability to collect, collate and interpret large volumes of information; the ability to communicate clearly and effectively, orally and in writing; the capacity to establish independent research programs (PhD holders).

Entry Requirements

The prerequisite for entry to the MPhil (Chemistry) program is a BSc degree in Chemistry with a minimum GPA of 3.00. Candidates holding Master's degrees in Chemistry are admitted directly into the PhD program, but the more general route to a PhD is via upgrading of registration from MPhil.

Duration of Programme

MPhil: approximately 3 years (Full-time); 5 years (Part-time)
PhD: approximately 5 years (Full-time); 7 years (Part-time)

Areas of Research

Bauxite/Alumina Chemistry, Catalysis, Chemical Education, Computer-assisted Chemistry, Electrochemistry, Food Chemistry, Inorganic Reaction Mechanisms, Metal Organic Framework Materials, Microbial Chemistry, Molecular Structure and Phase Transition, Nanomolecules, Natural Products, Nitrovasodilator Studies, Nutrient Pollution, Organic Synthesis, Organometallic Catalysis, Pesticide Degradation, Physical Chemistry of Interfaces, Pollution Chemistry, Quantum-dots, Structural Inorganic Chemistry, Structure and Properties of Electrochemical Interfaces, Supramolecular Chemistry, Surface Chemistry, Ultratrace Organic Toxin Analysis.

PROGRAMME STRUCTURE

Incoming graduate students register for the MPhil and, in the first semester, take a compulsory four-credit course, CHEM6904 (Research Methods). In the first and/or subsequent semesters candidates who intend to read for an MPhil take an additional two-credit course; those who plan to upgrade to a PhD must take courses (inclusive of Research Methods) which total nine (9) credits.

In the second semester each graduate student begins a research project in the programme of his/her chosen Supervisor(s). The research programmes of the individual academic staff members in the Department are, for the most part, executed by graduate students. After 2-3 years of research, a student is expected to either write a thesis and graduate with an MPhil or transfer from the MPhil to the PhD program. The transfer process entails the production of a document comprising a report of work completed and a proposal, the delivery of a seminar, and the presentation of an oral examination.

Required Courses

COURSE CODE	COURSE TITLE	CREDITS
	CORE COURSE	
CHEM6904	Research Methods	4
	COURSE (Electives)	
CHEM6002	Literature-based project	2
CHEM6101	Advanced Inorganic Chemistry	2
CHEM6201	Reaction Mechanisms in Organic and Bio-Organic Chemistry	2
CHEM6202	Organic synthesis: Methods, Design and Strategy	2

COURSE DESCRIPTIONS

CHEM6002 LITERATURE-BASED PROJECT

(2 Credits)

Course Description

Each student will choose a topic in an area of chemistry undergoing new and continuing developments and, using original papers, reviews and books as source material, write an organized and comprehensive review of the topic. Students will also deliver a short oral presentation which encapsulates the key elements of the review.

Assessment

- Continuous Assessment 15%
- Written review 60%
- Oral presentation 25%

CHEM6101 ADVANCED INORGANIC CHEMISTRY

(2 Credits)

Course Description

Two of the following three modules will be delivered.

- Bioinorganic chemistry - Coordination chemistry and the role of metal ions in biology. Metal ions in metalloproteins and metalloenzymes. Interactions of metal ions with biomolecules. Metals in medicine. Inorganic bio-transformations. Tuning of metals in the active sites of proteins. Frontiers in bioinorganic chemistry.
- Homogeneous & Heterogeneous Catalysis - Principles of catalysis. Thermodynamics and kinetics of catalytic processes. Homogeneous versus heterogeneous catalysts. Catalytic actions using inorganic catalysts.
- Chemistry of Materials - Bonding in solids, electronic conductivity - simple metals, insulators, semiconductors; photoconductors; superconductors; low-dimensional solids; laser, phosphor and quantum dot materials; inorganic polymers; clays; surface active materials; biomaterials; ceramics; nano-materials, dielectrics, electro-optics and ferro-electrics.

Assessment

- Examination 50%
- Assignments (3) and oral presentation (1) 50%

CHEM6201 REACTION MECHANISMS IN ORGANIC AND BIO-ORGANIC CHEMISTRY

(2 Credits)

Course Description

Two of the following three modules will be delivered.

- Physical organic chemistry and radical reactions - Kinetic vs thermodynamic control of reactions. Linear free energy relationships. Kinetic isotope effects. Hard and soft acids and bases. Mechanisms of some free radical reactions.
- Pericyclic reactions, photochemistry and singlet oxygen - The principle of Conservation of Orbital Symmetry. Frontier Molecular Orbital analysis of electrocyclic reactions, cycloadditions and sigmatropic rearrangements. Correlation diagrams. The Diels-Alder reaction a detailed treatment. Properties of photochemical excited states. Special features of photochemical reactions. Sensitization. Non-pericyclic photochemical reactions of alkenes. Photochemical reactions of carbonyl compounds. Singlet oxygen: formation, properties, reactions.
- Reaction mechanisms in bioorganic chemistry - Introduction to enzymes and coenzymes. Catalytic activity of enzymes. Hydrolytic and group transfer reactions. Biosynthetic redox processes. Enzymatic carbon-carbon bond formation. Enzymatic addition/elimination reactions. Selected enzyme-catalyzed isomerizations and rearrangements.

Assessment

- Examination 50%
- Assignments (3) and oral presentation (1) 50%

CHEM6202 ORGANIC SYNTHESIS: METHODS, DESIGN AND STRATEGY

(2 Credits)

Course Description

The aim of this course is to enlarge and deepen students' knowledge of key methods in organic synthesis and to equip them with the techniques for planning and designing their own organic syntheses. Topics covered: oxidation and reduction; asymmetric synthesis; synthesis of alkenes; organometallics in synthesis; carbenes and carbene complexes in synthetic transformations; retrosynthetic analysis.

Assessment

• Examination	50%
• Assignments (3) and oral presentation (1)	50%

CHEM6904 RESEARCH METHODS

(4 Credits)

Course Description

- Introduction to the concepts of scientific research, logical progression, methods of data collection and analysis, scientific writing and oral presentation, and research ethics.
- Applications of computers in chemistry introduction to some chemistry software packages available in the department or online.
- Training in the use of instruments available in the department: NMR, FT-IR and UV/Vis spectrometers. The use of available software for data collection and manipulation.

Assessment

• Two in-course tests	20%
• Computer exercise and submission of spectra	15%
• Report	40%
• Oral presentation	25%

MPHIL/PHD IN OCCUPATIONAL & ENVIRONMENTAL SAFETY AND HEALTH

PROGRAMME OVERVIEW

The Department of Chemistry, through the OESH Programme, offers the Master of Philosophy and Doctor of Philosophy in Occupational & Environmental Safety and Health.

The Masters Programme prepares persons to develop, design, implement and manage complex OESH programmes and systems. Graduates are able to provide consultancy services and education. The Doctoral Programme prepares persons to provide high level leadership in OESH research and policy design, implementation, analysis and evaluation.

Entry Requirements

Applicants must have either a First Degree or its equivalent in basic or applied sciences. Advanced placement will be made for applicants with prior training in health and safety and suitable work experience. Candidates with only the B.Sc. Degree or its equivalent are required to enroll in the final year B.Sc. (OESH) course before entering their M.Sc. or postgraduate research programme.

Programme Duration

MPhil

Full-time: Two (2) years Part-time: Four (4) years

PhD

Full-time: Three (3) years Part-time: Six (6) years

Applications for MPhil and PhD programmes are accepted year round.

Areas of Research

Industrial hygiene, workplace safety, all aspects of environment, ergonomics, toxicology, standards and policy development.

PROGRAMME STRUCTURE

PhD students must complete a minimum of 9 credits from the MSc OESH programme and conduct research leading to a thesis.

Students from the Bachelor of OESH programme must do the MSc. (OESH) coursework. Those with the MSc. (OESH) will need three years minimum residence in a research programme while those who opt to register for the PhD (OESH) degree without completing the MSc. (OESH) degree programme will be required to do a minimum of two more years of research. PhD students will register for the 'Seminar Course' (1 credit) each semester, attend regular seminars and make presentations once per semester.

Award of Degree

The degree will be awarded in Occupational and Environmental Safety and Health

Department of Computing

www.mona.uwi.edu/compsci

4

Certificate and Diplomas

Certificate in Applied Data Science
Diploma in Applied Data Science
Diploma in Information Technology

Taught Master's Degrees

MSc in Applied Data Science
MSc in Computer-Based Management Information Systems
MSc in Computer Science

Research Degrees

MPhil in Computer Science
PhD in Computer Science

Head of Department: Dr Gunjan Mansingh
Graduate Coordinators: Dr. Carl Beckford
Contact: 4 Anguilla Close
The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: computing@uwimona.edu.jm
Tel: (876) 702-4455 (Office) / (876) 970-0923 (Graduate Section)
Fax: (876) 702-4455

MASTER OF SCIENCE: APPLIED DATA SCIENCE

PROGRAMME OVERVIEW

The Master of Science in Applied Data Science provides for the development of key competencies in an expanding and increasingly demanding subject area of study. The programme seeks to develop a cadre of graduates with the key skills necessary to extract, apply and develop algorithms to make sense of data and scaling those methods in different platforms. The programme is meant to provide experiential and much practical engagement once the theoretic concepts have been introduced. It is expected that the graduate will both understand the reasons why these techniques work, and possess the ability to modify, extend and apply them in various specialty areas using the available tools and algorithms. Therefore, the programme provides tangible, immediately applicable skills coupled with foundations that allow the expansion of these for the ever-increasing application areas for data science.

Programme Objectives

This programme will enhance the current offerings in the Department of Computing to tap into this emerging field of Data Science and will be supported by the cluster of staff currently conducting research in related data science areas.

The programme offers a Graduate Diploma and Master of Science (MSc), allowing students to be immersed into data science at two levels. The diploma provides an introduction to the fundamentals and application areas; the MSc extends the breadth of coverage in the discipline.

The main objectives of this programme are:

a) To develop competence in students to identify and apply Data Science solutions to real world situations;
b) Provide advanced level Data Science education to better enable students to impact their organizations;
c) Equip students with skills necessary to advance in Data Science careers (Big Data, Analytics, Machine Learning, Knowledge Management)

Entry Requirements

The minimum entry requirement for either the Graduate Diploma or MSc is at least a first degree from an accredited university in any Natural, Applied or

Social Science. Applicants from other disciplines may be accepted on the basis of demonstrated quantitative coursework.

Additional Requirements

- Students entering the Graduate Certificate or Graduate Diploma must meet the minimum entry requirement and have a GPA of at least 2.5. Students may also be accepted if they have a GPA of 2.0 and at least 1 year of Technical Experience.
- Students seeking to enter the MSc must meet the minimum entry requirements and have at least a 2.5 GPA.

Transfers

- Transfers are not allowed after an award has been made.
- A student enrolled in the Graduate Certificate may transfer to the Graduate Diploma after completing at least six (6) credits and having at least a B average.
- A student who is enrolled in the Graduate Diploma may transfer to the MSc provided that they have completed all credits for Data Science taught courses (at least 15 credits, excluding the research paper) and have at least a B average. Such students shall apply for a change of major at any time before registering for their Capstone Project, which, if approved will result in automatic transfer to the MSc.
- A student enrolled in the MSc may request permission to be awarded the Graduate Diploma, provided they meet the requirements for the Graduate Diploma.
- A Student who has been awarded for Applied Data Science (Certificate/Diploma) is NOT allowed to enroll for any further Applied Data Science programmes.

Exemptions

Students entering the programme with a degree in any Computing Discipline may request to be exempted from the following courses without credit: COMP4217 – *Introduction to Database Principles*, COMP4620 – *Programming Principles*. Students who have been approved for these exemptions will be required to take additional MSc Computing courses to meet the credit requirements. Students who seek the award of the Master's in Data Science will be required to take MSc Computing electives to fulfil the credit requirements.

No exemptions are available for students enrolled in the Certificate in Applied Data Science.

PROGRAMME STRUCTURE

COURSE CODE	COURSE TITLE	CREDITS
COMP4217	Introduction to Database Principles	3
COMP4610	Statistics for Data Science	3
COMP4620	Programming Principles	3
COMP4621	Programming for Data Science	3
COMP5630	Data Visualization	3
COMP6720	Advanced Databases Systems	4
COMP6115	Knowledge Discovery and Data Analytics 1	4
COMP6125	Knowledge Discovery and Data Analytics 2	4
COMP6130	Big Data Analytics	3
COMP6815	Data Science Seminar	2
COMP6820	Data Science Capstone Group Project I	3
COMP6830	Data Science Capstone Group Project II	6

Programme Requirements

a) Graduate Certificate in Applied Data Science (15 credits)

- COMP4217 Introduction to Database Principles
- COMP4610 Statistics for Data Science
- COMP4620 Programming Principles
- COMP4621 Programming for Data Science
- COMP5630 Data Visualization

b) Graduate Diploma in Applied Data Science (25 credits)

- COMP4217 Introduction to Database Principles
- COMP4610 Statistics for Data Science
- COMP4620 Programming Principles
- COMP4621 Programming for Data Science
- COMP5630 Data Visualization

AND ANY TWO from the following:

- COMP6720 Advanced Databases
- COMP6115 Knowledge Discovery and Data Analytics 1
- COMP6125 Knowledge Discovery and Data Analytics 2

Plus COMP6820 - Data Science Capstone Group Project I

c) Master of Science in Applied Data Science (42 credits)

- COMP4217 Database Management Systems
- COMP4610 Statistics for Data Science
- COMP4620 Programming Principles

- COMP4621 Programming for Data Science
- COMP5630 Data Visualization
- COMP6720 Advanced Databases
- COMP6115 Knowledge Discovery and Data Analytics 1
- COMP6125 Knowledge Discovery and Data Analytics 2
- COMP6130 Big Data Analytics
- COMP6815 Data Science Seminar
- COMP6830 Data Science Capstone Project II

  Plus Additional MSc Computer Science electives to meet the credit requirements.

COURSE DESCRIPTIONS

COMP4217 INTRODUCTION TO DATABASE PRINCIPLES
(3 Credits)

Eligibility Requirement
Data Science Programme Students ONLY

Course Description
This course is a postgraduate-level introduction to the implementation of database management systems (DBMS). It falls between an undergraduate introductory database course and a graduate advanced database course. As a result, the course aims to introduce students to the basics of database management systems while introducing more advanced concepts such as Physical Database Design. This course also aims to give students practical experience in designing and manipulating database driven application using current database design techniques.

Learning Outcomes
On successful completion of this course, student should be able to:

- Describe the layered structure of a database
- Describe the basic principles of the relational data model
- Apply the modeling concepts and notation of the relational data model
- Demonstrate queries in the relational algebra
- Use a declarative query language to extract information from a database

- Explain how physical database design affects database transaction efficiency
- Evaluate a set of query processing strategies and select the optimal strategy
- Describe the issues specific to efficient transaction execution
- Describe strategies used by a DBMS for concurrency control
- Write queries to manipulate a NoSQL database
- Describe technical solutions to problems relating to information security in a DBMS

Course Content

1. Introduction to Database Concepts
2. Data Modeling
3. Relational Databases
4. Data Normalization
5. SQL
6. Query Optimization
7. Transaction Management
8. Distributed Databases
9. Physical Database Design
10. Database Security
11. NoSQL Databases

Assessment

The coursework will consist of assignments, assessed labs, a project and a final exam. The assignments, assessed labs, and project should allow students to demonstrate that the specific learning outcomes have been achieved.

- **Coursework** **60%**
    - Assignments (30%)
    - Assessed Labs (15%)
    - Project (15%)
- **Final examination** **40%**

Students will be required to pass both the coursework and the final examination to pass the course.

COMP4610 STATISTICS FOR DATA SCIENCE
(3 Credits)

Eligibility Requirements
Data Science Programme Students ONLY

Course Description
This course will introduce students to the statistics foundations necessary for data science application. The topics covered are primarily to help students understand the basis of advanced techniques which will be applied in other courses. The course will address key concepts necessary for understanding the results from many data science techniques and provide for proper interpretation of results. The course will not focus on excessive hand computations; instead, it will be heavily skewed toward employing and relating the concepts to the real-world areas. Concepts are made concrete through numerical computation.

Course Objectives
On successful completion of this course, student should be able to:

- Explain basic statistical principles and their limitations
- Apply statistical principles using software
- Apply and interpret statistical models on different data sets
- Explain the basic principles of statistical inference
- Apply core concepts of probability theory

Course Content

1. Introductory Statistical Concepts (Inferential and Descriptive Statistics basics)
2. Probability: (uncertain world, perfect knowledge of the uncertainty)
    - Counting
    - Random variables, distributions, quantiles, mean variance
    - Conditional probability, Bayes' theorem, base rate fallacy
    - Joint distributions, covariance, correlation, independence
    - Central limit theorem
3. Statistics I: (perfect knowledge of the uncertainty)
    - Bayesian inference with known priors, probability intervals
    - Conjugate priors
4. Statistics II: (imperfect knowledge of the uncertainty)
    - Bayesian inference with unknown priors
    - Frequentist significance tests and confidence intervals
    - Resampling methods: bootstrapping
    - Linear regression

Assessment

The coursework will consist of 1 project and 2 written assignments. The assignments should allow students to demonstrate that the specific learning outcomes have been achieved.

- **Coursework** **60%**
    - 2 Project at 20% each (40%)
    - 2 Written Group Project - (10%)
- **Final examination (2hrs)** **40%**

Students will be required to pass both the coursework and the final examination to pass the course.

COMP4620 PROGRAMMING PRINCIPLES

(3 Credits)

Eligibility Requirement

Data Science Programme Students ONLY

Course Description

This course introduces the basic foundational concepts in programming primarily applicable to data science. The student will be provided with hands on experience applying several techniques and data structures to retrieve and manage data and assess the performance implications based on the structures and techniques applied.

Learning Outcomes

On successful completion of this course, student should be able to:

- Discuss the various types of data structures suitable for representing different data;
- Analyze the performance implications of using different structure to manage data;
- Implement algorithms and data structures to organize and prepare data for analysis;
- Develop solutions to collect, retrieve and prepare data for different types of analysis.

Course Content

1. Basic programming constructs: data types, expressions, sequence, iteration, recursion, conditionals
2. Data structures and representations (e.g. lists, trees, dictionaries, data frames, graphs)

3. Sorting and Searching
4. Performance measurements (space and time complexity)

Assessment

The course will be assessed by coursework having three (3) components and a final examination. The assignments should allow students to demonstrate that the specific learning outcomes have been achieved. Students will be required to pass both the coursework and the final examination to pass the course.

- **Coursework** **60%**
    - 1 Project (20%)
    - Assignment (15%)
    - 5 Labs at 5% each (25%)
- **Final examination** **40%**

COMP4621 PROGRAMMING FOR DATA SCIENCE

(3 Credits)

Eligibility Requirement

Data Science Programme Students ONLY

Course Description

This course introduces fundamental data science process and attendant concepts. Students will be provided with hands on experience applying several techniques to extract, transform and analyze data and elicit meaning. The course will also introduce ethical considerations when implementing data science solutions.

Learning Outcomes

On successful completion of this course, student should be able to:

- Apply techniques to acquire and organize data from different sources
- Implement algorithms for techniques to clean and prepare data for analysis
- Apply exploratory data analysis methods on small data sets
- Apply the data science process to simple data analysis problems
- Describe ethical issues that may arise in data science applications

Course Content

1. Applying the Data Science Process
    - Data Wrangling: extractions, parsing, joining, standardizing, augmenting, cleansing, consolidating and filtering

- Data Cleaning (ETL): Data Auditing: Analysis (mean, standard deviation, range), Eliminating Duplicates, Translation and Normalization: Data Smoothing Techniques
- Describing data: Exploratory Data Analysis (EDA); Data Visualization: Summaries, aggregation, smoothing, distributions

2. Building structure from a variety of data forms to enable analysis
3. Data Modeling (Linear and Stochastic)
4. Ethics in Data Science

Assessment

The course will be assessed by coursework, consisting of both individual and group assignments. Students will be required to pass both the coursework and the final examination to pass the course.

- **Coursework** **60%**
    - 1 Project (25%)
    - Assignment (10%)
    - 5 Labs at 5% each – (25%)
- **Final examination** **40%**

COMP5630 DATA VISUALIZATION

(3 Credits)

Eligibility Requirements

Data Science Programme Students ONLY

Course Description

In this course we will study the art the science behind building visualizations with special focus on the techniques and algorithms for creating effective visualizations based on principles from graphic design, visual art, perceptual psychology, and cognitive science.

This course will develop the student's capacity to build, critique and improve visualizations of data. Through readings and discussion of seminal work, students will learn the principles of graphical perception and the visual encoding of quantitative information and learn how to use these principles to evaluate an effective visualization. Through exposure to famous and infamous visualizations, you'll explore what makes graphical representations of data successful or unsuccessful, and gain an appreciation of the different goals of visualization. A key part of the class will be developing visualizations and critiquing other's visualizations.

Learning Outcomes

On successful completion of this course, student should be able to:

- Deconstruct a graphic into the data displayed and how it is mapped to visual properties.
- Describe the order of accuracy of perceptual tasks and how this affects the choices made in constructing a visualization.
- Critique a visualization based on its purpose and use or abuse of perceptual principles.
- Suggest improvements of a visualization to enhance its effectiveness.
- Use color in visualization appropriately for the variable it is encoding.
- Create visualizations and explain visceral, behavioral characteristics and types of decisions that should be taken on the data.
- Combine tools for data manipulation and visualization, to collect, and clean data to create visualizations to answer questions of interest.

Course Content

1. Introduction: the purpose of visualization, the guiding principles of visualization, the deadly sins of bad graphics, describing graphics.
2. Deconstructing and constructing graphics: parts of a graphic, continuous and discrete variables.
3. Working with different types of data, dimensions, measure and spatial data/maps.
4. Create interactive visualizations.
5. Create visualizations which narrate a story by creating dashboards.

Assessment

The coursework will consist of an assignment and a project. The assignment expose students to different types of practical exercises and the project exposes students to applying their knowledge to a business problem that require visualization and their presentation skills. Students will be required to pass both the coursework and the final examination to pass the course.

- **Coursework** **60%**
    - Create Visualizations (30%)
    - Project (30%)
- **Final examination** (2hrs) **40%**

COMP6115 KNOWLEDGE DISCOVERY AND DATA ANALYTICS I

(4 Credits)

Prerequisites

COMP4217: Database MANAGEMENT Systems,
COMP4610: Statistics for Data Science,
COMP4620: Programming Principles,
COMP4621: Programming for Data Science

Course Description

This course will introduce students to various techniques of data mining such as predictive and descriptive analytics. There are two components of this course; the first focusses on the conceptual introduction to turning data into actionable knowledge and second introduces the set of techniques, algorithms and tools that can be used in performing the analysis. The course will equip students to identify and apply for a particular business/research problem appropriate data mining techniques/algorithm and tools.

Learning Outcomes

On successful completion of the course, students should be able to:

- Describe and apply a knowledge discovery process model to an analytics task.
- Apply appropriate data cleaning, pre-processing and integration methods to prepare the data for analysis.
- Apply and/or implement the principle algorithms for the data mining techniques.
- Select and apply a data mining technique (descriptive and predictive) for a given business/research problem.
- Evaluate the various performance measure that can be used to assess the developed models.
- Conceptualize a data mining solution to a practical problem.

Course Content

1. Introduction, basic concepts and motivation.
2. Knowledge Discovery Process Model.
3. Data pre-processing: preparing data for analysis, basic data transformations.
4. Classification and Prediction techniques: Regression; K- Nearest Neighbour; Decision trees; Neural networks; Simple Vector Machines.
5. Performance measures for models.
6. Clustering: Agglomerative and Hierarchical.

7. Association rule induction and Sequential rule mining. Domain-specific code generation

Assessment

The coursework assignments expose students to different types of practical exercises and the project exposes students to applying their knowledge to a business problem that require data mining and their presentation skills. Students will be required to pass both the coursework and the final examination.

- **Coursework** **50%**
  - Analytics – Assignment 1 15%
  - Analytics – Assignment 2 15%
  - Project 20%
- **Final examination** **50%**

COMP6125 KNOWLEDGE DISCOVERY AND DATA ANALYTICS II

(4 Credits)

Prerequisite

None

Course Description

This course will introduce students to various techniques to analyze unstructured data. There are two components of this course; the first focusses on mechanism of representing knowledge and second on algorithms and techniques that can be used on non-traditional data sources to perform the analysis. The course will equip students to identify and apply appropriate techniques while dealing with unstructured data.

Learning Outcomes

On successful completion of the course, students should be able to:

- Develop and implement an ontology
- Apply techniques for reasoning under uncertainty
- Apply the algorithms for the different techniques that work on unstructured data sources like human experts, documents and web forums
- Conceptualize and implement an analytics solution to a practical problem which requires unstructured data

Course Content

1. Introduction, basic concepts and motivation
2. Knowledge Representation- Production rules and Ontology
3. Reasoning under uncertainty

4. Natural Language Processing
5. Text Mining
6. Sentiment Analysis
7. Web Mining
8. Processing large amounts of data

Assessment

The coursework assignments expose students to different types of practical exercises and the project exposes students to applying their knowledge to a business problem that require data mining and their presentation skills. Students will be required to pass both the coursework and the final examination.

- **Coursework** **50%**
    - Paper Review, Discussion and Presentation – Assignment 1 (20%)
    - Analytics – Assignment 2 (15%)
    - Project (15%)
- **Final examination** **50%**

COMP6130 BIG DATA ANALYTICS

(3 Credits)

Prerequisites

COMP6720: Advanced Databases and
COMP6115: Knowledge Discovery and Data Analytics I

Course Description

This course will focus on the processing and analysis of large datasets (Big Data) while applying parallel machine learning techniques for handling these datasets. The use of tools like Apache Spark, Hadoop, MapReduce and NoSQL systems will be leveraged to speed up computation. The majority of the course material will be drawn from textbooks and research papers.

Learning Outcomes

On successful completion of this course, student should be able to:

- Understand the concepts of Big Data
- Build predictive systems that rely on large datasets.
- Analyze data streams using appropriate technology (e.g. Apache Spark)
- Process large datasets to extract valuable information

- Plan and implement a strategy for big data management in an organization
- Store and process unstructured data
- Apply the appropriate parallel machine learning algorithms to reduce computation
- Design graphical model solutions to problems

Course Content

1. Introduction to Big Data
2. Big Data Infrastructure (e.g. Apache Hadoop + MapReduce)
3. Stream Processing using appropriate technology (e.g. Apache Spark)
4. Machine Learning systems for Big Data
5. NoSQL Systems for Big Data
6. Graph Analytics for Big Data
7. Clustering Analysis for Big Data
8. Recommendation Systems using Big Data
9. Big Data Management

Assessment:

- **Coursework** **60%**
    - In-course Test (10%)
    - 2 Projects (40%)
    - 2 Homework assignments (10%)
- **Final examination** (3hrs) **40%**

COMP6720 ADVANCED DATABASE SYSTEMS

(4 Credits)

Prerequisite

COMP4217: Database Management Systems

Course Description

This course will extend the content covered in an undergraduate database systems course. Students will be provided with the opportunity for gaining a deep understanding of the important concepts and techniques of physical database design and provide students with the opportunity for gaining a fundamental understanding of the architecture of modern database management systems which include Relational and NoSQL systems.

Learning Outcomes

At the end of this course students should be able to:

- Define the Database Systems Concepts
- Describe the DBMS architecture and justify the need for the various components of the architecture.
- Describe query optimization and illustrate using relational algebra its importance for relational database management systems.
- Identify important systems implementation techniques and discuss their importance in terms of relational databases.
- Implement dynamic multilevel indexes using B-trees
- Use hashing to facilitate dynamic file expansion
- Explore the different uses and implementations of NoSQL databases.

Course Content

1. Hardware for DBMS
2. File and system structure
3. Indexing
4. Hashing
5. Advanced query processing
6. Query optimization
7. Failure recovery
8. Concurrency control
9. Transaction management
10. Parallel and distributed databases
11. NoSQL systems

Assessment

Students are required to demonstrate their ability to apply MDE techniques to the development of solutions. This includes creating languages, frameworks and code generators. This course is therefore heavily weighted towards the coursework components. Students must pass both coursework and examination components independently to successfully complete the course.

- **Coursework** **40%**
  - In-course test - (10%)
  - Group Project - (10%)
  - Assignments (2) - (20%)
- **Final examination** **60%**

COMP6815 DATA SCIENCE SEMINAR
(3 Credits)

Prerequisite
15 Credits of Data Science Programme Courses

Eligibility
MSc and Diploma Data Science Programme Students ONLY

Course Description
This course will develop the student's capacity to make presentations regarding applications of data science to real world problems and give a full seminar which evaluates and critically analyzes such problems and their solutions.

Learning Outcomes
On successful completion of this course, student should be able to:

- Evaluate Data Science solutions
- Make coherent, effective presentations of impact and quality of data science solutions
- Critically assess ethical issues related to specified data science solutions
- Assess risks and regulations related to data protection

Course Content

1. Performance Measures for Data Science Applications (value systems design)
2. Presentation Skills & Report Writing
3. Communication Methods
4. Case Studies in Data Science
5. Ethical Issues in Real-World Data Science Applications (Privacy, Confidentiality)

Assessment

- **Coursework** **100%**
    - Ethics Presentation (30%)
    - Critical Analysis Report and Presentation (70%)

COMP6820 DATA SCIENCE CAPSTONE GROUP PROJECT I
(3 Credits)

Eligibility
Diploma Data Science Programme Students ONLY

Prerequisite
19 Credits of Data Science Programme Courses

Course Description
This course is the required group project course for all students seeking the graduate diploma in Applied Data Science. It is intended to be a capstone course that will bring together many of the topics that were covered in the rest of the curriculum. For this reason, students will be expected to take this course as their final paper with no outstanding credits required for award of their Diploma and will be allotted 3 months to complete the project. The project must encompass all matters relating to the Data Science Process: Data Retrieval from external sources, pre-processing and cleaning, preparation and modeling. The data sources may either be structured or un-structured.

Students will be allowed to conduct the project in pairs, where numbers do not allow for equal pairs, the course coordinator may grant approval for one group of 3 with extended project scope.

Assessment
The final mark for each project will be based on documents, artifacts, presentations and demonstrations (where appropriate) of the following:

- Project Plan/Proposal **10%**
- Technical Documentation **25%**
- Software artifacts **25%**
- Final Presentation **40%**
    - Management Report
    - Presentation and demonstration of final product

COMP6830 DATA SCIENCE CAPSTONE GROUP PROJECT II
(6 Credits)

Prerequisite
32 Credits of Data Science Programme Courses

Eligibility Requirement
Diploma Data Science Programme Students ONLY

Course Description

This course is the required individual project course for all students seeking the Master of Science in Applied Data Science. It is intended to be a capstone course that will bring together many of the topics that were covered in the rest of the curriculum. For this reason, students will be expected to take this course as their final paper with no outstanding credits required for award of their MSc and will be allotted 6 months to complete the project. The project must encompass all areas relating to the Data Science Process: Data Retrieval from disparate sources, pre-processing and cleaning, preparation and modeling. The data used MUST be a combination of structured and un-structured, and be relatively large.

The student is required to complete their work as an Individual project.

Assessment

The final mark for each project will be based on documents, artifacts, presentations and demonstrations (where appropriate) of the following:

- Project Plan/Proposal 10%
- Technical Documentation 25%
- Software artifacts 25%
- Final Presentation 40%
    - Management Report
    - Presentation and demonstration of final product

DIPLOMA IN INFORMATION TECHNOLOGY

PROGRAMME OBJECTIVES

The Postgraduate Diploma in Information Technology (PGDIT) is aimed at bridging the gap for applicants with no prior academic experience or exposure to any Computing discipline. It is a self-financing programme and students are expected to complete the diploma over a period of three (3) sequential semesters with a total of thirty-two (32) credits.

Entry Requirements

The programme is open to candidates with at least a first degree in a discipline other than Computing. The programme is delivered in face-to-face mode, with classes held in the evenings to facilitate part-time working students.

PROGRAMME STRUCTURE

The programme is offered in an accelerated format over one academic year (3 semesters. Subject areas including programming in at least two (2) widely used languages, mathematics for the field of IT, software engineering, networking and databases. Courses are offered in pairs, over a period of eight (8) weeks. The eight-week period is broken down as follows:

- Contact hours - two 4-hour sessions per week over a period of six (6) weeks
- 2-week break
- Examinations for the two courses at the end of the 2-week break
- 1-week break between the examinations and the start of the next 2 courses

Credit Requirements

To graduate, a student must complete a total of 32 credits as follows:

- A core of six courses (Including Individual Project) for 24 credits
- Two electives for 8 credits

Programme Content

Course Code	Course Name	Credits
Core Courses		
CS41A	Introduction to Computer Programming	4
CS41Q	Computer Architecture	4
CS42A	Data Structures	4
CS42M	Discrete Mathematics	4
CS43Q	Operating Systems & Networks	4
CS49S	Individual Project	4
Electives (Any two)		
CS42Q	Introduction to Database Principles	4
CS43A	Algorithms & Analysis	4
CS44A	C Programming & Unix	4
CS44Q	Internet Computing	4
CS46S	Graphics & Multimedia	4

Additional Information/Notes:

- Students exempted from any course due to previous study are required to take replacement elective courses.
- Students proceeding to the MSc are required to take the Algorithms and Analysis elective.

COURSE DESCRIPTIONS

CS41A: Introduction to Computer Programming
4 Credits Semester 1

Course Description
A first course in computer programming

Course Content
Examines the syntax and semantics of a chosen programming language, including object-oriented programming techniques.

CS41Q: Computer Architecture

4 Credits Semester 1

Course Description

A study of the hardware components of modern microcomputers and their organization.

Course Content

Evaluation and comparison of the various microcomputer systems.

CS42A: Data Structures

4 Credits Semester 1

Course Description

Data Structures used in computer programming to represent domain objects and activities.

Course Content

Algorithms for manipulating the data structures. Advanced object-oriented programming techniques to implement the algorithms.

CS42M: Discrete Mathematics

4 Credits Semester 1

Course Description

The discrete mathematical skills fundamental to the computing and information sciences.

CS42Q - Introduction to Database Principles

4 Credits Semester 2

Course Description

This course provides students with an understanding of the importance of database technology in today's society and how they can use this technology to manage their own data requirements.

Course Content

Detailed discussions of database design and the relational database model.

CS43A: Algorithms and Analysis

4 Credits Semester 2

Course Description

Design of efficient data structures and algorithms.

Course Content

Analysis of algorithms and asymptotic time complexity. Graph, string and geometric algorithms.

CS43Q: Operating Systems & Networks

4 Credits (Semester 2)

Course Description

Introduction to fundamental concepts of operating systems and their implementation in UNIX and Windows. Principles of computer network design, operation and management.

CS44A: C Programming & UNIX

4 Credits (Semester 2)

Course Description

Programming in the C language in a UNIX environment.

Course Content

The syntax and semantics of the C language, with emphasis on features that make C effective for applications. Study of some code libraries available to C programming. The user environment of UNIX, its file system and tools. Programming for UNIX through the system call interface, including internet programming.

CS44Q: Internet Computing
4 Credits (Semester 2)

Course Description
Principles and practices used in creating interactive internet sites

Course Content
Using dynamic HTML, JavaScript, and the Common Gateway Interface. Effective use of search tools. Java Database Connectivity, swing, applets, and servlets. Principles and practices used in connecting web sites to back-end databases with Active Server Pages, PHP: Hypertext Preprocessor, JavaScript, Java servlets, and Java Server Pages. Internet programming with Python or Perl.

CS46S: Graphics and Multimedia
4 Credits (Semester 2)

Course Description
A first course in algorithms and techniques for image generation.

Course Content
Geometric transformations, algorithms for hidden surfaces and ray tracing. Programming with standard a graphics interface. The planning and creation of interactive multimedia presentations, developing a conceptual and practical understanding of the components of media and their production.

CS49S: Individual Project
4 Credits (Semester 3 (summer))

MASTER OF SCIENCE: COMPUTER-BASED MANAGEMENT INFORMATION SYSTEMS

PROGRAMME OVERVIEW

The Master of Science in Computer-Based Management Information Systems (CBMIS) is a joint programme offered by the Department of Computing (DOC) and the Mona School of Business and Management (MSBM). Since its inception in 1993, the CBMIS programme has sought to train and educate students to have a positive impact in various organizations, both regionally and globally. The programme was established in response to the rapidly growing demand for a new type of graduate student with an in-depth knowledge in management information systems and computer science. This demand arose from the increased use of computer-based systems in the financial, manufacturing, mining and retail sectors, as well as in the government sectors.

The purpose of the recently revised programme continues to be one of meeting the demand for the management of information.

Entry Requirements

Applicants must possess a first degree with a major in Management Studies or in a recognized Computing discipline from a recognized university.

Duration

The programme is offered over two years (24 months) inclusive of time needed for completion of the major Research Project.

PROGRAMME STRUCTURE

Courses will be offered in modular format; usually two (2) courses over a six-week period, followed by a two-week break.

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
COMP5110	Database Management	3
COMP5741	Introduction to Programming	3
COMP6101	Introduction to Software Engineering	3
MGMT6017	Organizational Theory and Behavior	3
MGMT6019	Finance	3
MGMT6021	Production and Operations Management	3
MGMT6031	Final Project	6**
MISY6110	Information Systems in Organization	3
MISY6113	Decision Support Systems	3
MISY6114	E-Commerce	3
MISY6115	IT Economics	3
MISY6116	IT Governance and Policies	3
MISY6117	IT Project Management	3
MISY6118	IT Security	3
MISY6119	Communication & Special and Emerging Topics in MIS	1*
SBCO6190	New Ventures and Entrepreneurship	3

*The number of hours covered for the seminar series captures the required time that will be logged for the students, and will be distributed across the duration of the programme. Students will be required to register in the final semester of the final year.
** Contact hours include consultation with project coordinator for the final project

COURSE DESCRIPTIONS

MANAGEMENT COURSES

MGMT6017 ORGANIZATIONAL THEORY AND BEHAVIOUR
(3 credits)

Course Description
This course introduces the basic concepts in social psychology relevant to the study and understanding of individual and group behaviour in an organizational setting. It shows the information system manager and analyst how interpersonal and structural variables influence job and task performance, individual and group productivity and their impact on the achievement of consistent quality in organizational outputs.

MGMT6019 FINANCE

Course Description

Finance is the study of how we allocate resources over time and under uncertainty. The objective of this course is to provide the student with an introduction to the principles of financial management. The areas of study include: financial markets and instruments, time value of money, valuation of assets and projects under certainty and uncertainty, and corporate financing policy. The ability to collect, analyze and present information (in our case financial information) is critical in every area of business, politics and economics. We will devote some of our class time to finance principles and their applications, and some time to building analytical skills.

Learning Outcomes

At the end of the course students should be able to:

- Understand the Time Value of Money
- Characterize the Nature of Financial Risk and how to characterize and value risky cash flows?
- Sharpen our Financial Math and Modeling Skills, and to investigate most areas in finance, developing the math skills needed to understand applications of finance theory, and ability to import, analyze and present financial data on a spreadsheet.
- Increase our Understanding of Financial Markets and Instruments, introduce and value stocks and bonds, discuss the financial markets and the implications of market efficiency on the investor and the firm.
- Understand the Goals of the Financial Manager and how should a manager decide among risky alternatives? Is there a rule to for making financial decisions in the best interest of the firm?

Course Outline

1. Introduction to Finance Management
2. Time Value of Money
3. Financial Statements Basic: Cash Flow
4. Analysis of Financial Statements
5. Discounted Cash Flow Valuation
6. Interest rates and Bond Valuation
7. Equity Market and Stock Valuation
8. Net Present Value and Investment Criteria
9. Capital Investment Decisions-making
10. Capital Market History, Efficient Market Hypothesis
11. Risk & Return
12. Cost of Capital
13. Leverage and Capital Structure

14. Dividends and Dividends Policy
15. Raising Capital

Assessment

• **Coursework**			**50%**
	Case study analyses	20%	
	Group Assignment	10%	
	Term paper	20%	
• **Final Examination** (One 3-hour examination)			**50%**

MGMT6021 PRODUCT AND OPERATIONS MANAGEMENT
(3 credits)

This course examines how formal analytic tools and quantitative techniques are used for managerial decision making. It examines the application of statistical concepts and models to decision making under uncertainty and linear programming and simulation models under conditional or relatively more certainty. An emphasis is placed on the development of computer based decision aids for managers.

MGMT6031 PROJECT
(6 credits)

In lieu of a thesis, each participant in the programme will be required to undertake a project which will entail defining and developing a software system which has real potential for solving a practical problem of significance to managers. The system will require students to draw on their capacity to analyse business problems as well as on their ability to implement the software development tools, techniques and concepts learned throughout the programme.

MISY6110 INFORMATION SYSTEMS IN ORGANIZATIONS
(3 credits)
This course establishes a foundation for understanding and analysing information in organizations, and its role in creating strategic advantage in companies. It examines the factors which underlie the evolution of Information Technology with the rapid convergence of voice, text, graphics and video technologies with traditional technologies for data processing. The goal is to introduce students to

some of the basic concepts and current developments in IT and to examine successful applications of IT to business problems in order to understand how to improve their awareness of the managerial issues raised by IT and its use in inspiring organizational effectiveness.

MISY6113 DECISION SUPPORT SYSTEMS
(3 credits)

The course is divided into two sections. The first section will discuss organizational decision-making within a problem-solving framework and examine the role of computer-based models in supporting the various stages of the decision-making process. It presents an organizing framework for classifying various types of organizational problems. Then Simon's model is used to illustrate a normative approach to the problem-solving/decision-making process. The second section of the course discusses knowledge-based decision support systems, with a particular emphasis on Expert Systems. We introduce students to Expert Systems as they offer an alternative solution to solving problems for which traditional solutions do not exist. The different stages involved in the development of expert systems and their relevance to real world applications will be discussed

MISY6114 E-COMMERCE
(3 credits)

The purpose of this course is to provide students with a solid understanding of E-Commerce principles, strategy and business application in order to enable them to identify opportunities and articulate strategies for employing E-Commerce initiatives within their own organizations

MISY6115 IT ECONOMICS
(3 credits)

The primary aim of the course is to introduce students to the importance of financial considerations in making decisions related to software; both in firms that develop software and in firms that use software to help them better achieve their strategic objectives. It will provide students with an introduction to the fields of software economics and IT business value analysis, and expose them to some of the tools that they can use to help firms make financially more responsible software related decisions.

MISY6116 IT GOVERNANCE AND POLICIES
(3 credits)

The course will enable students to gain an understanding of IT Governance, policy frameworks and Corporate Governance and how to utilize these strategies to meet key objectives, manage risks, deliver value and measure performance in an organization. Students will also be introduced to the organizational interventions required to cultivate and sustain an effective, business-specific IT governance model which is an essential tool for deriving benefits and meeting business objectives.

MISY6117 IT PROJECT MANAGEMENT
(3 credits)

The course introduces students to the defining characteristics of IT projects, a variety of project management techniques, the challenges involved in executing IT projects, how to recognize warning signs associated with failing projects and how best to avoid them. The course will also cover management issues associated with different alternatives for sourcing information systems and acquiring infrastructure components.

MISY6118 IT SECURITY
(Yr.1/Sem. 2) (3 Credits)

Course Description
Information Technology (IT) Security is a comprehensive study of the principles and practices of computer system security including operating system security, network security, software security and web security. Topics include common attacking techniques such as virus, Trojan, worms and memory exploits; the formalisms of information security such as the access control and information flow theory; the common security policies such as BLP and Biba model; the basic cryptography, RSA, cryptographic hash function, and password system; the real system implementations. The course also covers network intrusion detection; software security theory; web security; legal and ethical issues in computer security.

Learning Outcomes

Upon completion of the course students should be able to:

- Critically assess the strengths and weaknesses of the cyber security models including the CIA triad.
- Understand the interrelationship among modern security elements (people, hardware, software and policies).
- Develop layered information systems security strategies.
- Estimate possible consequences of misaligning business strategy, security policy and security plans.
- Evaluate principle of information systems risk.
- Critically assess and evaluate business continuity and disaster recovery.
- Critique current, legal and regulatory environment as it relates to information.
- Develop a result-based monitoring and evaluating framework for measuring information security strategies effectiveness.
- Determine human resource requirements necessary for the implementation of information security strategies
- Perform 'horizon scanning' to identify trends and patterns which will influence future state of information security.

Course Content

1. The Security Environment.
2. Principles of Cyber security.
3. Strategy and Strategic Planning.
4. Laws and Regulatory Requirements
5. Risk Management
6. Security Metrics and Key Performance Indicators (KPIs)
7. Physical Security and Environmental Events
8. Contingency Planning
9. Security Education, Training, and Awareness
10. The future of cyber security

Assessment

- **Coursework** **50%**
    - In course assessments (20%)
    - Annotated Bibliography (10%)
    - Group Project (20%)
- **Final exam** **50%**

Students will be required to pass both the coursework and the final examination.

MISY6119 COMMUNICATION & SPECIAL AND EMERGING TOPICS IN MIS
(Yr.1&2/Sem. 1&2) (4 Credits)

Prerequisite
NONE

Course Description
Information systems are always changing and it is paramount that for students in the Management_Information System (MIS) programme to be aware and to keep abreast of these changes. Additionally, there is the demand from both private and public sector employers for students to be conversant in relevant issues in their areas of study, and being able to communicate these effectively. Preparing students to be current and communicating ideas effectively is an on-going process and must be linked to the other courses offered in the programme. This course is designed with the intention of addressing these issues over the duration of the CBMIS programme. To achieve this, the coverage is divided into various seminars, scheduled at strategic points throughout the programme, thus helping students to align the topics covered to other courses.

Learning Outcomes
Upon completion of the course students should be able to:

- Demonstrate their understanding of fundamental concepts of MIS and it relations to organisations, measured by the inclusion of these concepts in their final projects
- Discuss the current changes in MIS and relate the relevance of these to their own organisation
- Demonstrate understanding of the fundamental principles of oral presentation by making a 15 minute presentation on a prepared topic
- Demonstrate awareness of audience characteristics and demographics in the design of presentations and mechanics of delivery
- Manipulate presentation content efficiently during the design process, adhering to 'best practices' to in order to achieve the desired objective from the particular audience
- Design presentation slides that: Support the content of the oral component without competing with the speaker; Stimulate audience thought along the desired direction of the presentation; Intrigue the audience with compelling visual content
- Convey information through the creative, professional and ethical use of visuals
- Deliver presentations with a confident, professional demeanour
- Display supportive and 'conforming' behaviour during group presentation
- Detect and respond appropriately 'on the fly' to audience cues (dissent, queries etc.)
- Manage the technical aspects of the delivery process adroitly

Course Content

- ***Seminar 1 - IT Fundamentals for Business***
    - This seminar will cover the fundamental concepts relating to these areas, and the relevant linkages between IT/MIS and disciplines such as Accounting, Marketing and Finance
- ***Seminar 2: Techniques in Business Presentation (Business Presentation Skills)***
    - Module 1 - Mastering Self (16 hours). Areas covered include
    - Module 2 - Audience Strategy and Creating and Delivering Content (24 hours)
- ***Seminar 3: Emerging Technologies and Developments in MIS***

Assessment

Though this is a 1 credit seminar, the coverage will be part of the input for the final project. That is, students are expected to demonstrate their understanding of concepts, ideas and issues covered in the seminar series in the completion of their projects. Students will be required to attend no less than 75% of the of the seminar series before they are allowed to give their final project presentation.

SBCO6190 NEW VENTURES AND ENTREPRENEURSHIP

(Yr.1/Sem. 2) (3 Credits)

Prerequisite

NONE

Course Description

This course examines the foundations of the Entrepreneurial process and provides students with a structure for assessing opportunities and bringing them to fruition. Students will identify opportunities and formulate credible business plans, which will be examined for their value creation and likelihood of viability. Because of the growing realization among firms that the cultivation of an Entrepreneurial Mindset within an organization can lead to innovations and market success, Corporate Entrepreneurship (Intrapreneurship) is also examined.

The course covers 3 main themes:

- The Entrepreneur/Intrapreneur:
- The Entrepreneurial Process:
- Entrepreneurship and its impact on the economy and society.

Learning Outcomes

At the end of the 12-module course, students should be able to:

- demonstrate the acquisition of practical skills and methodology for identifying, analyzing and developing new business concepts, measured from the output of the course project.
- demonstrate their understanding of the process of new business creation, evidenced from the completed course project.
- discuss their understanding of entrepreneurial behaviour and the entrepreneurial process, including issues that affect family-owned businesses.
- critically assess the role of entrepreneurial behaviour within large organizations.
- outline and analyse various methods of financing new ventures, growing companies and those in crisis.
- discuss the role of entrepreneurship in economic development, with particular reference to the Jamaican experience.
- compare and contrast approaches in new ventures and entrepreneurship in Jamaica with those of other countries

Course Content

1. Introduction to the New Ventures and Entrepreneurship course – The Entrepreneurial Process
2. Innovation and Creativity
3. The Entrepreneur/Intrapreneur
4. Identifying and Evaluating the Opportunity
5. Resource Requirements; the Business Plan
6. Managing Growth
7. Financing the Venture – Debt and Equity
8. Financing the Venture (continued)
9. Entrepreneurship and Society

Assessment

This course will be assessed by ***coursework (100%)*** only. The coursework is comprised of:

- **Individual Evaluation**
  - Idea Generation 15%
  - Case Quizzes 3 15%
  - Class Participation 5%
  - Profile of a Local Entrepreneur 20%
- **Group work**
  - Presentation of Business Plan to Panel 20%
  - Written Outline Business Plan 25%

COMPUTER COURSES

COMP5110 SOFTWARE ENGINEERING
(3 credits)

This course examines some of the different approaches to software construction including object-oriented approaches, formal specification techniques, and prototyping. The various stages in the life cycle of a piece of software, and the tools available for supporting the activities taking place in the different stages of the life cycle, as projects, will be examined.

COMP5741 BUSINESS INTELLIGENCE
(Yr.2/Sem. 2) (3 Credits)

Prerequisite
NONE

Course Description
The course provides an overview of important concepts and techniques in the design and implementation of data warehouses (DW) which enable OLAP. The course also introduces students to important concepts and techniques in descriptive and predictive data mining techniques which are becoming essential for modern organisations.

Learning Outcomes
At the end of this course, students will be able to:

- Explain their understanding of business intelligence
- Demonstrate an understanding of the problems in cleansing and integrating data for decision making through analysis of various data sets.
- Describe BI and derive insightful trends using BI techniques.
- Explain and justify the various stages of a Knowledge Discovery methodology.
- Compare and Contrast various BI techniques.
- Discuss various applications of Business Intelligence in organisations
- Discuss the social and ethical issues related to the use of Business Intelligence
- Analyse business problems and recommend appropriate BI techniques for solving these problems.
- Analyze data to generate information and knowledge that lead to informed decisions for businesses

- Generate predictive rules from given data sets using appropriate BI techniques and tools.
- Compare and Contrast Techniques that can be used for integrating disparate sources of data for BI applications.

Course Content

1. Introduction to Data Warehousing
2. Data Quality and Pre-processing
3. Data Virtualization
4. Data Warehouse Modelling
5. Introduction to data mining concepts:
6. Predictive modelling - Overview of building predictive models
7. Decision Trees (DT)
8. Segmentation
9. Association Rules and Sequential patterns
10. Exercises
11. Exercises

Assessment

- **Course work** **40%**
    - One on Data warehousing (10%)
    - Two on Data Mining (30%)
- **Final Examination** **60%**

COMP6101 INTRODUCTION TO PROGRAMMING DATABASES AND NETWORKING

(Yr.1/Sem. 1) (3 Credits)

Prerequisite

NONE

Course Description

It is a first programming course and focuses attention on basic programming concepts (such as computation, function, operations) and structures (such as basic and structured data, procedures). Since the focus is on writing programs which work on the web, the students will also be introduced to different components of the HTML. The course also includes database management systems and how they can be integrated into computer programs. Topics include data modelling techniques, conceptual and physical design. Special emphasis will be placed on relational databases and the application of query languages using relational operations. Students will also be exposed to networking concepts which will enable them to connect their web-based applications to their databases and to other web-based systems.

Learning Outcomes

Upon completion of the course students should be able to:

- Design and implement computer programs which use different control structures.
- Describe the concept of a function and implement functions to perform specific operations.
- Understand different HTML structures and how they are realized on a specific output interface.
- Understand the key networking protocols that govern the Internet: DNS, HTTP, UDP, TCP and IP.
- Explain the contemporary primary security concerns associated with web-based development and their countermeasures.

Course Content

1. Introduction to Programming
2. Introduction to Databases
3. Introduction to Networking

Assessment

- **Course work** **100%**
    - Programming assignment (15%)
    - Database assignment (15%)
    - Project (70%)

MASTER OF SCIENCE: COMPUTER SCIENCE

PROGRAMME OVERVIEW

The MSc. programme in Computer Science (CS) offered at Mona supports the strategic plan of the University in terms of strengthening postgraduate programmes. The aims and objectives of this revised programme are to:

- Expose candidates to cutting edge developments in computing technology and contemporary computing research.
- Meet industry research and development needs, as well as the needs of candidates seeking to pursue further academic research.
- Provide a programme that meets local and regional needs, while meeting or surpassing the standards of top international programmes.
- Offer a programme that will attract increased interest, by introducing specializations and courses that address current and future needs of the industry.
- Establish a framework and programme structure that will flexibly facilitate evolution of the programme without compromising any of the programme objectives.
- Strengthen the core of the programme by defining a core that can support a broad set of specializations in Computer Science.
- Introduce a framework that allows candidates who have completed their degrees at various times in the past, who may not have completed the current requirements of an undergraduate degree in Computer Science, to be brought to the same level of competence before pursuing advanced courses in Computer Science.

Entry Requirements

Applicants must possess a first degree with a major in a recognised Computing discipline from a recognised university.

Duration of Programme

The programme is duration 24 months (part-time) inclusive of time needed for completion of the major Research Project

PROGRAMME STRUCTURE

The degree shall consist of 40 Credit Hours (not including any courses taken to fulfill background requirements), as follows:

The degree consists of a core (12 credits), advanced elective courses in a number of specialized areas of Computer Science (20 credits), and a research project (8 credits).

The core cover key academic and practical areas of CS, being both a subset and an intersection of areas considered to be of prime relevance to national and regional needs as well as those deemed necessary globally (as recognized by the ACM/IEEE and other bodies). The core consists of two parts: firstly, two Computer Science courses, and secondly, a general requirement designed to ensure that the candidate has the necessary technical writing and research skills necessary to pursue the degree and to pursue research in industry or academia.

Candidates will be able to choose from elective courses from a number of areas of specialization in Computer Science in order to allow them to bring together knowledge and skills from multiple specializations. This flexibility is important in meeting the demands of modern industry and contemporary research. However, they must choose at least two courses in one area of specialization in order to achieve depth in at least one area.

Finally, the research project course allows candidates who are pursuing a career in either industry or research to complete an in-depth project, with the option to emphasize either the industry-related or academic aspects of the project in the design of the project and the accompanying technical report. The report must be of publishable or professional quality.

Credit Requirements

DESCRIPTION	CREDITS
A core of three (3) courses (one general and two in Computer Science)	12
Five (5) Computer Science courses (at least two from one specialization area)	20
A research project, industry-related or academic (COMP6810)	8
Total compulsory credits	**40**

Programme Content

Note that not all courses will be offered every year. Some courses will be offered in alternate years. Certain courses will be offered based on demand. However, core courses will be offered every year.

COURSE CODE	COURSE TITLE	CREDITS
	Core Courses and Research Project Course	
COMP6001	Research Methods and Technical Writing	4
COMP6105	Object-Oriented Design	4
COMP6430	Topics in Advanced Algorithms	4
COMP6810	Research Project	8
	Analytics and Knowledge Systems	
COMP6115	Knowledge Discovery and Data Analytics I	4
COMP6125	Knowledge Discovery and Data Analytics II	4
COMP6720	Advanced Database Systems	4
	Computer Security	
COMP6310	Topics in Computer Security	4
COMP6330	Security and Online Social Networks	4
COMP6730	Cryptography	4
	Networks and Distributed Systems	
COMP6420	Parallel Computing	4
COMP6550	Web-Design and Programming	4
COMP6620	Computer Vision	4
COMP6770	Advanced Computer Networks	4
COMP6771	Wireless Networks	4
	Software Engineering	
SWEN6110	Topics in Advanced Software Engineering	4
SWEN6310	Model-Driven Engineering	4
COMP6410	Formal Methods of Software Design	4

COURSE DESCRIPTIONS

COMP6001 RESEARCH METHODS AND TECHNICAL WRITING

(4 Credits)

Prerequisite

NONE

Course Descriptions

This course covers the skills and techniques used in research and technical writing. The emphasis will be on practical skills that enable students to produce professional and publishable reports and technical presentations

Learning Outcomes

At the end of this course students should be able to:

- Formulate purpose statements and research or investigation questions
- Choose strategies and methods that are relevant to the formulated statements, and explain these choices
- Conduct literature surveys
- Find and critically evaluate sources of information
- Organize, design and write technical reports for Computer Science that are coherent, clear and concise with appropriate use of citations
- Review the technical reports of others for the same qualities and be able to communicate their thoughts on the report's effectiveness
- Design and present technical presentations for Computer Science
- Plan research projects, information sources, and maintain records for reports and literature surveys

Course Outline

The course is divided into two parts: research methods and technical writing. The first part focus on applicable research methods in Computer Science and the student will learn when to apply them and how to critically review the results. The second part requires the student to clearly and concisely communicate their research results by writing a high quality technical report and by giving a formal presentation on it.

The course is structured as a mini research project, with the main phases being: propose research problem, perform literature survey and gap analysis, scope the research problem, define research strategy, perform research, critically review and improve results, write-up results and present findings.

Assessment

- Research Project **50%**
- Technical Report **25%**
- Presentations **25%**

COMP6105 OBJECT-ORIENTED DESIGN
(4 Credits)

Prerequisite
CS11R/COMP1160 or CS27Q/COMP2160 or equivalent

Course Description
This course covers advanced object-oriented analysis, design and programming. It looks at the principles behind current frameworks, and requires students to apply them in software design.

Learning Outcomes

- Use advanced object-oriented analysis and design methods to specify and implement software for systems such as enterprise systems
- Design, implement, and test large programs in an object-oriented programming language
- Create reusable software components
- Create and extend class libraries and APIs
- Apply design patterns to OOD problems
- Create exception frameworks
- Use multi-threading in software development
- Use industry frameworks such as J2EE in OO applications

Course Outline

- Advanced Object-Oriented Design and Programming
- Design Patterns
- Exception frameworks
- Multi-threading in software development
- Industry frameworks such as J2EE
- OO testing frameworks

Assessment

- 2-hour written final **40 %**
- Project with report and presentation (2) **60 %**

COMP6115 KNOWLEDGE DISCOVERY AND DATA ANALYTICS 1

(4 Credits)

Prerequisite

NONE

Course Description

This course will introduce students to various techniques of data mining such as predictive and descriptive analytics. There are two components of this course; the first focusses on the conceptual introduction to turning data into actionable knowledge and second introduces the set of techniques, algorithms and tools that can be used in performing the analysis. The course will equip students to identify and apply for a particular business/research problem appropriate data mining techniques/algorithm and tools.

Learning Outcomes

On successful completion of the course, students should be able to:

- Describe and apply a knowledge discovery process model to an analytics task.
- Apply appropriate data cleaning, pre-processing and integration methods to prepare the data for analysis.
- Apply and/or implement the principle algorithms for the data mining techniques.
- Select and apply a data mining technique (descriptive and predictive) for a given business/research problem.
- Evaluate the various performance measures that can be used to assess the developed models.
- Conceptualize a data mining solution to a practical problem.

Course Content

- Introduction, basic concepts and motivation.
- Knowledge Discovery Process Model.
- Data pre-processing: preparing data for analysis, basic data transformations.

- Classification and Prediction techniques: Regression; K- Nearest Neighbour; Decision trees; Neural networks; Simple Vector Machines.
- Performance measures for models.
- Clustering: Agglomerative and Hierarchical.
- Association rule induction and Sequential rule mining.

Assessment

- Final Written Examination (2 hours) **50%**
- Coursework **50%**
    - Analytics - Assignment 1 **15%**
    - Analytics - Assignment 2 **15%**
    - Project **20%**

Students will be required to pass both the coursework and the final examination to pass the course.

COMP6120 KNOWLEDGE DISCOVERY AND DATA ANALYTICS II
(4 Credits)

Prerequisite
COMP6110

Course Description
This course will introduce students to various techniques to analyze unstructured data. There are two components of this course; the first focusses on mechanism of representing knowledge and second on algorithms and techniques that can be used on non-traditional data sources to perform the analysis. The course will equip students to identify and apply appropriate techniques while dealing with unstructured data.

Learning Outcomes
On successful completion of the course, students should be able to:

- Develop and implement an ontology.
- Apply techniques for reasoning under uncertainty.
- Apply the algorithms for the different techniques that work on unstructured data sources like human experts, documents, web forums etc.
- Conceptualize and implement an analytics solution to a practical problem which requires unstructured data.

Course Content

- Introduction, basic concepts and motivation
- Knowledge Representation- Production rules and Ontology
- Reasoning under uncertainty
- Natural Language Processing
- Text Mining
- Sentiment Analysis
- Web Mining
- Processing large amounts of data

Assessment

- Coursework **50%**
  - Paper Review, Discussion and Presentation (Assignment 1) **20%**
  - Analytics (Assignment 2) **15%**
  - Project **15%**
- Final Written Examination (2 hours) **50%**

COMP6310 TOPICS IN COMPUTER SECURITY
(4 Credits)

Prerequisite
NONE

Course Description
This course will provide a graduate-level introduction to software security. It will investigate areas including computer security technology and principles, software security and trusted systems, management, cryptography, network security and forensics. Material will come from papers from well-established/leading computing technical papers, conferences and journals. Students must therefore be comfortable reading technical papers and writing code. There are no programming language or operating system requirements: students can choose platforms that they are comfortable with and that can provide the services necessary to complete their required work.

Learning Outcomes
At the end of this course students should be able to,

- Discuss the core principles of computer security

- Describe the computer security attack, mechanism and service architecture
- Explain widely accepted cryptographic algorithms and their use
- Describe common malware classifications
- Discuss formal models of computer security
- Explain the importance of security policies
- Explain internet security protocols, wireless network security and basic network forensics
- Critically evaluate papers and articles on computer security

Course Content

1. Core principles
2. Computer security architecture
3. Malware
4. Cryptographic tools and formal models for computer security
5. Structure and purpose of security policies
6. Network security and basic network forensics

Assessment

- Coursework **60%**
  - Individual (paper review, discussion and presentation) 20%
  - Group demonstration of implemented computer 40%
    - attack
    - service or mechanism
- Final Exam **40%**

COMP6330 SECURITY AND ONLINE SOCIAL NETWORKS
(4 Credits)

Prerequisite
NONE

Course Description
Students will learn about social networks and their related security issues. For example, the issues of online privacy including tracking, leakage and anonymity. There are no required books for this course. All material will come from papers from well-established/leading computing technical papers, conferences and journals. Students must therefore be comfortable reading technical papers and writing code. There are no programming language or operating system

requirements: students can choose platforms that they are comfortable with and that can provide the services necessary to complete their required work.

Learning Outcomes

At the end of this course students should be able to:

- Define an online social network
- Discuss the characteristics of online social networks
- Explain the technologies behind online social networks
- Explain the security issues pertaining to online social networks
- Critically evaluate papers and articles on online social
- Demonstrate an understanding of security issues and protection mechanisms by creating an online social network with appropriate security mechanisms

Course Content

1. What is an online social network?
2. What are the characteristics of online social networks?
3. Technologies used in online social networks
4. Security issues in online social networks
5. Protection mechanisms

Assessment

Students must pass both coursework and examination components independently to successfully complete the course.

- Coursework **70%**
    - class attendance and participation 5%
    - individual (paper review, discussion and presentation) 20%
    - group project development and presentation 45%
- Final Exam **30%**

COMP6410 FORMAL METHODS OF SOFTWARE DESIGN

(4 Credits)

Prerequisite

NONE

COMP6420 PARALLEL COMPUTING
(4 Credits)

Prerequisite
NONE

Course Description
Parallel processing has matured to where it has started to make the computer marketplace. This course seeks to equip students to specify, design and evaluate parallel architectures for specific-purpose and general-purpose application. This course will present computational science needed to support engineering and scientific computations. It also intends to provide rigorous research results in parallel algorithms and prepare interested students to carry out independent research in Parallel Computing. Topics covered include: design and analysis of concurrent algorithms, process synchronization, deadlock detection, concurrency control, communication with Message Passing Interface (MPI) and a detailed performance prediction will be performed.

Learning Outcomes
At the end of this course students should be able to,

- Design and implement parallel algorithms
- Research and present current topic of interest to Parallel Computing
- Solve large scale problems on different parallel platforms with MPI
- Analyze, measure and evaluate the performance of parallel programs
- Identify alternative approaches to parallelization codes for real-world interdisciplinary problems
- Develop codes for computing large scale scientific problems on parallel environment
- Given a parallel algorithm, implement it using MPI and determine computational bottlenecks and optimize the performance of the code

Course Content
1. Parallel Computer architectures
2. Parallel programming models
3. Parallel programs design
4. Parallel programming using MPI
5. Parallel algorithms and applications
6. Mesh generation
7. Support vector machines and singular value decomposition

Assessment

Students will be required to actively participate in assignments, programming projects and final examination to pass the course. Students must pass both coursework and examination components independently to successfully complete the course.

- **Coursework** **40%**
  - Two quizzes (15%)
    Group programming project and presentation (15%)
  - Assignment (10%)
- **Final examination** **60%**

COMP6430 TOPICS IN ADVANCED ALGORITHMS

(4 Credits)

Prerequisite

CS20R/COMP2111 (Algorithms) or CS20A (Data Structures) or equivalent

Course Description

This course covers advanced data structures and algorithm analysis techniques that are not normally covered in an undergraduate course. It presumes that students have already been exposed to basic data structures, such as lists, trees, stacks, queues, binary heaps, and graphs, and aims to expose students to:

- applications in which combinations of these basic structures are useful
- other data structures that have good performance, but often require a reasoning capacity to analyse them beyond what is normally expected at the undergraduate level
- algorithm analysis techniques that are often covered only briefly, or not at all at the undergraduate level

Learning Outcomes

At the end of the course, students should be able to:

- Use dynamic programming to solve a novel problem (once told that dynamic programming is appropriate).
- Apply amortised analysis to an algorithm in order to characterise its time complexity.
- Analyse the expected running time of a randomised algorithm whose input probabilities are well defined.
- Apply an appropriate graph algorithm to a problem, once told that it can be efficiently represented by a graph.

- Design modifications to a given algorithm to suit a specified situation.
- Prove that a given problem is NP-hard, given a hint of either an analogous problem or a suggested reducibility widget.
- Design an algorithm to solve a problem analogous to one covered in lectures, and to be able to characterise its time and space complexity.
- Evaluate the relative merits of two proposed algorithms for the same problem, and recommend one for a given situation.

Course Outline

- Review: Orders of growth, definitions of complexity classes; Deterministic time complexity analysis: Master Theorem, Recurrence Relations; Basic probability theory; NP-complete problems and polynomial time reducibility
- Approximation algorithms for NP-complete problems
- Randomised algorithms
- Dynamic Programming
- Amortised analysis
- Advanced data structures for efficient searching: tries, skip lists, interval trees
- Graph algorithms and their applications:

Assessment

- 2-hour written final **50%**
- Coursework **50%**
  (4 equally weighted written assignments)

COMP6550 WEB DESIGN AND PROGRAMMING
(4 Credits)

Prerequisite
NONE

Course Description
This course covers the technologies that enable the creation of interactive websites that process and modify server-based data. This includes networking technologies, data representation for the Web, Web UI design and site design, client-server architecture and client-side and server-side programming. It covers relevant topics in network security, ethical and social issues, and relevant software engineering concepts such as the three-tier architecture, frameworks for the Web, and mobile Web development.

Learning Outcomes

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

- Design and implement a simple web application [ACM]
- Compare and contrast Web programming with general purpose programming [ACM]
- Describe the differences between software-as-a-service and traditional software products [ACM].
- Describe the browser security model including same-origin policy and threat models in Web security [ACM]
- Describe the concept of Web sessions, secure communication channels such as TLS and importance of secure certificates [ACM].
- Describe common types of vulnerabilities and attacks in web applications, and defences against them [ACM].
- Use client-side security capabilities in an application [ACM].

Course Outline

1. Networking concepts
2. Web platform constraints
3. Web standards
4. Software as a Service (SaaS)
5. Web programming languages
6. Client-side programming
7. Server-side programming
8. Fundamental web frameworks and design patterns for the Web
9. Web services standards
10. Web database connectivity
11. Mobile web platforms
12. Web services
13. Software engineering for Web applications
14. Web security

Assessment

• **Coursework**		**60%**
○ Projects (8)	50%	
○ Report	10%	
• **Final Exam**		**40%**
○ 3-hour written exam		

Students will be required to pass both the coursework and the final examination.

COMP6620 COMPUTER VISION

(4 Credits)

Prerequisite

NONE

Course Description

This course presents an overview of conventional techniques that have been implemented in image processing applications, and explores development trends in the field. No prior knowledge of image processing concepts are required, however students are expected to have a detailed understanding of the operation of conventional computer systems.

Learning Outcomes

At the end of this course students should be able to:

- Explain commonly used image representations
- Write programs to perform image analysis in spatial and frequency domains
- Implement algorithms that perform object detection
- Interpret programs that perform image and video analysis
- Write programs that implement video analysis techniques
- Compare image analysis algorithms to determine appropriate techniques to be applied given available processing power, time and space.
- Evaluate research trends in image analysis.

Course Content

1. Image Representation
2. Image Processing
3. Image Analysis
4. Feature and Object Detection
5. Image Segmentation
6. Motion Analysis
7. Compressed Sensing

Assessment

- **Coursework** **60%**
  - Assignment 1 5%
  - Assignment 2 15%
  - Assignment 3 15%
  - Assignment 4 15%
  - Mid-Semester examination 10%
- **Final Exam** **40%**

COMP6720 ADVANCED DATABASE SYSTEMS
(4 Credits)

Prerequisite
COMP3161 (Database Management Systems) or equivalent undergraduate course in databases

Course Description
This course will extend the content covered in an undergraduate database systems course. Students will be provided with the opportunity for gaining a deep understanding of the important concepts and techniques of physical database design and provide students with the opportunity for gaining a fundamental understanding of the architecture of modern database management systems which include Relational and NoSQL systems.

Learning Outcomes
At the end of this course students should be able to:
- Define the Database Systems Concepts
- Describe the DBMS architecture and justify the need for the various components of the architecture.
- Describe query optimization and illustrate using relational algebra its importance for relational database management systems.
- Identify important systems implementation techniques and discuss their importance in terms of relational databases. These include:
- Implement dynamic multilevel indexes using B-trees
- Use hashing to facilitate dynamic file expansion
- Explore the different uses and implementations of NoSQL databases.

Course Content
1. Hardware for DBMS
2. File and system structure
3. Indexing
4. Hashing
5. Advanced query processing
6. Query optimization
7. Failure recovery
8. Concurrency control
9. Transaction management
10. Parallel and distributed databases
11. NoSQL systems

Assessment

- **Coursework** **40%**
  - In-course test - (10%)
  - Group Project - (10%)
  - Assignments (2) - (20%)
- **Final examination** **60%**

COMP6730 CRYPTOGRAPHY
(4 Credits)

Prerequisite
NONE

Course Description
The intent of this course is to expose the student to some applied aspects of cryptography. The course focuses on the mathematical techniques for providing certain aspects of information security, such as confidentiality, entity authentication, data origin authentication, and data integrity.

Learning Outcomes
At the end of this course students should be able to:

- Identify the primary applications of cryptographic primitives, and when they ought to be used
- Distinguish between symmetric-key and public-key cryptographic schemes.
- Demonstrate how to encrypt and decrypt a message using RSA, El Gamal, Substitution Cipher, TranspositionCipher
- Explain the importance of digital signatures
- Demonstrate at least two methods of digitally signing a message
- Explain at least one digitally secure method of user authentication
- Distinguish between various modes of cipher block encodings
- Apply a key sharing protocol (e.g. Shamir's) to a given situation

Course Content

1. Mathematical Background
2. Cryptography Overview
3. (Symmetric Key) Block Ciphers
4. Modes of Operation
5. Feistel Ciphers
6. Public Key Ciphers

Assessment

- **Coursework** **60%**
- **Final examination** **40%**

COMP6770 ADVANCED COMPUTER NETWORKS
(4 Credits)

Prerequisite
COMP3191 or equivalent undergraduate networking course

Course Description
This course covers advanced fundamental principles of computer networks. Thus we study foundational material on networking, advanced network architecture, network control, and network management. The goal is to teach networking fundamentals that will be useful for years and will equip students to carry out research in networking.

Learning Outcomes
Upon successful completion of this course, students should be able to:

- Identify the protocol mechanisms commonly found in network protocols
- Compare architecture of the Internet with public switched telephone network
- Defend choice of one scheduling discipline over another in design of a router.
- Discuss how providers like Netflix leverage content distribution networks to bring media closer to users.
- Identify emerging trends in software defined networking.

Course Content

1. Protocol mechanisms
2. Network architecture
3. Router design
4. Network resource allocation
5. Software-defined networking
6. Content centric networks

Assessment

- **Coursework** **50%**
  - Quizzes 5%
  - Homework (4) 25%
  - Midterm exam (90 mins) 10%
  - Project 10%
- **Final Exam** **50%**
  - 3-hour final written exam

COMP6771 WIRELESS NETWORKS
(4 Credits)

Prerequisite
COMP6770 Advanced Computer Networks

Course Description
This course covers wireless networking technologies and their protocols, including the evolution of wireless networking, transmission media, antennas and signal propagation.

Learning Outcomes
Upon successful completion of this course, students should be able to:

- Compare the relative merits of several medium access techniques, such as TDMA, FDMA, and CDMA.
- Recommend a wireless network architecture for a given scenario.
- Discuss various techniques for dealing with node mobility in wireless networks
- Analyse the expected latency, and throughput for data sent under a given protocol.
- Simulate the performance of a given routing protocol deployed in a wireless network.
- Describe the future of wireless networking, "next generation" networking, its features and applications.
- Compare contemporary wireless technologies with those that are likely to be present in next generation networks.

Course Content
1. Why use wireless communications?
2. Why is wireless different?
3. The Physical Layer
4. Medium access
5. WiFi
6. Personal Area Networks and Bluetooth
7. WiMAX
8. Wireless in the Internet
9. Sensor and ad hoc networks
10. Cellular
11. Wireless network simulation
12. RFID
13. Localization
14. Rate adaptation
15. Dynamic spectrum access

16. Challenged networks
17. Next generation networking

Assessment

- **Coursework** **50%**
  - Quizzes 5%
  - Homework (4) 25%
  - Midterm exam (90 mins) 10%
  - Project 10%
- **Final Exam** **50%**
  - 3-hour written exam

COMP6810 RESEARCH PROJECT
(8 Credits)

Prerequisite
NONE

Course Descriptions
This course requires students to perform individual research on a topic chosen in conjunction with a supervisor. The purpose of this component of the programme is to allow students to carry out and document independent research as a thesis.

Assessment
Students will be required to pass both the coursework and the final examination to pass the course.

SWEN6110 TOPICS IN ADVANCED SOFTWARE ENGINEERING
(4 Credits)

Prerequisite
NONE

Course Description
Advanced software engineering will provide a student with the requisite core body of knowledge (CBOK) in software engineering that is expected at the master's level. It will also delve deeply into at least one knowledge area or sub-area of the SE CBOK to at least the synthesis level of Bloom's taxonomy. Such depth strengthens analytic skills and enables a student to solve hard problems in

at least one knowledge area of the SE CBOK. The material that will be covered will include research papers that span the SE CBOK.

Learning Outcomes

At the end of this course students should be able to:

- Select new technologies given a particular problem, while understanding the technology's limitations and appropriate uses
- Analyze a current, significant software technology by,
    - articulating its strengths and weaknesses; comparing it to alternative technologies; specifying and promoting improvements or extensions to the technology
- Demonstrate mastery of content by either,
    - developing a modest-sized software system of a few thousand lines of code from scratch; modifying an existing large-scale software system exceeding 1,000,000 lines of code; integrating third-party components that are themselves thousands of lines of code

Course Content

1. Software Engineering Core Body of Knowledge areas
    - Ethics and Professional Conduct
    - Requirements Engineering
    - Software Design
    - Software Processes
2. One knowledge area that will be selected from,
    - requirements engineering
    - software design
    - software engineering management
    - testing
    - software quality
    - software processes
3. Analysis of new or emerging technologies

Assessment

- **Coursework** **70%**
    - Formal discussion on chosen CBOK area (20%)
    - Component creation: development, deployment, demonstration (10%)
- **Final examination** **30%**

SWEN6310 MODEL-DRIVEN ENGINEERING

(4 Credits)

Prerequisite

NONE

Course Description

The key elements of a DSM solution are modelling languages, code generators and framework code. Models are built representing different views of a software system using different formalisms, i.e. modelling languages. The formalism is chosen in such a way that the model concisely expresses the properties of the system that are important at the current level of abstraction. During development, high-level specification models are refined or combined with other models to include more solution details, such as the chosen architecture, data structures, algorithms, and finally even platform and execution environment-specific properties. The manipulation of models is achieved by means of model transformations. Truly model-driven development uses automated transformations in a manner similar to the way a pure coding approach uses compilers. Once models are created, target code can be generated and then compiled or interpreted for execution. From a modeller's perspective, generated code is complete and it does not need to be modified after generation. This means, however, that the "intelligence" is not just in the models but in the code generator and underlying framework.

Learning Outcomes

At the end of this course students should be able to:

- Explain the concepts, principles, and theories of MDE
- Discuss the activities involved in MDE
- Discuss the merits and challenges of MDE
- Create a domain specific model for a small, well defined problem
    - create a domain specific modelling language
    - create an associated domain specific code generator
    - create an associated domain specific framework
- Generate a solution from a DSM
- Recommend when either an MDE or other contemporary software engineering approach should be used to solve particular problems

Course Content

1. What is MDE
    a. raising the level of abstraction for the development of software solutions

   b. domains, languages, models, frameworks, generators, transformations
2. When should MDE be used
3. Domain-specific language development
4. Model creation using general-purpose and purpose built languages
5. Domain-specific framework development
6. Domain-specific code generation
7. Model to code transformation

Assessment

• **Coursework**		**70%**
○ report	5%	
○ language construction	15%	
○ model creation	10%	
○ framework construction	10%	
○ code generator	15%	
○ model transformation	15%	
• **Final Exam**		**30%**

MPHIL/PHD IN COMPUTER SCIENCE

PROGRAMME OVERVIEW

The MPhil degree is designed to prepare students for doctoral (PhD) research. The PhD degree in Computer Science is a research degree which is awarded on the basis of original research culminating in a dissertation. Typical applicants to both programmes will have undertaken a bachelor's degree in any of the five internationally recognised Computing disciplines: computer science, software engineering, computer systems engineering, information technology, information systems.

Entry Requirements

For the MPhil, applicants must have been awarded at least an upper second class honours degree in any one of the five aforementioned Computing disciplines and for the PhD, applicants must have an MPhil or an MSc degree in any one of the same Computing disciplines. Acceptance into both programmes is subject to the availability of a supervisor within the department.

Duration of Programme

- MPhil: approximately 3 years full-time, 5 years (Part-Time)
- PhD: approximately 5 years full-time, 7 years (Part-Time)

Areas of Research

At present, the main areas of research interest in the department are:

- Computer Security
- Software Engineering
- Analytics and Knowledge Systems
- Networks and Distributed Systems
- Web, Animation, Visualisation and E-learning

PROGRAMME STRUCTURE

Incoming graduate students must register for the MPhil in Computer Science. As part of the programme of study, MPhil students must complete a minimum of six (6) credits, PhD students a minimum of nine (9) credits. In both cases the credits must be attained through taught courses. The courses that should be taken to satisfy these credit requirements are recommended to be selected from any of those offered in the MSc Computer Science programme. These courses are listed in the table below.

PhD students must also complete a minimum of three (3) seminars over the duration of their programme. These seminars are an opportunity for a student to formally present, discuss and receive feedback on their research. Every student enrolled in a research degree must also register in every semester for the course RETH9005 - Thesis (Science and Technology) until they have completed their programme of study.

Programme Content

MSc clusters of areas of interest and courses			
CORE Object Oriented Design (COMP6105), Topics in Advanced Algorithms (COMP6430), Research Methods and Technical Writing (COMP6001)			
Computer Security	**Software Engineering**	**Analytics and Knowledge Systems**	**Networks and Distributed Systems**
COMP6300 Topics in Computer Security	SWEN6110 Advanced Software Engineering	COMP6115 Knowledge Discovery and Data Analytics 1	COMP6420 Parallel Computing
COMP6330 Security and Online Social Networks	SWEN6310 Model-Driven Engineering	COMP6120 Knowledge Discovery and Data Analytics 2	COMP6550 Web-Design and Programming
COMP6730 Cryptography and Digital Security	SWEN6410 Formal Methods of Software Design	COMP6720 Advanced Database Systems	COMP6620 Computer Vision
			COMP6770 Advanced Computer Networks
			COMP6771 Wireless Networks

COURSE DESCRIPTION

COMP6010 RESEARCH METHODOLOGIES IN COMPUTER SCIENCE
(6 Credits)

Prerequisite
NONE

Course Description
This course aims to provide the incoming MPhil Computer Science student with the basic training necessary to make a smooth transition to the point where he/she will be able to confidently start pursuing his/her research in a safe environment.

Learning Outcomes
At the end of this course students should be able to:

- Be able to Identify and avoid potential hazards in the Computer Laboratory and to deal effectively with such hazards should the occasion arise;
- Be able to use the available tools in the library confidently and effectively in pursuing his/her research;
- Be exposed to examples of well-written articles, reports and theses and to appreciate their style and construction;
- Be able to carry out literature search in the prospective area of the M.Phil. project, possibly including a focus problem, to prepare a clearly written, concise and substantial document;
- Be able to present an oral summary of the preceding report in a seminar.

Course content

1. Safety Precautions in the Computer Laboratory. One-day course run with the assistance of the University Safety Officer.
2. Effective technical writing (proposals, journal papers and theses)
3. Use of Library (to be organized with the librarian, Science Library)
4. Literature research in the prospective area of the MPhil project, possibly including a focus problem, resulting in a written document. This to be done under the guidance of the supervisor.
5. Oral presentation of literature research in a public seminar.

Assessment

- Short-answer questions/practical demonstration. (Pass or Fail).
- Literature Review and Report **70%**
- Oral presentation **30%**

Students will be required to pass both the coursework and the final examination to pass the course.

Department of Geography & Geology

www.mona.uwi.edu/dogg

5

Research Degrees

MPhil/PhD in Geography
MPhil/PhD in Geology

Head of Department: Dr Donovan Campbell
Graduate Coordinator: Dr Arpita Mandal
Contact: The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: geoggeol@uwimona.edu.jm
Tel: (876) 927-2129 / (876) 927-2728
Fax: (876) 977-6029
Ext: 2258

MPHIL/PHD IN GEOGRAPHY/GEOLOGY

The Department offers programmes leading to the award of MPhil and PhD degrees in Geography and Geology. Collaborative projects may be done with other departments or with other universities or institutions.

PROGRAMME OBJECTIVES

- To produce a cadre of leaders in science for academia (research and teaching), government and quasi-governmental organizations and industry: exponents of science and technology and conduits for S & T driven change and development.
- To generate new knowledge and publishable results
- To produce graduates with:
    - a thorough knowledge of their specific areas of research (current state, trends, prospects) and good familiarity with allied high levels of technical and analytical skill;
    - the ability to collect, collate and interpret large volumes of information;
    - the ability to communicate clearly and effectively, orally and in writing;
    - the capacity to establish independent research programs (PhD holders).

MPHIL/PHD GEOGRAPHY

Entry Requirements

Entry to the MPhil (Geography) programme requires a BSc/B.A degree in Geography with a minimum GPA of 3.00. Candidates holding Masters degrees in Geography are admitted directly into the PhD programme, but the more general route to a PhD is via upgrading of registration from MPhil.

Duration of Programme

MPhil: approximately 3 years (Full-time); 5 years (Part-Time)
PhD: approximately 5 years (Full-Time); 7 years (Part-Time)

Areas of Research

Human Geography, Physical Geography (Coastal and Riverine), Geomorphology and earth surface processes, Social Economic studies, Agricultural Geography, Climate change and impacts on water and food security, Coffee leaf rust and climatic impacts on coffee growth, Fisheries and tourism, Crime and gender, Palaeoclimate studies, Quarternary research.

MPHIL/PHD GEOLOGY

Entry Requirements

Entry to the MPhil (Geography) programme requires a BSc degree in Geology with a minimum GPA of 3.00. Candidates holding Masters degrees in Geology are admitted directly into the PhD program, but the more general route to a PhD is via upgrading of registration from MPhil.

Duration of Programme

MPhil: approximately 3 years (Full-time); 5 years (Part-Time)
PhD: approximately 5 years (Full-Time); 7 years (Part-Time)

Areas of Research

Sedimentology and Facies studies, Geochemistry (soil, water, rock), Hydrology and water resources, Impact of climate variability on water resources, Flood plain mapping and modelling, Beach rock analysis and diagenesis, Geo-heritage and application of GIS, Palaeontological studies, Marine geology, Coastal inundation and beach erosion, Mapping and mineral exploration, Reconstruction of geologic history, Earthquake seismology.

PROGRAMME STRUCTURE

Incoming graduate students register for the MPhil and take a course on Research Methods offered by SALISES and/or Life Sciences. In the first and/or subsequent semesters, candidates who intend to read for an MPhil take an additional two-credit course; those who plan to upgrade to a PhD must take courses (inclusive of Research Methods) which total nine credits.

In the second semester each graduate student begins a research project in the programme of his/her chosen Supervisor(s). The research programmes of the individual academic staff members in the Department are, for the most part, executed by graduate students. After 2-3 years of research a student is expected to either write a thesis and graduate with an MPhil or transfer from the MPhil to the PhD program; the latter process entails the production of a document comprising a report of work completed and a proposal, delivery of a seminar and an oral examination.

Seminars

- MPhil - Minimum of two seminar presentations
- PhD - Minimum of three seminar presentations

Department of Life Sciences

www.mona.uwi.edu/lifesciences

6

Taught Masters

MSc Agricultural Entrepreneurship
MSc Marine and Terrestrial Ecosystems

Research Degrees

MPhil/PhD in Botany
MPhil/PhD in Environmental Biology
MPhil/PhD in Experimental Biology
MPhil/PhD in Marine Sciences
MPhil/PhD in Oceanography
MPhil/PhD in Zoology

Head of Department: Dr Dwight Robinson
Graduate Coordinator: Dr Tannice Hall
Contact: 4 Anguilla Close
The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: lifesci@uwimona.edu.jm
Tel: (876) 927-1202 / (876) 927-2753
Fax: (876) 977-1075

MASTER OF SCIENCE: AGRICULTURAL ENTREPRENEURSHIP

PROGRAMME OVERVIEW

The programme aims to provide students with the tools and skill set necessary to create, resuscitate and/or rehabilitate agricultural enterprises. Graduates will possess the skills necessary to translate cutting-edge agricultural research into business opportunities along the agriculture value chain. The programme is also intended to assist in meeting the Millennium Development Goals (MDG) aimed at assisting in the eradication of extreme hunger and to ensure environment sustainability.

Programme Objectives

Graduates from the MSc in Agricultural Entrepreneurship will be equipped with the necessary tools to start their businesses within any aspect of the agricultural value chain. They will have the ability to work on their own and within private, national and international institutions that focus on agricultural research and development.

Students pursuing this programme will:

- Acquire knowledge and develop new research and ideas into business opportunities;
- Describe the different physical, economic and social environments in which agriculture operates and encapsulate these components into agricultural enterprises;
- Translate recent developments in agricultural research into practical projects while responding to challenges such as climate change, environmental sustainability, ecosystem preservation, and globalization; and develop business plans aimed at attracting financing from local and international private and public institutions.

Entry Requirements

- Entrants to this course are normally required to have obtained an honours degree (minimum GPA 2.25) or its equivalent in agriculture, forestry, botany, biological, agronomy, chemical, environmental, or social sciences; rural development, development planning and management or a related subject.
- Applicants with other qualifications and who have at least 2 years' professional experience in a relevant field of agriculture and development are also eligible to apply for admission to this course.

- Applicants who do not possess the requisite qualification and experience will be required to do pre-qualification courses in agriculture/sciences and the social sciences. References will also be taken into account.

Duration of Programme

The programme duration is 18 months and is offered in the evenings and on weekends.

PROGRAMME STRUCTURE

Credit Requirements

Of note, there are 12 credits of qualifying courses that are required, namely AGBU1002, AGRI1010, MGMT6018 and MGMT6020.

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
	SEMESTER 1	
AGBU1002	Introduction to Agro-Environmental Management	3
AGRI1010	Introduction to Agriculture, Crop, and Livestock Production	3
MGMT6018	Marketing	3
MGMT6020	Decision models for managers	3
	SEMESTER 2	
AGLS6003	Tropical Livestock Development	4
BIOL6001	Research Methods in Science	4
BIOL6102	Standards and Risk Management in Agriculture Production Systems	3
BIOL6104	Advanced Crop Production Technologies	3
	SUMMER	
CHEM6501	Agro-Processing Technologies for Entrepreneurs	3
MGMT6162	International Entrepreneurship in Agricultural Enterprises	3
	SEMESTER 3	
AGBU6202	Agribusiness Management	3
ECON6145	The Economics of Farm and Farming Systems	3
MGMT6164	New Venture Creation	3
MGMT6165	Agricultural Marketing Strategies	3
	SEMESTER 4	
AGRI6001	Agricultural Seminar	1
MGMT6166	Final Project/Research Paper	6

COURSE DESCRIPTIONS

AGBU1002 INTRODUCTION TO AGRO ENVIRONMENTAL MANAGEMENT

(4 Credits) (Semester 1)

Course Description

This course explores the role and importance of the environment for social development and as a life support system. It will look at the impact of agricultural practices on the environment viewed from an ecosystem perspective. Students will also examine case studies of impacts related to various agricultural systems. They will also utilise the integration of the concepts and issues discussed in designing sustainable agro-environmental systems for the tropics with a focus on small island states.

Learning Outcomes

At the end of this course, students will have developed their understanding of the interaction between agriculture and the environment, with an emphasis on sustainability and the ecological consequences of unsound management. It gives you the skills for a career related to:

- Sustainability in farming systems
- Environmental management
- Rural development

Course Content

1. Agriculture and environment
2. Agriculture, environment and natural resources
3. Ecological Management of Agrosystems
4. Agro-environmental Management at Farm Level
5. Agricultural policy and environmental regulation
6. Protection of the Agrosystems

Assessment

- **Coursework** **50%**
    - Field report 25%
    - Term Paper 25%
- **Final Examination** **50%**
    - One three hour examination

AGBU6202 INTRODUCTION TO AGRO ENVIRONMENTAL MANAGEMENT
(4 Credits) (Semester 3)

Course Description
Concepts of Management; Forms of Business Organisation; Financial Management for Agribusiness; Production/Operations Management; Business Development; Human Resource Management; Information and Decision-Making; Project Management.

Assessment
- **Coursework** **50%**
    - Field report 25%
    - Term Paper 25%
- **Final Examination** **50%**
    - One three hour examination

AGLS6003 TROPICAL LIVESTOCK DEVELOPMENT
(4 Credits) (Semester 2)

Course Description
This course looks at livestock classes including aquaculture and poultry and the choice of livestock production technology breeding (AI, embryo transfer) as well as factors influencing livestock development. Harvesting practices, marketing and the role of Government and Private sector are also explored.

Learning Outcomes
Upon the completion of the module, students should be able:
- To deal with issues encountered in intensive or extensive animal husbandry structures for livestock production;
- To provide an understanding of Livestock Development;
- To provide an awareness of the political, social, economic and environmental issues that affect Livestock Development;
- To describe the major Livestock Production Systems;
- To provide an understanding of the effect which the Government and the Private Sector can have on Livestock Development;
- To understand the dynamics surrounding the International Trade in Livestock Products; and
- To be familiar with possible Alternative Approaches to Livestock Development for Small States in the future.

Course Content

1. The Global Environment and Livestock Development in Jamaica and the CARICOM
2. Environmental Constraints to Livestock Production in Developing Countries
3. Role and functions of livestock
4. The systems approach to livestock production and research
5. Livestock production systems
6. The contribution of livestock industries to GDP in advanced economies
7. Evolution of Jamaican livestock industry structure
8. The concept of value chain alignment
9. Approaches for livestock development
10. Emerging opportunities in value-added and competitive strategy

Assessment

- **Coursework** **50%**
  - Field trip report 20%
  - Group report 20%
  - Oral presentation 10%
- **Final Examination** **50%**
  - One three-hour examination

AGRI1010 INTRODUCTION TO AGRICULTURE, CROP, AND LIVESTOCK PRODUCTION

(4 Credits) (Semester 1)

Course Description

This course traces the historical development of agriculture its importance to the economy, with special emphasis on the tropics and the Caribbean. Special attention is paid to the physical and technical aspects and the relationships between the crop, livestock, agro-processing, marketing and distribution sub-sectors. It provides an overview of crop and livestock production and deals with major species of livestock in the CARICOM region, along with the factors that affect their productivity and profitability.

Learning Outcomes

Upon the completion of this course, students will be able to:

- Explain the crucial role plants play in providing food for humans,
- Explain the features and uses of land,

- Describe the importance of soil fertility,
- Identify important crops,
- Describe how to select crop varieties,
- Demonstrate cultural requirements of major crops,
- Describe minor and emerging crops
- Discuss cultural practices for crops.
- Explain how crops are harvested for maximizing quality,
- Understand pest and diseases managements, and
- Understand the principles livestock production

Course Content

1. Factors affecting crop production
2. Seeds and seedling practices
3. Vegetative propagation including plant tissue culture
4. Land preparation
5. Soils and crop nutrition
6. Mechanization in crop production
7. Water management
8. Production systems of crops/plants
9. Soil and nutrient management practices for crop production
10. Cropping systems in the Caribbean
11. Plant protection: Insects, weeds and plant pathogens
12. Organic farming and composting
13. Growbox technology
14. Harvesting and post-harvest technology
15. New developments in Agriculture (advances in crop production)
16. The role of livestock/animals
17. The fundamental principles in livestock production
18. The different breeds and breeding systems used in the Caribbean
19. Factors affecting livestock production

Assessment

- **Coursework** **50%**
  - Oral presentation 10%
  - Field trip report 20%
  - One in-course test 10%
- **Final Examination** **50%**
  - One three-hour examination

AGRI6001 AGRICULTURAL SEMINAR

(1 Credit) (Semester 4)

Course Description

This course will provide students the opportunity to delve into topics of relevance to agricultural entrepreneurship and the value chain. They will perform the literature searches and interact with stakeholders in the industry to identify nuances and provide possible niches which can be used to address the topic. This course will train students to prepare and deliver an effective presentation on an area of choice within the agricultural entrepreneurship programme at a typical advanced scientific/business forum.

Learning Outcomes

At the end of the course students will be able to:

- Effectively assess current literature on chosen topic
- Prepare a comprehensive well-structured coverage of the topic
- Do an effective oral presentation before peers and faculty using state of the art audio-visual aides
- Provide appropriate and constructive responses to queries and comments of their presentation.

Course Content

Students in the MSc Agricultural Entrepreneurship must present a seminar based on a topic of the student's choice and must cover some aspect of the agriculture value chain. The topic chosen must be agreed on by the course coordinator/lecturer. The seminar must be presented to faculty and students and must reflect a comprehensive understanding of the subject. Students will be evaluated for content and oral delivery. Audio visual aides are to be used in the presentation. Students are expected to give constructive responses to queries raised during the presentation. Attendance is compulsory for group seminars.

Assessment

- Written Report 40%
- Seminar critique report 10%
- Oral Presentation 50%

BIOL6001 RESEARCH METHODS FOR BIOLOGISTS

(4 Credits) (Semester 2)

Course Description

The goal of this course is to provide students with a solid background in the philosophy of research, research design, in modern methods of data and information collection, as well as in data handling and analysis for environmental management. The course also aims to develop student skills in making oral presentations as well as writing for scientific papers and technical reports.

Learning Outcomes

On completion of this course, students will be able to:

- Understand methodological naturalism and the general conceptual process of scientific inquiry;
- Construct, test, and evaluate scientific hypotheses;
- Think critically about questions and evidence
- Design appropriate and optimized experiments for answering agribusiness questions;
- Choose and justify an appropriate analysis for a dataset and research question;
- Interpret results of statistical tests in biologically relevant terms
- Critically evaluate findings and make inferences from analyses presented in the literature;
- Effectively communicate the outcomes of agribusiness programmes and experiments to a range of audiences.
- Understand basic research ethics and how findings are disseminated.
- Learn how to synthesize research on a particular question to determine the limits of knowledge.

Course Content

1. Philosophy and Concepts of Research
2. Planning and Conducting Effective Research
3. Scientific methods including Ethical Concepts
4. Locating information for research and documenting sources
5. Project planning and management
6. Research proposal and budget
7. Securing resources
8. Research process
9. Experiment design, data collection, analysis and interpretation

10. Thesis structure including Literature review
11. Technical report writing and presentation
12. Presentation skills: orals and posters

Assessment

- **Coursework (Group work on literature research) 20%**
- **Final research project (Individual) 80%**
    - Research proposal & literature review 60%
    - Seminar/Oral presentation of research 20%

BIOL6102 STANDARDS AND RISK MANAGEMENT IN AGRICULTURE PRODUCTION SYSTEMS

(3 Credits) (Semester 2)

Course Description

The aim of the course is to assist students to recognize the various risks associated with agriculture production and the use of the various standard and safety procedures which can be employed to identify risks and develop mitigation protocols.

Learning Outcomes

At the end of the course students will be able to:

- Discuss in detail the various risks associated with agricultural production in the Caribbean and their methods of assessment;
- Describe the requirements for total quality management
- Explain the basis of application of process standards for local and export agro-products;
- Develop risk mitigation protocols.

Course Content

1. Risk Management in Agriculture Production
2. Soil and water pollutions: quality assessment and management
3. Plants and crops diseases and biological identification techniques.
4. GIS, GPS and supporting ICT techniques and risks managements
5. Production standards: GAP, Organic farming, etc
6. Good Manufacturing Practices (GMP)
7. HAACP/ISO9000/14000 systems
8. Harvesting and postharvest handling of agricultural produce
9. Traceability

Assessment

- **Coursework** **50%**
  - Laboratory report 20%
  - Course assignment 10%
  - Field trip report 20%
- **Final Examination** **50%**
  - One three hour examination

BIOL6104 ADVANCED CROP PRODUCTION TECHNOLOGIES

(3 Credits) (Semester 2)

Course Description

To provide a framework of use of state-of-the-art advances in crop production techniques to the production of existing and new crops based on the agricultural value chain approach.

Learning Outcomes

At the end of the course students will be able to:

1. Describe improved production practices
2. Explain the advantages of new and improved production techniques
3. Discuss in detail protected production technologies
4. Design efficient water and soil management protocols

Course Content

Production systems of crops/plants including vegetables, roots and tubers, tree crops, agroforestry, ornamentals, fibre crops and bio-fuels, forages, pastures and turf, beverage crops, herbs, spices and medicinal plants. Soil and nutrient management practices for crop production. On-farm water management/irrigation and drainage management. Protected agriculture-greenhouse, biotechnology and plant breeding and propagation techniques. Agricultural mechanization and use of ICT and GIS.

Assessment

- **Coursework** **50%**
  - One in-course test 10%
  - Field trip/laboratory report 20%
  - In-course assignment 20%
- **Final Examination** **50%**
  - One three hour examination

CHEM6501 AGRO-PROCESSING TECHNOLOGIES FOR ENTREPRENEURS

(3 Credits) (Semester 3, summer)

Course Description

This course provides an overview and introduction to the underlying principles and technologies used in processing of agricultural produce, and it demonstrates the manufacturing of good quality products in concert with minimal waste generation.

Learning Outcomes

At the end of the course students will be able to:

- outline and justify raw material handling methods for minimization of loss;
- apply simple material and energy balances for control of processing lines;
- compare and select appropriate processing technologies for given raw materials;
- choose and justify suitable packaging technologies for value added products;
- explain the concept of quality control and the need for traceability;
- describe waste management strategies applicable to particular products.

Course Content

1. Introduction to food processing
2. Processing technologies
3. Modern packaging technology
4. Quality Control concerns.
5. Records and traceability
6. Agro-processing Waste Management

Assessment

- **Coursework** **50%**
    - Term paper 20%
    - One Oral presentation 10%
    - Field Trip Report 20%
- **Final Examination:** **50 %**
    - One three hour examination

ECON6145 THE ECONOMICS OF FARMING AND FARMING SYSTEMS

(3 Credits) (Semester 3)

Course Description

This course provides an overview and introduction to the underlying principles of agricultural economics and technologies used in agricultural production and marketing/trade involving a critical look at existing and improved farming systems that are appropriate for the development of a new agriculture in the Caribbean.

Course Outcomes

At the end of the course students will be able to:

- Assess the role of agricultural economics in assessing farming and farming systems in the Caribbean
- Review and analyse the major farming systems in the tropics with particular reference to the most important ones in the Caribbean
- Stimulate critical thinking and to challenge students to think of the critical issues that are important for the development of an agri-preneur who can make informed decisions about his/her agri-business.
- Compare and select appropriate technologies for select farming enterprises;
- Assess nuances and impact of price, markets and trade on farming

Course outline

1. Methodology in economics and the role of agricultural economics
2. Specifics of agricultural markets and the agricultural sector
3. Price formation on the land market
4. The impact of technological change on factor and product prices and the adjustment of the agricultural sector
5. Specifics of agricultural trade
6. Evaluation of agricultural policies

Assessment

- **Coursework** **50%**
    - Case study analyses 20%
    - Group Assignment 10%
    - Field trip report 20%
- **Final Examination** **50%**
    - One three-hour examination

MGMT6018 MARKETING
(3 Credits) (Semester 1)

Course Description
This course is designed to acquaint students with key concepts, theories and techniques of marketing. These aspects of marketing will be applied to business challenges; and applications for agricultural entrepreneurship will be furnished as far as possible. Students will also be afforded the opportunity to examine the impact of key factors such as technological developments, competition, economic policies and cultural trends, on marketing practice and decision-making. The focus of this course is on goods and service marketing in the area of agriculture. However, reference will be made to the Value Chain as a market-focused, demand driven process in which producers and/or business enterprises collaborate to develop a value-added product.

Learning Outcomes
- Understand and analyse customer behaviour, and focus resources on specific customer segments and against specific competitors.
- Demonstrate a clear understanding of major marketing concepts, marketing theories, principles, strategies and how they are applied to agriculture
- Evaluate the effectiveness of an existing product marketing strategy
- Select, analyse and define a target market for a select product or service.
- Develop an integrated marketing plan for a product or service
- Identify components of the value chain as applied to agriculture
- Identify value chains of different agricultural commodities/products
- Design value chains for the agri-industry
- Identify partnerships for exploitation of potential value chains
- Develop value chains for a range of prescribed agriculture commodities/agro industries
- Advantages of the agricultural value chain.
- Identifying and developing agricultural value chains for selected agricultural commodities.
- Analysis of Value Chain case studies

Course Content
1. Defining Marketing for the 21st Century
2. Developing Marketing Strategy and Plans

3. Designing and Managing Services
4. Developing Pricing Strategies and Programs
5. Structures and peculiarities of the agricultural value chain
6. Value chain analysis and evaluation
7. Limitations of value chain advantages
8. Advantages of the agricultural value chain.
9. Identifying and developing agricultural value chains for selected agricultural commodities
10. Value Chain case studies

Assessment

- **Coursework** **50%**
  - Value-added case study 20%
  - Marketing Plan Presentation 20%
  - In course test 10%
- **Final Examination** **50%**
  - One three hour examination

MGMT6020 DECISION MODELS FOR MANAGERS
(3 Credits) (Semester 1)

Course Description
This course examines how formal analytic tools and quantitative techniques are used or managerial decision making. It examines the application of statistical concepts and models to decision making under uncertainty and under conditions of relative uncertainty. Specific attention is paid to the role of forecasting, systems design production planning and scheduling and materials management. The use of information systems in planning, design and control of manufacturing and service organizations is introduced.

Delivered in two complementary modules, the first introduces the principles of statistics and their application to managerial decision-making, while the second provides an introduction to a selection of quantitative techniques that are commonly used to structure and analyze business decision problems.

Learning Outcomes
Upon completion of Module 1, Statistical Techniques for Managerial Decision Making, students should be able to:

- Use descriptive statistics to summarize quantitative data;
- Describe data sets using various measures;

- Demonstrate their understanding of the rules and use of basic probability;
- Explain the difference between probabilistic and non-probabilistic sampling designs;
- Distinguish between different types of discrete and continuous probability distributions;
- Draw inferences about population parameters from sample statistics;
- Evaluate qualitative and small sample data;
- Use EXCEL/SPSS software to generate statistics, formulate and estimate statistical models and interpret output.

Upon completion of Module 2, Quantitative Techniques for Managerial Decision-Making, students should be able to:

- Formulate quantitative models using linear programming, decision trees and forecasting techniques;
  Use appropriate computer software such as EXCEL to improve their efficiency in modelling;
- Interpret the output of the models/techniques and use them to assess risk and guide management decision making;
- Recommend the appropriate modelling technique for different classes of business decision-making problems;
- Evaluate business scenarios and choose the "best" model to apply in solving business problems.

Course content

1. Introduction to Data and Statistics
2. Probability
3. Probability Distributions
4. Inferences Based on Single Sample

Assessment

- **Coursework** **40%**
    - Project Development 20%
    - Case studies discussion 10%
    - In course test 10%
- **Final Examination** **60%**
    - One three-hour examination

MGMT6162 INTERNATIONAL ENTREPRENEURSHIP IN AGRICULTURAL ENTERPRISES

(3 Credits) (Summer)

Course Description

This course looks at agricultural entrepreneurship theory and practice in an international context in terms of environmental factors, financing and operations of global corporations.

Learning Outcomes

On completion of this course, students will be able to understand:

- Environmental factors (global and national) influencing international entrepreneurship;
- Entrepreneurial process in other countries/cultural settings, and managing a growth orientated global entrepreneurial venture, including a sound understanding of international expansion of a venture and pertinent sources of financing in international entrepreneurship;
- Relational aspects of international entrepreneurship that comprise managing relationships with key stakeholders impacting upon any venture;
- The paradigm of 'corporate social responsibility', its implications on strategy, policy and practices of global organisations in terms of new business venturing, usually in the form of social enterprises created through corporate community involvement.

Course Content

1. Entrepreneurship, Traits of an Entrepreneur, Opportunity Seeking and Recognition
2. The entrepreneurial venture's business environment
3. Assessing business opportunities in the international market Strategies which entrepreneurial firms can use to go international
4. Getting mature entrepreneurial firms to go international
5. The strategic management of the entrepreneurial firm
6. Managing in a growing international firm
7. Cross cultural issues in managing an international firm
8. Networks and the internationalization of the entrepreneurial firm
9. Assembling resources for international operations
10. Raising financing for international business transactions

Assessment

- **Coursework** **50%**
  - Project 35%
  - Essay 15%
- **Final Examination** **50%**
  - One three-hour examination

MGMT6164 NEW VENTURE CREATION
(3 Credits) (Semester 3)

Course Description
This course aims to develop the skills necessary for creating a new venture within the agriculture value chain, with a particular focus on communicating through written and verbal presentations. This course allows the student hands-on opportunity to use, in a holistic manner, the various techniques learned (agribusiness management and entrepreneurial techniques) to design and implement a business along the agricultural value chain. The new venture creation process provides an opportunity to refine these skills and integrate them into a cohesive plan for a new venture.

Learning Outcomes
At the end of the course students should be able to:

- Identify the various links in the agriculture value chain
- Use appropriate tools to assess potential opportunities for development of value added
- Demonstrate thought process in the selection and analysis of product service development
- Develop a plan of a series of novel ventures from the value chain for agriculture products/services of his choice

Course Content
Emphasis will be placed on real world application in agribusiness theory through the building of an effective business plan, case study analysis and interaction with the agribusiness sector. External practitioners will participate, providing front line insight to the real life issues, challenges and skills needed to fund and launch a successful venture.

Student teams take a multi-disciplinary approach to the preparation and presentation of a professional business plan to a group of venture investors, entrepreneurs, attorneys, and operating executives.

Topics include:

1. Business models for entrepreneurs
2. What to do before the business Plan is written
3. Preparing a Business Plan
4. Presenting the Business Plan

Assessment

- **Coursework:** **50%**
    - Case study analyses 20%
    - Two written assignments 20%
    - Oral presentation 10%
- **Final Examination:** **50%**
    - One three hour examination

MGMT6165 AGRICULTURAL MARKETING STRATEGIES

(3 Credits) (Semester 3)

Course Description

The course aims to develop the competence of students to use cutting edge marketing strategies to analyze and identify market niches for adding value to agriculture all along the value chain. This is a general course in marketing of agricultural commodities with particular emphasis on food products. The course analyzes and focuses on efficiency criteria, consumer behaviour, market organizations and institutions, and marketing functions.

Learning Outcomes

At the end of the course students will be able to:

- Describe what marketing is and the role of marketing in food and fiber systems;
- Identify and describe the major participants in the food supply chain;
- Explain how each participant contributes to the final products and services offered to consumers;
- Delineate the major elements of a firm’s marketing strategy and account for how that strategy will vary depending on whether it is a B2B or a B2C customer;
- Give an account of the relationships between farm, nonfarm and retail food prices;
- Discuss the benefits and drawbacks of the various industrial organizational structures;

- Explain spatial and temporal aspects of agri-food marketing;
- Identify major trends in food spending and consumption;
- Use the skill developed on the to create a marketing strategy for agri-products and services

Course Outline

1. Analyzing Consumer Behaviour/Market Demand
2. Sample Studies of Consumer Food Demand
3. Formation of Tastes and Preferences
4. Value Theory and Product Valuation
5. Introduction to Economic Experiments: Applications to Marketing

Assessment

- **Coursework** **50%**
  - Case study analyses 20%
  - Group Assignment 10%
  - Term paper 20%
- **Final Examination** **50%**
  - One three hour examination

MGMT6166 FINAL PROJECT

(6 Credits) (Semester 4)

Course Description

The course aims to increase the level of competence in all aspects of agricultural project preparation to the pre-investment stage. The course allows students to integrate and apply the learning they have been exposed to during the progamme to an approved project of their choice. Emphasis will be placed on solving real issues and identifying opportunities for actual implementation in partnerships with key stakeholders including agribusiness entities, state and tertiary education, and R&D institutions.

Learning Outcomes

At the end of the course students will be able to:

- Discuss the state of the art in the project topic
- Prepare draft report with relevant areas for developing project document
- Prepare a comprehensive document suitable for MSc Project Examination
- Develop project in collaboration with relevant stakeholders

Course Description

This creative component is in lieu of thesis and mandates all participants in the programme to undertake a final project which entails the development and implementation of an agricultural enterprise which has a real potential for real world applicability. It will involve developing a business plan for the promotion of an agricultural enterprise with emphasis on some aspect of the agriculture value chain. This proposal will be presented to a panel of judges who will determine whether or not the idea is feasible. The project outline should include the preliminary questions or issues, context, literature review and methods. Permission from instructor/coordinator is required prior to the development of the plan.

Assessment

- The final project will be assessed by two examiners. The candidate must have obtained an average mark of 70% or more to obtain a distinction.

MASTER OF SCIENCE: MARINE AND TERRESTRIAL ECOSYSTEMS

PROGRAMME OVERVIEW

This programme is offered jointly by the Department of Life Sciences and Environmental Management Unit (EMU) and is a specialisation of the overarching MSc in Natural Resources Management. **(See Section 2: CEM for details)**

The primary aim of this programme is to provide a regionally integrated approach to marine and terrestrial ecosystems management. This will involve the collection and analysis of data required for the detailed study of these areas and the knowledge of biological and other interventions for conservation, monitoring and integrated management of marine and terrestrial ecosystem resources towards sustainable use.

Programme Objectives

The programme will cover selected aspects of biodiversity associated with Jamaican aquatic and terrestrial environments, with a greater emphasis on their management, conservation and sustainable use. At the end of this programme students will be able to:

- identify the issues affecting terrestrial and marine communities and the processes which make these systems unique,
- appropriately use GIS, Geoinformatics, remote sensing as well as other environmental tools in the study of the environment,
- outline environmental management strategies that integrate biological, political, legal, social and ethical issues as well as design appropriate interventions to conserve threatened species and environments,
- execute sound research for monitoring and providing solutions for problems related to the environment.

Entry Requirements

Entrants are required to have obtained a B.Sc. (honours) degree in the biological sciences from a recognized institution.

Programme Duration

The programme duration is 15 months full-time or 18 months with the 12-credit project and will be offered on evenings and weekends.

NRM CORE (see Section 2: CEM for additional information on the NRM)		
	YEAR 1, SEMESTER 1	
ENVR6401	Environmental Law and Multilateral Environmental Agreements	3
ENVR6402	Research Methods and Project Management	3
ENVR6406	Socio-ecology and Natural Resource Management	3
	YEAR 1, SEMESTER 2	
ENVR6403	Environmental Impact Assessment	3
ENVR6404	Principles and Practice of Geoinformatics	3
ENVR6405	Management and Analysis of Environmental Data	3
	SUMMER	
ENVR6407	Environmental Economics (Applies only to students in who elect to do ENVR 6500 Research project; N**ot required by students doing BIOL6550**)	3
BIOL6421	Coastal Habitat Restoration and Rehabilitation (during summer term of Year 1 at the Discovery Bay Marine Lab)	3
DLS SPECIALISATION: MaTE		
	YEAR 2, SEMESTER 1	
BIOL6413	Sustainable Use and Management of Natural Resources	3
BIOL6414	Integrated Coastal Zone Management	3
	YEAR 2, SEMESTER 2	
BIOL6412	Conservation & Management of Biodiversity	3
BIOL6415/ ENVR6430	National Parks, Tourism and Recreational Amenities	3
ENVR6500	Environmental Project	9
OR		
BIOL6550	Environmental Research project	12**
	TOTAL CREDITS	**45**
** Access to BIOL6550 is contingent on student performance in the Semester 1 courses. (No failures and B+ or better in all courses).		

MPHIL/PHD IN LIFE SCIENCES

PROGRAMME OVERVIEW

The Department of Life Sciences offers research programmes leading to the award of the MPhil and PhD degrees in Botany, Zoology, Experimental Biology, Environmental Biology or Oceanography. Registration for the research degrees may be on a part-time or full-time basis.

Programme Objectives

- students will possess advanced knowledge and training in one or more areas of biology with more specific subject-related skills in one of these.
- the subject-related skills developed will be in an area of applied biology.
- students will develop significant information gathering and analytical skills.
- students will be able to take a critical approach to any biological/environmental problems which they may encounter.

Entry Requirements

- Entry to the MPhil degree program requires a First or Upper Second Class BSc (Honours) degree in the Life Sciences.
- Candidates having a Lower Second Class Honours BSc degree may be considered for acceptance into an MPhil programme on special recommendation by the Department.
- Applications for transfer to a PhD program from MPhil are encouraged where students display exceptional promise.

Areas of Research

Biodiversity and conservation, Biotechnology, Coastal Zone Management, Coral reef ecology, Entomology, Pest Management, Fish Biology, Freshwater Ecology Fisheries and Aquaculture, Forest Ecology, Horticulture, Marine Ecology, Molecular Biology, Parasitology, Animal Physiology, Plant Breeding, Plant Pathology, Plant Physiology, Terrestrial and Aquatic Ecology, Tissue culture and Virology.

Duration of Programme

The MPhil degree normally takes two to three years of intensive research on a full-time basis, while a PhD degree usually takes three to four years. Registration can be part-time or full-time.

An MSc degree will normally take between 18 and 24 months, with sessions taking place evenings and weekends. Candidates across the MSc. programmes are registered part time as the programmes are geared to facilitate working professionals who desire academic improvement or practical, hands on application of the desk operation of their employment.

PROGRAMME STRUCTURE

Required Courses/Credit Requirements

Students are also expected to read prescribed courses covering Research Methodology, Project Management, Technical Report Writing and Statistics. The intention of these courses is to provide students with research techniques and skills that will not only help them to complete their current research topic, but strengthen their practical application skills for life after university.

Master of Philosophy

- Requires the completion of six (6) credits from postgraduate courses in addition to a thesis documenting the results of the research carried out over a period.

Doctor of Philosophy

- Requires the completion of nine (9) credits from postgraduate courses in addition to a thesis documenting the results of the research carried out over a period.

Code	Title	Semester
ENVR6402	Research Methods and Project Management	1
ENVR6405	Management and Analysis of Environmental Data	2
Plus an Elective Graduate Course (e.g. from the NRM programme)		

Seminars

PhD candidates are required to have presented at least three (3) seminars before they can submit their theses for examination. MPhil candidates are required to have had two (2) seminars before they can submit their theses for examination.

Award of Degree

For the award of the research degree, the student submits a thesis and, in the case of PhD candidates, defend this work in an oral examination. Normally research leading to a PhD would demonstrate a level of originality beyond that of an MPhil.

Research degrees are awarded in the following subject areas: Botany, Environmental Biology, Marine Biology, Oceanography and Zoology

COURSE DESCRIPTIONS

ENVR6402 RESEARCH METHODS AND PROJECT MANAGEMENT
3-credits (Semester 1)

Prerequisite: Registered Graduate student

Course Description

The goal of this course is to provide students with a solid background in the philosophy of research, research design, in modern methods of data and information collection, as well as in data handling and analysis for environmental management. This will include an introduction to the conceptual and practical aspects of qualitative and quantitative research and the types of topics for which each approach is useful. Students will be introduced to various quantitative and qualitative analytical methods including media and public education, participant observation, participatory action research, media and textual analysis as well as software for data analysis. The modules will provide the student with a broad range of research skills which can be utilized both for the specific Masters project and as a basis for more long-term projects. The course also aims to develop student skills in making oral presentations as well as writing for scientific papers and technical reports.

ENVR6405 MANAGEMENT AND ANALYSIS OF ENVIRONMENTAL DATA

3-credits (Semester 1)

Prerequisite: Registered Graduate Student

Course Description

The aim of this course is to provide students with a fundamental understanding of the importance of storage, retrieval and analysis of environmental data. In particular, the course will provide practical training in statistical analysis of environmental data and demonstrate the storage and retrieval of biodiversity information using national and international databases. As such, this course will show students how data, through appropriate management and analysis, becomes information which then informs the decision-making process. In addition, it will provide the student with fundamental skills which may underpin many elements of their future research project and career.

Department of Mathematics

www.mona.uwi.edu/mathematics

7

Taught Master's Degrees

MSc in Mathematics
MSc in Enterprise Risk Management

Research Degrees

MPhil in Mathematics
PhD in Mathematics

Head of Department: Dr. Nagarani Ponakala
Graduate Coordinator: Dr. Mahesha Narayana
Contact: The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: maths@uwimona.edu.jm
Tel: (876) 977-2693
Fax: (876) 927-2464
Ext: 2284 / 2621

MASTER OF SCIENCE: MATHEMATICS

PROGRAMME OBJECTIVES

The primary objective of the M.Sc. Mathematics programme is:

- to provide graduates with a comprehensive advanced knowledge of important areas of mathematics;
- to produce graduates with high level of analytic and numerical skills required in a 21^{st} century economy;
- to furnish graduates with the necessary background for further study in Mathematics, and enhance their research capabilities; and
- to enable graduates to function effectively as teachers, at both the school and university levels.

Entry Requirements

- To enter this programme, a candidate must normally hold a first degree with at least second class honours and a major in Mathematics. Candidates with different qualifications may be considered but will be required to pass qualifying courses, as prescribed by the Department.

- Students must have passed the following courses (or their equivalent):
    - MATH2401 – Elements of Mathematical Analysis
    - MATH2410 – A First course in Linear Algebra
    - MATH3402 – A First course on Metric Spaces & Topology

- It should be noted that students must pass all the **assigned** qualified courses before proceeding to the MSc programme. Resits of qualifying courses are not permitted.

Programme Duration

The programme will be offered over two years (24 months) inclusive of time needed for completion of the major Research Project.

Courses are offered in the evenings during the week.

PROGRAMME STRUCTURE

Level	Semester	Course	Credits
Year 1	1	2 core courses: MATH6624 and MATH6621	8
	2	1 core course (MATH6626) Plus 2 Electives (8 credits total)	12
Year 2	1	1 core course (MATH6625) Plus 2 Electives (8 credits total)	12
	2	1 core course: MATH6800	8

Programme Content

COURSE CODE	COURSE TITLE	SEMESTER	CREDITS
	CORE COURSES		
MATH6621	General Topology	I	4
MATH6624	Topics in Mathematical Analysis	I	4
MATH6625	Measure and Integration	I	4
MATH6626	Elements of Functional Analysis	I	4
MATH6800	Research Project	II	8
	ELECTIVES		
MATH6622	Differential Equations	II	4
MATH6623	Numerical Methods for Differential Equations		4
MATH6627	Group Theory with Applications	I	4
MATH6628	Differential Geometry	I	4
MATH6629	Mechanics of Interacting Particles	II	4
MATH6633	A Course in Algebraic Number Theory	II	4
MATH6634	A Course in the History of Mathematics	II	4
MATH6635	Complex Analysis and Application	I	4
STAT6630	Introduction to Stochastic Process	II	4
STAT6631	The Analysis of Time Series	I	4
STAT6632	Multivariate Statistical Analysis	I	4

COURSE DESCRIPTIONS

MATH6621 GENERAL TOPOLOGY
(4 Credits) (Semester 1)

Course Description
Topology is the study of spaces and sets and can be thought of as an extension of geometry. It is an investigation of both the local and the global structure of a space or set. The foundation of General Topology (or Point-Set Topology) is set theory. The motivation behind topology is that some geometric problems do not depend on the exact shape of an object but on the way the object is put together. The course gives an up-to-date and modern overview of the main concepts in General Topology. Topological properties and several examples of topological spaces arising in several branches of mathematics are studied to show how topology is a unifying theme in different mathematical fields. A course in general topology is essential for enrolled students since it provides them with fundamental notions such as those of topological space, topological vector space, connectedness, and compactness.

Learning Outcomes
By the end of the course, students will be able to:
1. explain the characteristics of topological, metric and normed spaces;
2. discuss the implications of the cardinality of the continuum;
3. construct new spaces from old, including subspaces, quotients and product spaces;
4. construct continuous functions between topological spaces;
5. test convergence of sequences in different spaces;
6. identify connections between modern analysis and topology;
7. discuss the consequences of Urysohn's lemma;
8. use examples to explain the significance of Tychonoff's theorem.

Course Content
Topological, metric and normed spaces; Continuity; Connectedness; Hausdorff' spaces; Compactness; Completeness; Topological vector spaces; Quotient spaces; Completion of maps, metric and normed spaces; Homotopy; Countability axioms and their role in mathematics; Urysohn's lemma; Tietz's extension lemma; Paracompact spaces and Stone's theorem; Tychonoff's theorem and its role in Functional Analysis.

Assessment

- **Coursework:** **40%**
  - In-Course test 20%
  - Group Project 20%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6622 DIFFERENTIAL EQUATIONS

(4 Credits) (Semester II)

Prerequisite

NONE

Course Description

This course presents various classes of differential equations, and shows how each may be used to construct models in various branches of science and engineering, demonstrates existence and uniqueness of solution, and shows where possible how each may be solved. Students will be exposed to modern mathematical software specifically designed for the solution of differential equations, and will be taught to use this software to explore the properties of the equations encountered on the course.

Learning Outcomes

On completion of this course, the student should be able to:

1. state and prove the existence theorem for first order initial value problems, and apply Picard's theorem to determine if a first-order initial value problem has a unique solution;
2. state and interpret the existence and uniqueness theorem for linear higher order initial value problems;
3. solve second order non-homogeneous equations by the method of variation of parameters;
4. use Sturm-Liouville theory to solve given boundary value problems;
5. solve systems of linear differential equations;
6. model systems in physics, economics, biology, and engineering with differential equations using analytic and computational methods;
7. interpret Lyapunov stability in the context of physical phenomena;
8. use mathematical software to solve differential equations.

Course Content

- Existence and uniqueness: Introduction to ordinary and partial differential equations, Review of exact equations of first order differential equations. Lipschitz conditions, Existence and Uniqueness of solutions for first order initial value problem, examples, Non-local existence of solutions.

- Second Order Equations: General solution of homogeneous equations, Non-homogeneous equations, Wronskian, Method of variation of parameters.
- Sturm-Liouville theory: Sturm comparison theorem, Sturm separation theorem, Boundary value problems, Green's functions, Sturm-Liouville problems.
- Systems of Differential Equations: Algebraic properties of solutions of linear systems, The eigenvalue-eigenvector method of finding solutions, Complex eigenvalues, Equal eigenvalues, Fundamental matrix solutions, Nonhomogeneous equations, Existence and uniqueness for linear systems.
- Nonlinear Differential Equations and Stability: The phase plane, The Poincare-Bendixon theorem, Perturbed linear systems, Lyapunov methods.

Assessment

- **Coursework:** **40%**
  - Two written assignments 2x5%
  - Two In-Course tests 2x15%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6623 NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS
(4 Credits) (Semester 1)

Prerequisite
NONE. Prior knowledge of Computer Programming would be an asset

Course Description
Differential equations are abundant in the theoretical modelling of problems in science and engineering as well as economics, social science, biology, business, health care, etc. Though there have been many well-developed analytical solution techniques available for hundreds of years, often the systems described by differential equations are so complex, or the systems that they describe are so large, that a purely analytical solution is not tractable. It is in these complex cases that numerical methods are used to obtain an approximate solution of the differential equation. With high-speed computers and advancement in Numerical analysis and efficient computer programmes, one can tackle challenging problems in the above fields.

This course is intended to introduce and give an understanding of numerical methods for the solution of ordinary and partial differential equations. The methods will be derived and the convergence and stability of the methods will be analyzed. The applications of these methods in solving real world problems will be emphasized. Students will be exposed to modern mathematical software for the practical use of the problems and for better visualization of the convergence and stability of these methods.

Learning Outcomes

On completion of this course, the student should be able to:

1. Develop a logical mathematical approach to solve differential equations and solve these equations using numerical methods where those are required.
2. Investigate the occurrence of errors in different techniques developed in the course.
3. Analyze the convergence and stability of the methods of the study.
4. Write codes in available software to simulate numerical methods for the differential equations and Understand visually basic computational aspects related to accuracy, stability and convergence of numerical methods.

Course Content

- Introduction: Initial Value Problem (IVP); Boundary Value Problem (BVP); Classification of second order Partial Differential Equations (PDE); Errors in Numerical Methods; Convergence and stability of numerical methods; Fundamentals in Programming, Review of Iterative Solution of Linear Algebraic Systems.
- Initial Value Problems for Ordinary Differential Equations
- Picards method, Taylor series method, Euler Method; Runge-Kutta methods; Errors and Stability, Predictor corrector methods.
- Boundary value problems for Ordinary differential Equations
- Finite Difference Methods; Shooting Method; Collocation methods.
- Numerical Solutions to Partial Differential Equations
- Finite difference Schemes for Parabolic, Elliptic and Hyperbolic Equations; Consistency, convergence and stability of finite difference schemes.
- Lab hours (14): Implementation of the methods used for the solution of differential equations; practical understanding of convergence and stability.

Assessment

- **Coursework:** **50%**
    - Two written assignments 10%
    - One In-Course test 20%
    - One Laboratory test 20%
- **Final Exam** **50%**
    - One three-hour theory paper

MATH6624 TOPICS IN MATHEMATICAL ANALYSIS
(4 Credits) (Semester 1)

Prerequisite
None

Course Description
Even though the students are familiar with the notion of limit from high school, they still need to understand deeper the limit concept, countability and non-countability, consider paradoxes and counter examples, extend their understanding of convergence of sequences and series of functions, derivative, integral.

The course aims to teach students the tools of modern analysis as it related to further study in mathematics, especially numerical analysis, differential equations, functional analysis, topology, stochastic processes. This course is intended to develop the ability of the students to work with abstract ideas.

Learning Outcomes
By completion of this course, students should be able to:
1. Define infimum and supremum of the set on real line;
2. Find infimum and supremum of selected sets;
3. Explain the role of paradoxes in the set theory;
4. State and prove Bolzano-Weierstass and Heine-Borel theorems;
5. Define the Riemann-Stieltjes integral and explain the difference with the Riemann integral;
6. Explain the notion of compactness and give example of compact and non-compact sets;
7. Explain the notion of point-wise and uniform convergence of functions and give examples.

Course Content
- Real numbers and Set equivalence: Axioms of real numbers, infimum, supremum, integers, rationals. Set equivalence, countable and uncountable sets, axiom of choice, Godel and independence proofs, Zorn' lemma, Zermelo-Russell paradox.
- Sequences of real numbers: Convergent and divergent sequences, limit theorems, number e and real exponents, Bolzano-Weierstrass Theorem, Cauchy condition, limsup and liminf of bounded and unbounded sequences.
- Calculus for Vector-Valued functions: Vector-valued functions, limits and continuity, differentiation and Jacobian, inverse function theorem, implicit function theorem. Compactness in R^n. The Heine-Borel theorem and the consequence for continuous function on the Real line.
- Sequences and series of functions: Pointwise and uniform convergence of functions, integration and differentiation of uniformly convergent

sequences; Series of functions, Weiershtrass Test, Weierstrass' example. Summability methods and Tauberian theorems.

- Riemann-Stieltjes integral: Riemann-Stieltjes integration with respect to an increasing integrator, Riemann-Stieltjes sums, Riemann-Stieltjes integration with respect to an arbitrary integrator, functions of bounded variations, Riemann-Stieltjes integration with respect to functions of bounded variation, measure zero and Cantor set, necessary and sufficient conditions for existence of Riemann integral.

Assessment

- **Coursework:** **40%**
  - One In-Course test 30%
  - One written assignment 10%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6625 MEASURE AND INTEGRATION
(4 Credits) (Semester 1)

Prerequisite
None

Course Description
The construction of the Riemann integral is known to every undergraduate mathematics student. However, this integral has certain inherent limitations that prevent its use in a wide range of mathematical applications, including modern developments in the fields of probability theory, stochastic processes and dynamical systems. This issue is dealt with by extracting the fundamental ideas behind the construction of such integrals, and providing a mathematically rigorous, though abstract, foundation upon which to define more powerful notions of integration.

This course is intended to develop the ability of students to work with abstract ideas.

Learning Outcomes
On completion of this course, the student should be able to:

1. Define the Dirichlet function and explain why it is not Riemann integrable;
2. Demonstrate the role of Lebesgue outer inner measure in the definition of measurable sets;
3. Prove the Caratheodory Criterion for measurability;
4. Use the Caratheodory Criterion to prove selected properties of measurable sets;
5. Evaluate the Lebesgue integral of selected functions;

6. State and prove the monotone convergence theorem, dominated convergence theorem, Fatou's lemma;
7. Explain the role of each in the construction of the Lebesgue integral;
8. Describe the elementary approach to probability and explain why it fails for general sample spaces;
9. Explain how the Lebesgue measure may be used to construct a probability space.

Course Content

- Introduction: First principles construction of the Riemann integral; Riemann integrable functions; the role of the Fundamental Theorem of Calculus; the Dirichlet function.
- Lebesgue Measure: Measure in the line and plane; abstract measure spaces and the Caratheodory criterion; properties of Lebesgue measure; construction of non-measurable sets.
- Measurable functions: Measurable functions on R; simple functions; algebraic operations on measurable functions; equivalent functions.
- The Lebesgue integral: Definition and basic properties on bounded sets; the Monotone Convergence Theorem; Fatou's Lemma; the Dominated Convergence Theorem; integration over sets of infinite measure; comparative analysis of Riemann and Lebesgue integrals; generalisation of the Fundamental Theorem of Calculus.
- Applications to probability theory: Probability spaces as measure spaces; random variables as measurable functions; expectation as Lebesgue integral with respect to a probability measure.

Assessment

- **Coursework:** **40%**
  - One In-Course test 20%
  - One written assignment 20%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6626 ELEMENTS OF FUNCTIONAL ANALYSIS
(4 Credits) (Semester 1)

Prerequisite
MATH6621 General Topology

Course Description
The course gives an up-to-date and modern overview of the main concepts in Functional Analysis. Functional analytic properties and several examples of

Banach and Hilbert spaces arising in several branches of mathematics are studied to show how functional analysis is a unifying theme in different mathematical fields.

Learning Outcomes

At the end of the course, students will be able to:

1. Explain rigorously the meaning of metric, normed, Banach, and Hilbert spaces;
2. Discuss the implications of the Hahn-Banach theorem, Cathegory theorem, Uniform Boundedness Theorem, Open Mapping Theorem, Closed Graph Theorem;
3. Construct functionals and adjoints;
4. Construct operators between normed, Banach, and Hilbert spaces;
5. Test strong and weak convergence of sequences in different spaces;
6. Test convergence of sequences of operators and functionals;
7. Identify connections between functional analysis and topology;
8. Use examples to explain the significance of Hahn-Banach theorem, Category theorem, Uniform Boundedness Theorem, Open Mapping Theorem, Closed Graph Theorem.

Course Content

- Metric spaces: metric space, examples of metric spaces, open sets, closed sets, neighborhood, convergence, Cauchy sequence, completeness.
- Normed spaces: vector space, normed space, Banach space, properties of normed spaces, finite dimensional normed spaces and subspaces, compactness and finite dimension.
- Linear operators: linear operators, bounded and continuous linear operators between Banach spaces, linear functionals, linear operators and functionals on finite dimensional spaces, normed spaces of operators, the dual space.
- Hilbert spaces: inner product space, Hilbert space and its properties, orthogonal complements and direct sums, orthonormal sets and sequences, representation of functionals on Hilbert spaces, adjoint, self-adjoint, unitary and normal operators, strong and weak convergence, convergence of sequences of operators and functionals.
- Some fundamental theorems of Functional Analysis: Zorn's lemma, Hahn-Banach theorem, Category theorem, Uniform Boundedness Theorem, Open Mapping Theorem, closed linear operators and the Closed Graph Theorem.

Assessment

- **Coursework:** **40%**
    - One In-Course test 20%
    - One group project 20%
- **Final Exam** **60%**
    - One three-hour theory paper

MATH6627 GROUP THEORY WITH APPLICATIONS

(4 Credits) (Semester 1)

Prerequisite

None

Course Description

Group theory studies the algebraic structures known as groups. The concept of a group is central to abstract algebra and recurs throughout mathematics. Moreover, the methods of group theory have strongly influenced many parts of algebra. Lie groups theory is a branch of group theory that has experienced tremendous advances and it cannot be skipped in any course in group theory. Group theory and the closely related representation theory have many applications in physics and chemistry since various physical systems, such as crystals and the hydrogen atom, can be modeled by symmetry groups.

The course gives an up-to-date and modern overview of the main concepts in Group Theory. Group theoretical properties and several examples of groups arising in many branches of mathematics, physics, and chemistry are studied to show how group theory emerges in different mathematical fields and in applied sciences.

Learning Outcomes

At the end of the course, students will be able to:

1. Explain rigorously the meaning of transformation, symmetry, permutation, Lie groups;
2. Discuss the implications of symmetry groups in physics and chemistry;
3. Construct quaternions and Clifford algebras;
4. Identify Lie groups and Lie algebras;
5. Construct one-parameter subgroups;
6. Identify group of isometries;
7. Use examples to explain the significance of Grassmann algebras.

Course Content

- Groups: Elements of group theory, transformations and permutation groups, matrix groups, normal subgroups and factor groups, group actions.
- Symmetry groups: Rotation group SO(3), Euclidean group, Galilean group, Lorentz group.
- Algebras: Algebras and ideals, complex numbers and complex structures, quaternions and Clifford algebras, Grassmann algebras.
- Lie groups and Lie algebras: Lie groups, matrix Lie groups, infinitesimal generators, the exponential map, one-parameter subgroups, complex Lie groups, Lie groups of transformations, group of isometries.

Assessment

- **Coursework:** **40%**
  - One In-Course test 20%
  - One group project 20%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6628 DIFFERENTIAL GEOMETRY
(4 Credits) (Semester 1)

Prerequisites
None

Course Description
This course is about the analysis of manifolds such as curves, surfaces and hypersurfaces in higher dimensional space using the tools of calculus and linear algebra. There will be many examples discussed, including some which arise in the theory of general relativity. Emphasis will be placed on developing intuitions and learning to use calculations to verify and prove theorems. Students need a good background in linear algebra. Some exposure to differential equations is helpful but not absolutely necessary.

Learning Outcomes
At the end of the course, students will be able to:

1. Explain rigorously the geometrical meaning of curvature and torsion of curves, surfaces and more complex manifolds;
2. Compute Lie derivatives of vector fields and differential forms;
3. Compute covariant derivatives of tensor fields;
4. Compute geodesics in Riemannian and pseudo-Riemannian manifolds;
5. Compute curvatures and scalar curvatures of Riemannian and pseudo-Riemannian manifolds ;
6. Investigate isometries of manifolds by solving the corresponding Killing equation;
7. Identify connections between linear algebra and multivariable calculus and differential geometry;
8. Investigate singularities of manifolds;
9. Solve Einstein field equations in vacuum for spherically symmetric manifolds.

Course Content

- Manifolds: Heuristic introduction, definitions, examples, differentiable maps, tangent and cotangent space, one-forms, tensors and operations with tensors, tensor fields, pullback and pushforward, one-parameter group of transformations, flows and Lie derivatives.

- Differential Forms: Definitions, exterior derivatives, interior product and Lie derivatives of forms, integration of differential forms, orientation, Stokes theorem.
- Riemannian Geometry: Riemannian and pseudo-Riemannian manifolds, metric tensor, parallel transport, connection and covariant derivative, affine connections, parallel transport and geodesics, the covariant derivative of tensor fields, the metric connection.
- Curvature, torsion and Levi-Civita connections: Definitions, geometrical meaning of the Riemann tensor and the torsion tensor, the Ricci tensor and scalar curvature, Levi-Civita connections, the normal coordinate system, Riemannian curvature tensor with Levi-Civita connection.
- Isometries and conformal transformations: Definitions, Killing vector fields, non-coordinate bases, Cartan's structure equations, Levi-Civita connection in a non-coordinate bases.
- Aspects of General Relativity: Axiomatic introduction to general relativity, the Einstein-Hilbert action, Einstein field equations and their solution for a spherically symmetric manifold.

Assessment

- **Coursework:** **40%**
  - One In-Course test 20%
  - One group project 20%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6629 MECHANICS OF INTERACTING PARTICLES

(4 Credits) (Semester 1)

Prerequisites

MATH6627, MATH6628

Course Description

The course gives an up-to-date and modern overview of the main concepts in the Mechanics of interacting particles. Starting with an introduction to Newtonian mechanics and the Lagrangian/Hamiltonian formalism the course continues with an axiomatic approach to Quantum Mechanics. Path integrals and path integral quantization of Bosonic and Fermionic particles are also treated. A short introduction to Gauge Theories and the Higgs field is given at the end of the course.

Learning Outcomes

At the end of the course, students will be able to:

1. Explain rigorously the meaning of Lagrangian and Hamiltonian formalism of classical mechanics;
2. Construct the Lagrangian and Hamiltonian of systems of interacting particles;
3. Discuss the implications of the canonical quantization;
4. Construct the partition functions of a Bosonic and Fermionic oscillator;
5. Construct the quantization of a Dirac and scalar field;
6. Construct coherent states;
7. Use examples to explain the significance of Abelian and non-Abelian gauge theories;
8. Explain the Higgs field.

Course Content

- Analytical Mechanics: Newtonian mechanics, Lagrangian and Hamiltonian formalisms, applications.
- Quantum Mechanics: Axioms of canonical quantization, Heisenberg equation, Heisenberg picture and Schroedinger picture, harmonic oscillator.
- Path integral quantization of Bose and Dirac particles: Path integral quantization, imaginary time and partition function, time-ordered product and generating functional, Fermionic harmonic oscillator, calculus of Grassmann numbers, coherent states and completeness relation, partition function of a Fermionic oscillator.
- Quantization of a Dirac and scalar field: Free Dirac and scalar fields, interacting Dirac and scalar fields.
- Gauge theories: Abelian gauge theories, non-Abelian gauge theories, Higgs fields.

Assessment

- **Coursework:** **40%**
    - One In-Course test 20%
    - One group project 20%
- **Final Exam** **60%**
    - One three-hour theory paper

MATH6633 A COURSE IN ALGEBRAIC NUMBER THEORY

(4 Credits) (Semester 2)

Prerequisite

None

Course Description

Even though the students are familiar with basic concepts of algebra, they still need to understand the new ideas and techniques, consider potential applications in coding theory and cryptography, extend their understanding of Archimedean, non-Archimedean metrics, norms, completions, integrality, number fields, quadratic forms, groups, rings, discriminants and bases.

The aim of the course is to teach students the tools of modern algebra and number theory as it is related to further study in mathematics. This course is intended to develop the ability of the students to work with abstract ideas and their applications.

Learning Outcomes

By completion of this course, students should be able to:

1. Explain rigorously the concepts of Algebraic Numbers and their Rings of Integers;
2. Compute Norms, Traces and investigate Quadratic Forms;
3. Find the Roots of Polynomials, the Degrees of Field Extensions;
4. Study the Groups of Automorphisms of Normal Field Extensions;
5. Explain the role Local and Global Fields in the Algebraic Number Theory;
6. Compute norms in Archimedean, Non-Archimedean valuations and use the concepts of p-adic Number Field and its extensions in Number Theory;
7. State the Kronecker-Weber Theorem and use it for computations in Algebraic Number Fields.

Course Content

- Preliminaries from Commutative Algebra and Group Theory
- Quadratic Forms, Norms and Traces
- Polynomials and their Roots
- Algebraic Numbers, Rings of Integers
- Field Extensions including an introduction to Galois theory
- Dedekind Domains; Factorization
- Class Numbers, the Unit Theorem
- Cyclotomic Extensions; Kronecker-Weber Theorem; Fermat's Last Theorem
- Valuations; Archimedean, Non-Archimedean Metrics
- Hensel’s lemma; p-adic Number Field, Local Fields
- Global Fields
- Applications of Algebraic Number Theory

Assessment

- **Coursework** **40%**
  - In-Course test 30%
  - Written assignment 10%
- **Final Exam** **60%**
  - One three-hour theory paper

MATH6634 A COURSE IN THE HISTORY OF MATHEMATICS
(4 Credits) (Semester 2)

Prerequisite
Graduate Standing

Course Description
In this course, students will study the origins and development of topics of great modern importance. The course is designed primarily for graduate students interested in teaching and mathematics pedagogy. However, it is suitable for all mathematics students also. The course will focus primarily on the axiomatic development of mathematics, the creative processes leading to new methods, and, the development of the calculus.

Learning Outcomes
On successful completion of the course, the student should be able to:

1. Produce proofs of geometrical results similar to those of antiquity, presented in a deductive format similar to that used in antiquity;
2. Perform explorations and computations similar in nature to those performed historically in the development of the calculus;
3. Compare and contrast the methods of exploration, discovery, and proof from different time periods;
4. Investigate mathematical developments from time periods not covered by this course.

Course Content

- Euclid: definitions, postulates, and common notions; propositions
- Archimedes: measurement of a circle; quadrature of the parabola; area of an ellipse; volume and surface area of a sphere; method of compression; method of discovery.
- Early Quadratures and Tangent Methods: Kepler; Cavalieri; arithmetical quadratures; quadratures of fractional powers; Fermat; Descartes; the rules of Hudde and Sluse.
- Newton: Fluxions; Fundamental Theorem of Calculus; Chain Rule; infinite series; reversion of series; sine and cosine series; integral tables.

Assessment

- **Coursework:** **60%**
  - Four assignments 40%
  - One written assignment 20%
- **Final Exam** **40%**
  - One three-hour theory paper

MATH6635 COMPLEX ANALYSIS AND APPLICATIONS

(4 Credits) (Semester 1)

Prerequisite

Real Analysis (Undergraduate level)

Course Description

This course develops Complex Analysis as an extension of Real Analysis. Apart from concentrating on the theoretical developments, emphasis will be on unifying aspects in theory and applications. Examples will be taken from different applied subjects to showcase the elegance and utility of introducing methods based on complex analysis.

Learning Outcomes

By the end of the course, students will be able to:

1. Identify and construct analytic functions using the Cauchy Riemann equations;
2. Use branch cuts to construct an analytic function from a multi-valued elementary function;
3. Compute contour integrals via path parameterization;
4. Apply the Cauchy-Goursat theorem, the Cauchy integral formula and the principle of deformation of path to compute contour integrals;
5. Develop Taylor and Laurent series representations for elementary functions;
6. Classify isolated singular points and compute residues;
7. Use the Residue Theorem to evaluate improper real integrals.
8. Appreciate the effective use of Complex Analysis in i) understanding many results which are real variables in nature. And ii) solving problems in applied areas.

Course Content

1. Basic Complex Analysis and overview: Algebraic and geometric representation of complex numbers; Comparison of real and complex analysis, Euler's formula; Rational powers and roots of complex numbers; Sets of points in the complex plane. Complex functions, Special

power functions, Linear Mappings, Limits and Continuity, Applications
2. Analytic Functions: Complex Differentiability and Analytic functions; Cauchy Riemann equations; Harmonic functions; The complex exponential function; Trigonometric and Hyperbolic functions and inverses; The complex logarithm – definition, properties, branches and branch cuts. Conformal mapping, Elliptic Functions, Gamma and Zeta functions Analytic Continuation, Applications
3. Complex Integration: The contour integral – definition, properties, application; Bounds on integrals; Antiderivatives; Fundamental Properties of Holomorphic Functions, Cauchy's and Morera's theorems, The Cauchy-Goursat theorem and the principle of deformation of path, Cauchy's integral formula; Lioville's theorem, fundamental theorem of Algebra; Cauchy's inequality and the Maximum Modulus Principle; Applications
4. Series: Convergence of sequences and series; Power series – absolute and uniform convergence, integration and differentiation; Taylor and Laurent series; Applications
5. Residues and Poles: Meromorphic Functions, Isolated singularities, Calculus of residues and the Residue Theorem; Classifying isolated singular points; Residues at poles; Evaluation of improper real integrals by contour integration around poles; Applications

Assessment

- **Coursework:** **40%**
    - One In-Course test 20%
    - Written assignment 20%
- **Final Exam** **60%**
    - One three-hour theory paper

MATH6800 RESEARCH PROJECT IN MATHEMATICS
(8 Credits) (Semester 2)

Course Description
Each student will work on a mathematical project under the supervision of a faculty member. The project will culminate in an oral presentation to the Department of Mathematics. The topic of the project will be agreed upon by the student and supervisor.

Assessment

- Course assessment 100%

STAT6630 INTRODUCTION TO STOCHASTIC PROCESSES

(4 Credits) (Semester 2)

Prerequisites

None

Course Description

Even though the students are familiar with the main notions of Probability Theory, they still need deeper and wider knowledge of many concepts of it. The Theory of Stochastic Processes will bring the students to a higher level of understanding of randomness, discussing how the random variables change over time, learning the exciting properties of Poisson process, Markov chain, Random walk, Brownian motion. This course will teach students to work successfully with stochastic modelling in different areas, including Finance, Queue Theory, Population Dynamics.

This course aims to give students a broad overview of the main concepts in the theory of probability and stochastic processes. It will provide students with solid grounding in modern probabilistic and statistical methods.

Learning Outcomes

By completion of this course, students should be able to:

1. Define conditional expectation;
2. Explain the idea of Bayers Estimators and apply it to the Insurance problems;
3. Define the martingale process and solve selected problems about the martingale.
4. State the Martingale Convergence Theorem and prove the Strong Law of Large Numbers;
5. Define the Brownian motion process and apply it into Financial modelling;
6. Define Markov chain process and apply it to the Birth and Death processes.

Course Content

- Main notions of Probability Theory: Probability, Random Variables, Borel-Cantelli Lemma, Expected value. Moment Generating and Characteristic Function, Laplace Transforms, Main Discrete and Continuous Probability; Distributions, Conditional Expectation and Bayes Estimators. The Exponential Distribution, Lack of Memory and Hazard Rate Functions. Some Probability Inequalities. Limit Theorems. Stochastic Processes

- Poisson Process: Counting Process, Poisson Process, Interarrival and Waiting Time Distributions, Conditional Distribution of Arrival Times
- Renewal Process: Some Limits Theorems, Wald's Equation, Elementary Renewal Theorem, Regenerative Process, Symmetric Random Walk and Arc Sine Laws
- Markov Chains: General Random Walk, Simple Random Walk, Chapman-Kolmogorov Equation, Classification of States, Limit Theorems, Branching Processes. Continuous Time Markov Chains, Birth and Death Processes, Kolmogorov Backward and Forward Differential Equations
- Martingales: Stopping Times, Martingale Stopping Theorem, Azuma's Inequality for Martingales, Submartingales, Supermartingales, Martingale Convergence Theorem, Strong Law of Large Numbers
- Brownian Motion Process: Brownian Bridge Process, Hitting Times, Maximum Variable, Arc Sine Laws. Variations on Brownian Motion: Brownian Motion Adsorbed at a Value, Brownian Motion Reflected at the Origin, Geometric Brownian Motion, Integrated Brownian Motion, Brownian Motion with Drift. Using Martingales to Analyze Brownian Motion

Assessment

- **Coursework** **40%**
    - One In-Course test 20%
    - One written assignment 20%
- **Final Exam** **60%**
    - One three-hour theory paper

STAT6631 THE ANALYSIS OF TIME SERIES
(4 Credits) (Semester 1)

Prerequisite
None

Course Description
Classical statistical analysis is ineffective when applied to sets of observations that are correlated in time: for example, share prices. Time series analysis is a specialised branch of statistical science which deals with such data sets, providing an essential toolset for statisticians, scientists, engineers and financial analysts.

The course covers the fundamental concepts required for the description, modeling and forecasting of time series data, both in the time- and frequency-domains. Attention to the theoretical underpinnings of the subject is complemented by the analysis of real-world data sets, and a practical laboratory component introduces students to the software package R.

Learning Outcomes

On completion of this course, the student should be able to:

1. Classify time series and identify forms of variation present in data;
2. Generate time plots and correlograms of time series data using software;
3. Prove the main properties of random walk, MA, AR, ARMA, (S)ARIMA, ARCH and GARCH models
4. Fit time series models to real-world data sets;
5. Interpret and evaluate time series models fitted by computer packages;
6. Produce forecasts (with associated error bounds) from a real-world data set using a Holt-Winters or Box-Jenkins approach;
7. Explain the significance of the Nyquist and fundamental Fourier frequencies;
8. Prove Parseval's Theorem;
9. Derive the spectral representation of selected stochastic processes.

Course Content

- Introduction: Examples of time series and classification; objectives of time series analysis; types of variation; stationary time series; the time plot; transformations; filtering; differencing; basic models and decomposition of time series; the correlogram.
- Stochastic models for time series: Stochastic processes (ensemble and realisation); stationary processes; autocovariance and autocorrelation functions; purely random processes; random walks; moving average processes; invertibility; autoregressive processes; mixed ARMA models; integrated ARIMA models; ARCH and GARCH models.
- Estimation in the time domain: Estimating the mean, autocovariance and autocorrelation functions; interpreting the correlogram; fitting autoregressive and moving average process; estimating the parameters of an ARMA model; estimating the parameters of an ARIMA model; the Box-Jenkins Seasonal (SARIMA) model; residual analysis and the Akaike Information Criterion.
- Forecasting: Automatic and non-automatic forecasting; Exponential smoothing; the Holt-Winters method; Box-Jenkins forecasting.
- Stationary processes in the frequency domain: The spectral distribution function; the spectral density function, the spectrum of a continuous process, derivation of selected spectra.
- Spectral Analysis: Fourier analysis; a simple sinusoidal model, the fundamental Fourier and Nyquist frequencies; the periodogram; spectral analysis: consistent estimation procedures; confidence intervals for the spectrum, a comparison of different estimation procedures (spectral window or kernal, bandwidth.
- Laboratory work: Time series basics – time plots, decomposing data, multiple time series, differencing; Autocorrelation and the correlogram;

Holt-Winters forecasting; Fitting models to data and model-based forecasting; Spectral analysis of time series.

Assessment

- **Coursework:** **40%**
    - One In-Course test 20%
    - Laboratory assignment 20%
- **Final Exam** **60%**
    - One three-hour theory paper

STAT6632 MULTIVARIATE STATISTICAL ANALYSIS

(4 Credits) (Semester 2)

Prerequisite

None

Course Description

Multivariate techniques are applied to a wide array of disciplines, such as business, health sciences and economics. In many cases, a multivariate method is used as one component to better understand multi-dimensional data such as data reduction and how variables are correlated.

The aim of the course is to introduce a variety of standard statistical methods used to analyze multivariate data. Emphasis will be placed on developing the theory of these methods as well as the various interpretations of results derived from applying these methods. The (free) R statistical computing package will be used for data analyses.

Learning Outcomes

On completion of this course, the student should be able to:

1. Pose informed and insightful questions concerning multivariate data and its analysis.
2. Evaluate various aspects of a multivariate dataset and choose an appropriate type of analysis.
3. Demonstrate proper data manipulation and exploratory data analysis skills for multivariate data.
4. Perform
5. Multivariate Analysis of Variance (MANOVA)
6. Predictive Discriminant Analysis (PDA)
7. Principal Components Analysis (PCA)
8. Exploratory Factor Analysis (EFA)

9. Cluster Analysis
10. Write a clear report of statistical analysis methods and results.

Course content

- Linear Algebra (Matrix Theory) Review
- Random vectors
- Multivariate distributions–normal, Wishart, Hotelling's-T, Skew-T, Skew-Normal
- Estimation and testing of multivariate distribution parameters
- Multivariate Analysis of Variance (MANOVA)
- Predictive Discriminant Analysis (PDA)
- Principal Components Analysis (PCA)
- Exploratory Factor Analysis (EFA)
- Cluster Analysis

Assessment

- **Coursework:** **50%**
    - Two In-Course test and in-class tests 20%
    - One Laboratory assignment 20%
    - Two graded (at home) assignments 10%
- **Final Exam** **50%**
    - One three-hour theory paper

MASTER OF SCIENCE: ENTERPRISE RISK MANAGEMENT

PROGRAMME OVERVIEW

Offered by the Department of Mathematics, in conjunction with the Mona School of Business, Faculty of Social Sciences (UWI, Mona), the MSc ERM programme is designed to address the demand in the financial services and other industries for modern risk management skills. Risk professionals require a set of integrated skills in risk modelling and management of the risks associated with assets/liabilities of their business operations. The programme is designed to produce graduates with skills in risk techniques and practices who also understand the business contexts and thus are able to address complex risk issues. The programme will attract professionals seeking breadth in risk management. They will typically have backgrounds in a wide cross-section of industries such as the financial services (especially banking, insurance), consultancy, the non-financial sector as well as from the public sector. This is an important added value, which prepares the student for team work with members of diverse backgrounds.

Programme Objectives

The main aims of the MSc-ERM are to:

- Introduce the basic concepts and techniques of quantitative risk management across an enterprise, as well as the business context in which such risk management takes place.
- Provide a good grounding in risk management best practices.
- Identify and measure risks; to take actions to mitigate risks and exploit opportunities.
- Apply quantitative as well as qualitative approaches to risk management.
- Familiarize students with computational techniques and risk management software.

Entry Requirements

- Minimum GPA of 3.0 in a Bachelor's degree (or equivalent from an overseas institution) in a quantitative discipline.
- Preference will be given to those applicants with 3 years relevant work experience.

Programme Duration

- 24 months part-time (evenings)

Target Groups

Risk Officers, Financial Officers, Actuaries, Risk Professionals, Risk Modellers, Asset Liability Management Practitioners, Equity Analysts and other Investment Professionals.

PROGRAMME STRUCTURE

Classes are taught Mondays, Tuesdays and Thursdays from 5:00 to 9:00 p.m.

COURSE CODE	COURSES TITLE	CREDITS
PRELIMINARY COURSES		
MTRM6001	Mathematics for ERM	0
MTRM6002	Statistical Methods	0
	IT Tools	0
CORE COURSES		
MTRM6010	Risk Categorization & Identification	3
MTRM6020	Time Series Analysis	3
MTRM6030	Stochastic Calculus	3
MTRM6040	Quantitative Analysis of Financial Data	3
MTRM6050	Risk Management & Optimization	3
MTRM6060	Credit Risk Management & Modelling	3
MTRM6070	ERM Concept, Framework & Process	3
SBRM6010	Risk Management in the Business Enterprise	3
SBRM6020	Corporate Finance	3
SBRM6030	Financial Markets	3
SBRM6040	Economics of Enterprise Risk Management	3
SBRM6050	Enterprise Risk Management Governance	3
SBRM6060	Legal and Regulatory Framework for Enterprise Risk Management	3
SBRM6070	ERM in the Global Business Environment	3
SBRM6080	Enterprise Risk Management Integrative Module	3
TOTAL CREDITS		45

Figure 1: Proposed Matrix for the MSc-ERM Programme - Core Courses

	FOUNDATION COURSES (0 credits)	Computer Business Applications (MSB)	Statistical Methods (MATH)
		Mathematics for ERM (MATH)	
ERM CONCEPTUAL FRAMEWORK	TOOLS & OVERVIEW (12 credits)	Risk Management in the Business Enterprise (MSB)	Stochastic Calculus (MATH)
		Time Series Analysis (MATH)	Quantitative Analysis of Financial Data (MATH)
	OPERATIONAL RISKS/BUSINESS HAZARD EXPOSURES (9 credits)	Risk Categories & Identification (MATH)	ERM Concept, Framework and Process (MATH)
		The Economics of ERM (MSB)	
	FINANCIAL RISKS (9 credits)	Corporate Finance (MSB)	Financial Markets (MSB)
		Credit Risk Management & Modelling (MATH)	
	STRATEGIC RISKS (6 credits)	ERM Governance (MSB)	Risk Management & Optimization (MATH)
	CARIBBEAN/GLOBAL PERSPECTIVES (6 credits)	Ethical, Legal & Regulatory Framework for ERM (MSB)	ERM in the Global Business Environment (MSB)
	RESEARCH PROJECT (3 credits)	Leading Issues in ERM: A Project-Based Approach (MSB-MATH)	

COURSE DESCRIPTIONS

PRELIMINARY COURSES

MTRM6001 MATHEMATICS FOR ERM

(0 Credits) (Semester 1)

Prerequisite

None

Course Description

The course aims to provide students with a broad knowledge of mathematical techniques that are widely used in the finance arenas. The course is divided into four sections, namely; Sequence & Series, Calculus, Linear Algebra and Numerical Methods. First, we will look at limits and continuity, Taylor series and sequences. Secondly, we introduce functions of one and several variables, differentiation, integration, partial differentiation, Optimisation, and Lagrange multipliers. Thirdly, we solve a system of equations, Eigenspace, and quadratic forms. Finally, we look at methods of solving linear and non-linear equations, Cholesky decomposition, constrained and unconstrained numerical optimisation and finite difference methods.

Learning Outcomes

At the end of the course, the student will be able to:

- Define the meaning of convergence/sum of an infinite series of numbers in terms of its partial sums.
- Determine whether a series converges or diverges by selecting an appropriate convergence test (nth-term, comparison, integral, p-test, alternating, ratio, absolute convergence) and applying it.
- Use partial sums to estimate the sum of a convergent series, and find error bounds where appropriate (e.g., using integrals, the alternating series test and Taylor's remainder).
- Use Maclaurin series and Taylor series to approximate values of transcendental functions and definite integrals.
- Verify the value of the limit of a function at a point using the definition of the limit
- Calculate the limit of a function at a point numerically and algebraically using appropriate techniques including L'Hospital's rule
- Use Bisection method, Newton-Raphson's method to solve the equation $f(x)=0$ within the given tolerance
- Estimate numerical errors using basic calculus concepts

- Compute the expression for the derivative of a function using the rules of differentiation including the power rule, product rule, and quotient rule and chain rule
- Find the anti-derivative of elementary polynomials, exponential, logarithmic and trigonometric functions
- Find general and particular solutions to differential equations using the techniques of separation of variable, integrating factors, techniques of undetermined coefficients, variation of parameters, power series and Laplace transforms
- Perform matrix operations, including matrix inversion
- Translate linear systems into matrix equations, and use matrix inverses to solve, where appropriate
- Use Cholesky decomposition, where appropriate, to solve a system of linear equations.

Course Content

- Sequence and Series: Convergence theorem, Limits and Continuity, Taylor series, Infima and Suprema and Montonicity
- Calculus: Derivatives of functions including logarithmic functions, product, quotient and chain rule, L'Hospital's Rule, first and higher order derivatives, Partial Derivative (single and several variables); Definite integral and methods of integration, Lagrange Multipliers; Ordinary Differential Equations
- Numerical Methods: Finite difference methods, Error Analysis, Bisection and Newton-Raphson, Cholesky decomposition, optimisation
- Linear Algebra: Matrices, determinants, eigenvalues, eigenvectors, quadratic forms

Assessment

- **Coursework** **40%**
  - Group assignment 20%
    (written and oral presentation)
  - Mid-semester exam, two hours 20%
- **Final Exam** **60%**
  - Three-hour duration

MTRM6002 STATISTICAL METHODS
(0 Credits) (Semester 1)

Prerequisite
None

Course Description

This course will introduce and examine ways of presenting statistical information graphically and descriptively. We then proceed to ideas of probability, distribution and density along with expectation and variation. Building on this, we look at special type of probability distribution, such as, normal, lognormal, and others. What makes a good estimator? Confidence intervals, hypothesis testing, and regression. In addition, the statistical package R will be used throughout the course.

Learning Outcomes

At the end of the course, the student will be able to:

1. Identify and apply appropriate statistical techniques to real-world scenario
2. Assess different statistical procedures
3. Calculate probabilities and solve problems relating
4. Interpret statistical output
5. Analyse statistical data
6. Design and evaluate statistical models

Course Content

Probability:

- Introduction: Events, measures of probability, conditional probabilities, independence, Bayes' theorem, total probability rule
- Discrete Random Variables and Probability Distribution
    - Random variable, probability mass function, cumulative distribution function
    - Mean and variance of discrete random variable
    - Uniform, Binomial, Geometric, Poisson, Indicator variables
- Moments of Distribution (Mean, Variance, Skewness, Kurtosis) and central moments
- Continuous Random Variables and Probability Distribution
    - Probability density function and cumulative distribution function
    - Mean and variance of continuous random variable
    - Uniform, Normal, Log-normal, Gamma, Beta, Weibull, Student's t, F, Chi-square
- Multi-Variate Distribution
    - Joint distribution: discrete and continuous random variables
    - Marginal and Conditional distribution; Covariance and conditional expectation
- Asymptotic Theory: Central Limit Theorem, SLLN, Chebyshev's Theorem/Inequality
- Methods of Transformation: Distribution function technique, Probability integral transform

Statistics:

- Data Summary
  - Frequency distributions, measures of central tendency (mean/median/mode), measures of dispersion (quartiles, percentiles, range, variance, standard deviation)
  - Coefficient of variation, Skewness, Kurtosis; Correlations (Pearson's, Spearman's, Kendall's)
- Parameter Estimation
  - Biased and Unbiased estimators; Mean square Error, Consistency, MVUE, Method of moment, Maximum Likelihood Estimator; Likelihood Ratio test
- Hypothesis Testing and Inferences
  - Type I and Type II errors, level of significance, Confidence Intervals, Hypothesis testing (means, variance, ratio), p-values
  - Graphical methods for confidence intervals
- Regression Analysis
  - Simple and Multiple Regression; Model Selection; Collinearity and Variance Inflation
  - Diagnostics: Leverages, Residuals, Cook's D, Model Assumptions
  - Transformation of variables
- Exploratory Data Analysis: Introduction; Histogram and Kernel Density Estimation; Quantile-Quantile plots; Boxplots; Data transformation; Test of normality; LOESS

Assessment

• **Coursework**		**40%**
○ Group assignment (written and oral presentation)	20%	
○ Mid-semester exam, two hours	20%	
• **Final Exam**		**60%**
○ Three hour duration		

IT TOOLS

The aim of this course is to enhance and improve the basic knowledge and use of personal productivity software, generally available in software office suites, which include spreadsheet, word processing, and presentation software.

CORE COURSES

MTRM6010 RISK CATEGORIZATION & IDENTIFICATION

(3 Credits) (Semester 1)

Prerequisite

None

Course Description

Traditional risk management approaches are typically done on a silo basis. What has generally been lacking is the ability for companies to assess their key risks on an integrated basis and in a quantitative manner. Enterprise risk management is a significant advancement in the field of risk management and provides a process for companies to identify, measure, manage and disclose all key risks. In this course the student will learn keys to successful risk identification and develop risk categorization and definition tools. The student will understand the types of risks faced by an entity and be able to identify and analyze those risks in an integrated manner as a portfolio.

The course seeks to provide a thorough grounding in the identification and assessment of a wide range of risks that an entity might be exposed to in order to facilitate accurate and timely decision making in terms of the actions necessary to counter (or exploit) the risks.

Learning Outcomes

Upon completion of this course, the candidate should be able to

1. Explain what is meant by risk and uncertainty;
2. Explore different definitions and concepts of risk;
3. Discuss risk taxonomy;
4. Explain the concept of ERM and the drivers behind it;
5. Discuss the value of ERM to organizations;
6. Demonstrate an understanding of the various approaches to risk identification including the risk self-assessment process;
7. Investigate and interpret financial and non-financial risks faced by an entity;
8. Properly identify, define, analyze and categorise the risks faced by an entity;
9. Demonstrate an understanding of the various approaches to emerging risk identification including the role of stress-testing and scenario analysis;
10. Conduct effective qualitative risk assessments.

Course Content

1. Concept of Risk: Nature and definition of risk, risk versus uncertainty

2. Risk identification (categorization): Components of risk identification; Keys to successful risk identification. Risk Categorization and definition
3. Risk identification (qualitative risk assessment): Purpose and Process
4. Emerging risk identification: Monitoring known risks; Environmental scanning: stress-testing, scenario analysis

Assessment

- **Coursework** **40%**
    - Mid-semester evaluation 20%
    - Group assignment 20%
- **Final Exam** **60%**
    - One three-hour theory paper

MTRM6020 TIME SERIES ANALYSIS
(3 Credits) (Semester 2)

Prerequisite:
None

Course Description
Time series data, for example records of stock market indices, in general are not susceptible to classical statistical analysis, since observations tend to be correlated in time. Time series analysis is a specialised branch of statistical science which deals with such data sets, providing an essential toolset for finance and business analysis, economic forecasting, and decision-making.

The course covers the fundamental concepts required for the description, modeling and forecasting of time series data. A particular emphasis is placed on the analysis of real-world data sets from finance and economics, and a practical laboratory component introduces students to the software package R (or other software).

Learning Outcomes
On completion of this course, the student should be able to:
1. Classify time series and identify forms of variation present in data;
2. Generate time plots and correlograms of time series data using software;
3. Prove the main properties of random walk, MA, EWMA, AR, ARMA, (S)ARIMA, ARCH and GARCH models (multivariate and orthogonal);
4. Fit time series models to real-world data sets, including financial and economic time series;

5. Interpret and evaluate time series models fitted by computer packages;
6. Produce forecasts (with associated error bounds) from a real-world data set using a Holt-Winters or Box-Jenkins approach.

Course Content

- Introduction: Definition and classification of time series data; objectives of time series analysis; the time plot; types of variation; stationary processes; transformations; filters; autocorrelation and the correlogram.
- Stochastic models for time series: white noise; the random walk with and without drift; definition and properties of MA, EWMA, AR, ARMA and ARIMA processes in the time domain.
- Estimation in the time domain: sample autocovariance and auto-correlation functions; fitting ARMA models to stationary data; fitting (seasonal) ARIMA models to non-stationary data; volatility – ARCH and GARCH models (multivariate and orthogonal); model evaluation - residual analysis and the Akaike Information Criterion.
- Forecasting: Automatic and non-automatic forecasting; Exponential smoothing; the Holt-Winters method; Box-Jenkins forecasting.
- Laboratory work: R basics – variables, importing data, scripting; Time series basics – time plots, decomposing data, multiple time series, differencing; Autocorrelation and the correlogram; Holt-Winters forecasting; Fitting models to data and model-based forecasting.

Assessment

- **Coursework** **40%**
    - In-Course test 20%
    - Laboratory assignment 20%
- **Final Exam** **60%**
    - One three-hour theory paper

MTRM6030 STOCHASTIC CALCULUS
(3 Credits) (Semester 3)

Prerequisite
None

Course Description
The course aims at providing students with the tools required for a rigorous understanding of financial modelling and pricing techniques and therefore provides the mathematical grounding for financial derivatives.

Learning Outcomes

On completion of this course, the student should be able to:

1. Explain what a stochastic process is
2. Apply stochastic models to different financial situations
3. Formulate, analyse and apply Black-Scholes methodology
4. Apply Ito's formula and recognize its use in application

Course Content

- Introduction: Revision of main notions of probability, Binomial, normal, generalized hyperbolic and lognormal probability distributions. The central Limit Theorem, variance, standard deviation and volatility
- Basic concepts and object of a financial market: basic securities, (OTC, Exchange Traded, Premium due), derivative instruments of a financial market (futures, options, swaps), interest rates, liquidity, currency, commodity arbitrage and completeness, type of options (Δ, Γ, Θ, ρ of options), hedging.
- Stochastic Processes: Main definitions and properties; Poisson Process, Markov Chains, Martingales, Random Walk, Binomial Trees.
- Brownian Motion Process: Main definitions and modifications, properties of Brownian motion; Idea of the Ito integral, Geometric Brownian motion asset model and linear stochastic Ito equation, Ornshtein-Uhlenbeck process. Ito lemma.
- Stochastic Models: discrete stochastic models for financial markets, Cox-Ross-Rubenstein formula, Black-Scholes model, the Risk-neutral processes, and Girsanov's theorem, interest rate models, Vasichek model, measurement and behaviour of volatility. Strike adjusted spread. Dynamic asset price; Merton model; Madan, Carr and Chang model; Longstaff and Schwartz model. Hazard rate models.

Assessment

- **Coursework** **40%**
  - In-Course test 20%
  - Assignment 20%
- **Final Exam** **60%**
  - One three-hour theory paper

MTRM6040 QUANTITATIVE ANALYSIS OF FINANCIAL DATA

(3 Credits) (Semester 1)

Prerequisites

MTRM6020, MTRM6030

Course Description

This is a course in quantitative risk management and financial econometrics. In this course focus will be on the statistical modelling of financial time series (asset prices and returns) with an emphasis on modelling volatility and correlation for quantitative risk management. This course discusses the various approaches to analyze and model financial data with real and simulated data via the computer package R (or other programming language).

The aims of the course are to introduce state-of-the-art techniques for modelling financial time series and managing financial risk and to use the open source R statistical software (or other software) to provide hands-on experience with real world data.

Learning Outcomes

On completion of this course, the student should be able to:

1. State the main characteristics of a univariate financial time series;
2. Apply appropriate statistical and computational methods to evaluate the fatness of the tails of returns data;
3. Analyze strengths and weaknesses of existing approaches to measuring risk;
4. Apply the fundamental concepts and theorems in Extreme Value Theory (EVT);
5. Demonstrate how analysis of financial data using EVT differs from traditional statistical methods;
6. Design statistical models using EVT to financial data;
7. Explain and apply the main copulas;
8. Evaluate how different copulas affect the return distribution of a two asset portfolio;
9. Propose empirical techniques that can be applied to financial time series data to establish the presence of stochastic volatility;
10. Evaluate simple time series models for stochastic volatility and demonstrate how these affect the distribution of returns over time;
11. Analyse high frequency data.

Course Content

1. Financial Time Series and their Characteristics:
    a. Assets Returns: Net, Gross, Log Returns; Adjustment for Dividends
    b. Distributional Properties
    c. Processes to Consider
    d. Random Walk Model: Random walk, Geometric random walks, Lognormal Geometric random walk (are log prices a LNGRW?)
    e. Volatility Models
2. CoIntegration and Unit Root Tests

   a. Unit Root Tests
   b. Cointegration
3. Copulas and Dependence
   a. Introduction
   b. Gaussian and t-Copulas; Archimedean Copulas
   c. Tail dependence, Rank correlation;
   d. Fitting Copulas to Returns data
4. Aggregate Risk
   a. Risk Measurement (risk capital, capital adequacy, VaR, variance, expected shortfall)
   b. Coherent Measures of Risk
5. Extreme Value Theory
   a. Value at Risk (VaR), RiskMetrics
   b. Fisher-Tippet Theorem and generalised Extreme Value Distribution
   c. EV approach to VaR
6. High frequency Data Analysis and Market Microstructure
   a. Introduction: Nonsynchronous trading and terminologies
   b. Bid-ask spread and other factors
   c. Realised Volatility and Estimators
   d. Modelling High Frequency Data

Assessment

- **Coursework** **40%**
  - In-Course test 20%
  - Laboratory Assignment 20%
- **Final Exam** **60%**
  - One three-hour theory paper

MTRM6050 RISK MANAGEMENT & OPTIMIZATION
(3 Credits) (Semester 1)

Prerequisite
None

Course Description
The student will understand the means available for managing various risks and how an entity decides on which technique is appropriate. This is a follow-up course to Risk Categories and Identification. After identification the risks, the student will understand how risks are measured and the strategic decision process for taking action (mitigate risks or exploit risky opportunities).

Learning Outcomes

Upon completion of this course, the candidate should be able to:

1. Explain the rationale for managing risk
2. Demonstrate the selection of the appropriate risk retention level.
3. Demonstrate an understanding of risk transference (including transferring risk to a third party; costs and benefits of transferring risk).
4. Evaluate the performance of risk transference activities.
5. Recommend risk mitigation strategies by transfer of risk.
6. Demonstrate means for reducing risk without transferring it (internal hedges).
7. Describe and evaluate risk management techniques (consider both financial and non-financial risks).
8. Demonstrate an understanding of the pros and cons of different approaches to risk mitigation.
9. Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting) balancing benefits with inherent costs.
10. Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting) including exposure to credit risk, basis risk, moral hazard, and other risks.
11. Analyze the application of Asset Liability Management principles to Investment Policy and Asset Allocation.
12. Analyze funding and portfolio management strategies to control equity and interest rate risk, including key rate risks.
13. Contrast modified duration and effective duration measures.
14. Calculate effective duration and effective key-rate durations of a portfolio.
15. Explain the concepts of immunization including modern refinements and practical limitations.
16. Demonstrate how derivatives, synthetic securities, and financial contracting may be used (to manage interest rate risk, including key rate risks; to manage equity risk (eg equity market guarantees found in variable annuities)).
17. Analyze the practicalities of market risk hedging, including dynamic hedging.
18. Define liquidity risk, strategic risk, operational risk
19. Explain methods for managing each risk, both pre-event and post-event.
20. Evaluate case studies of company disasters that resulted from these types of risks.

Course Content

- Module 1. General Risk Management
    - Rationale, risk retention, risk transfer, risk reduction;
    - Internal hedge, risk management techniques, hedging strategy (reinsurance, derivatives, financial contracting).

- Module 2. Asset Liability Management
    - ALM principles, investment policy, asset allocation, funding and portfolio management strategy;
    - Modified and effective duration, key rate duration;
    - Interest rate risk & Equity risk: Immunize interest rate risk (include key rate risks), equity risk (incl. equity market guarantees in variable annuities);
    - Manage interest rate risk and equity risk (using derivatives, reinsurance and financial contracting);
    - Market risk hedging, dynamic hedging.
- Module 3. Risk Management
    - Techniques for managing liquidity risk, strategic risk, operational risk, (briefly overview credit risk)
- Module 4. Case Studies
    - Analysis of Company disasters: the exposure, what occurred, the sequence of events; analyze management actions and their impacts (what actions management took/didn't take/ could have/should have taken); Financial impacts and general consequences.

Assessment

• **Coursework**		**40%**
○ Mid-semester evaluation	20%	
○ Group assignment	10%	
○ Oral presentation	10%	
• **Final Exam**		**60%**
○ One three-hour theory paper		

MTRM6060 CREDIT RISK MANAGEMENT & MODELLING
(3 Credits) (Semester 2)

Prerequisite
MTRM6030

Course Description
This course is an introduction to credit risk management and to the models for analyzing, predicting and mitigating credit risks. Students will learn the basis for widely used modelling methods for credit risk assessment and implement those methods through programming assignments using R (or other software).

The aims of the course are:

1. To introduce students to quantitative models for measuring and managing credit risks
2. To provide students with a critical understanding of the credit risk methodology used in the financial industry
3. To give students an appreciation of the regulatory framework in which the models operate

Learning Outcomes

On completion of this course, the student should be able to:

- Demonstrate an understanding of the nature of credit risk
- Define and evaluate credit risk as related to fixed income securities
- Define and evaluate spread risk as related to fixed income securities
- Explain how to incorporate best practices in credit risk measurement, modelling and management
- Explain credit risk as related to derivatives
- Explain credit risk as related to reinsurance ceded
- Define counter-party risk and demonstrate the use of comprehensive due diligence and aggregate counter-party exposure limits
- Evaluate risk mitigation techniques and practices: credit derivatives, diversifications, concentration limits, and credit support agreements
- Explain and/or Apply the theoretical underpinnings of models used in the financial industry
- Construct statistical approaches to calibrate credit risk models
- Interpret computer output from credit risk models
- Analyze mixture models of default and derive their mathematical properties
- Demonstrate a knowledge of the regulatory framework and, in particular, the Basel II regulatory capital formula
- Demonstrate understanding of the methods used for calculating portfolio loss distribution
- Modify and validate credit risk models

Course Content

- Module 1. Introduction to Credit Risk Management
  - The Global Crisis of 2007-2009; The Changing Nature of Banking; Financial Institutions and Markets; Regulatory failure. Sources of credit risk. Credit bubbles.
- Module 2. Implications of new regulations:
  - New regulations impact on every day activity in the financial industry.
- Module 3. Loans as options
  - The Link between Loans and Options; Moody's KMV Model; Credit Scores.
- Module 4. Reduced Form Models

- Risk-Neutral Probabilities of Default; Risky Debt Pricing; Loss Intensity; Risk Information Services; Bond Spreads.
- Module 5. Other Credit Risk
  - Credit Scoring Systems; Mortality Rate Systems; Artificial Neural Networks;

Assessment

- **Coursework** **40%**
  - Mid-semester evaluation 20%
  - Group assignment 10%
  - Oral presentation 10%
- **Final Exam** **60%**
  - One three-hour theory paper

MTRM6070 ERM CONCEPT, FRAMEWORK & PROCESS
(3 Credits) (Semester 3)

Prerequisites
None

Course Description
The candidate will demonstrate an understanding of the ERM concept, understand the components of an ERM framework, be able to evaluate the appropriateness of a framework in a given situation and understand each step of the ERM process.

The course aim is to provide students with a good understanding of ERM and the regulatory frameworks who can execute ERM at the strategic level to drive decision making.

Learning Outcomes
Upon completion of this course, the candidate should be able to:

1. Demonstrate an understanding of the concept of ERM , the drivers behind it and the resulting value to an organization; Demonstrate an understanding of the evolution of ERM and the various events which have driven its development
2. Evaluate a risk-management framework.
3. Design an appropriate framework for an organization’s ERM including governance, committee structure, policy development, roles and responsibilities.
4. Evaluate an organization’s risk management culture; Demonstrate how an organization can create a risk management culture.

5. Demonstrate an understanding of governance issues; Explain the elements of risk governance; Demonstrate how governance issues are resolved through organizational structure.
6. Compare and contrast various regulatory risk frameworks in industry: Basel II, Sarbanes-Oxley Act, Dodd/Frank, Solvency II, UK FSA guidelines, Aus/NZ, ISO 31000, and COSO and implement their main requirements.
7. Explain the perspectives of regulators, rating agencies, stock analysts, and company stakeholders and how they evaluate the risks and the risk management of an organization.
8. Identify regulatory capital requirements and describe how they affect decisions.
9. Demonstrate an understanding of the elements of an organization's risk policy.
10. Demonstrate an understanding of the elements of the ERM process: identification, measurement, monitoring and management.
11. Articulate, define and measure an organization's risk appetite; Demonstrate how an organization uses its risk appetite to develop business strategy and to make decision.
12. Propose how an ERM process can create value for an organization through better assessment of the organization's risk profile, possible reduction in economic capital, improvement in ratings etc.
13. Assess the overall corporate risk exposure.
14. Propose a structure for an organization's risk management function
15. Analyze the risk and return trade-offs that result from changes in the organization's risk profile
16. Discuss the importance of communication across the organization to ERM success.
17. Analyze the application of ERM to real (case studies) and hypothetical contexts.

Course Content

- Module 1. ERM Concept
    - Definition of Enterprise Risk Management; principal terms used in ERM; fundamental concepts of risk management
- Module 2. ERM Framework
    - Value-based ERM framework; Challenges;
- Module 3. ERM process cycle
    - Risk Decision-Making (risk appetite, risk limits); Risk Messaging; Risk governance (components, roles, responsibilities, organization structure, policies, procedures); regulatory frameworks,

stakeholder perspectives; governance issues (market conduct, audit and legal risk); Risk management culture

Assessment

- **Coursework:** **40%**
  - Mid-semester evaluation 20%
  - Group assignment 10%
  - Oral presentation 10%
- **Final Exam** **60%**
  - One three-hour theory paper

SBRM6010 RISK MANAGEMENT IN THE BUSINESS ENTERPRISE

(3 Credits) (Semester 1)

Prerequisite

None

Course Description

The management of risks in business enterprises represents one of the greatest challenges facing business leaders in the world. The awareness of risks, identification of risks and the tools and methodologies of measurement and management of risks facing the enterprise are either non-existent or inconsistently applied in individual enterprises and across business sectors. Each risk type is usually handled in isolation: only the financial risks have commonly received robust quantification.

Operational risk has received attention primarily by companies in particular industries where operational failures are a common hazard. The specialized knowledge and techniques developed for these sectors are incorporated into ERM and can be critically applied across a broader spectrum of industries to mitigate operational risks that are critical impediments to business performance and creation of shareholder value.

ERM also enables enterprises to determine the overall risk appetite of the firm and incorporate this in the enterprises' policies and procedures, and manage risk exposures within the risk appetite. By providing a superior framework for fundamental risk-return decision-making at the highest levels, ERM represents a seminal advancement in business management.

Learning Outcomes

On completing this course, students should be able to:

1. Define ERM and describe the ERM process, the fundamental benefits of ERM, the value-based ERM framework and how it addresses shortcomings of traditional ERM frameworks
2. Identify and measure the key risks facing an enterprise by analyzing cases.
3. Describe the regulatory framework governing the conduct of business that impacts ERM across a variety of industries.
4. Explain the qualitative and quantitative issues underlying the study of risk management.
5. Create key dashboard of risk indicators and reporting structures for enterprise risk management.
6. Apply ERM strategies that will increase the velocity with which enterprise risks are recognized, reported and addressed and integrated with policy formulation.
7. Define and categorize risks and conduct effective qualitative risk assessments and quantify various types of risk (e.g. financial, market, credit, operational and strategic risks). Describe the quantification of individual risk scenarios and aggregate enterprise risk exposure.
8. Integrate the ERM framework with the Strategic Planning and Strategic Management frameworks of the enterprise in a variety of industries
9. Analyze a firm's risk appetite and identify key measures to manage risk exposures within risk appetite
10. Implement proper risk messaging, including integration of ERM into incentive compensation and risk disclosures.

Course Content

1. ERM: Introduction, Evolution and Challenges
2. Defining ERM: Risks, process cycle and benefits to key stakeholders
3. ERM framework: functional organization
4. ERM and Risks: Risk governance, roles, Organizational structure, Policies and procedures
5. Challenges of Integrating Strategic Planning and Strategic management frameworks with Enterprise Risk management
6. Risk quantification and aggregation
7. Developing a baseline valuation
8. Challenges of developing a risk model
9. Regulatory framework for risk management: Ethical challenges; Caribbean perspectives on risk management

Assessment

- **Coursework:** **40%**
  - Group assignment 20%
  - Mid-semester examination 20%
- **Final Exam** **60%**

SBRM6020 CORPORATE FINANCE
(3 Credits) (Semester 1)

Prerequisite
None

Course Description
The main objective is to provide an understanding of corporate finance concepts and decision making in competitive financial markets from the point of view of risk managers. This course serves as an introduction to corporate finance and financial management for students pursuing the Master's in Enterprise Risk Management.

The course seeks to provide a framework, concepts, and tools for analyzing corporate finance problems and issues, based on the fundamental principles of modern financial theory, with an understanding of application to "real-world" situations. In all cases an underlying focus will be on the analysis of risk and the tools of risk mitigation from a corporate finance perspective.

How does this course dovetail with the course on Financial Markets?

- This course focuses on non-financial companies while Financial Markets focuses on the financial services sector and financial markets.
- This course focuses on the analysis and management of company specific risk while Financial Markets focuses on risk analysis and management in and by the financial sector, as well as systemic risk.

Learning Outcomes
At the conclusion of this course students will be able to:

1. Interpret and apply the fundamental principles of corporate finance, namely: time value of money, capital budgeting and company and security valuation, the cost of capital, working capital management, capital structure and company restructuring issues
2. Configure cash flows for valuation and forecasting purposes.
3. Compare and contrast the strengths and weaknesses of financial models and understand the context in which they can be utilized in financial analyses.
4. Create financial models using Excel spreadsheets
5. Demonstrate an understanding of key financial, economic, psychological and business concepts that are essential inputs into corporate financial decision making by tests & examinations, case write-ups and discussions, participation in class discussion and on line forums.
6. Demonstrate an understanding of the strengths and weaknesses of corporate financial concepts to 'real-world' risk analysis and

management issues by tests & examinations, case write-ups and discussions, participation in class discussion and on line forums.

Course Content

- Introduction to the Course
- Time Value of Money & Valuation
    - FV (Compounding) & PV (Discounting)
    - Single Payments & Annuities
    - Applications of Present and Future Value
    - Nominal & Real Rates of Interest
- Financial Statement & Cash Flow Analysis
- Required Returns: The Cost of Debt, Equity & Capital and Risk Adjusted Required Returns
- Capital Budgeting
    - NPV, Payback, ARR, IRR, MIRR, and PI
    - Complications in Capital Budgeting
- Company Financing & Valuation
    - Valuation of Bonds
    - Valuation of Stocks
    - Valuation of a Company
- Working Capital Management
- Capital Structure, Company Financing and Financial / Business Risk
- Financial Distress & Company Restructuring

Assessment

• **Coursework**		**40%**
o Case write-ups (Group)	10%	
o Take home Mid-term test	10%	
o Excel model preparation	15%	
o In Class & Online participation	5%	
• **Final Exam**		**60%**

SBRM6030 FINANCIAL MARKETS

(3 Credits) (Semester 1)

Prerequisite

None

Course Description

Well-functioning markets are constantly changing, so too with financial markets. It was not long ago that most financial markets were domestic in scope and limited in institutional variety. Today financial markets are global in nature, with open foreign exchange markets and a growing variety of financial institutions and instruments. These changes have increased the importance of readily available and accurate information and of a well-designed regulatory framework. Moreover, with global financial markets being harsh in response to poorly managed economies, national, regional and international economic management has taken on increased importance.

This course will examine financial markets in terms of the tools it provides to the risk manager as well as looking at the risks, especially those of a systemic nature that are often created and propagated by financial markets.

How does this course dovetail with the course on Corporate Finance?

- This course focuses on the financial markets and institutions while Corporate Finance focuses on the financial operations of non-financial companies.
- This course focuses on risk analysis and management in and by financial institutions and markets while Corporate Finance focuses on the analysis and management of company specific risk

Learning Outcomes

At the conclusion of this course students will be able to:

1. Demonstrate an understanding of the functions of capital and money markets and the economic and social benefits they are expected to generate.
2. Demonstrate an understanding of the functions and risks of various financial institutions.
3. Evaluate the risk adjusted performance of different financial institutions
4. Identify the main risks facing financial markets and institutions – interest rate, liquidity, credit, solvency, foreign exchange and systemic.
5. Explain and apply the various tools to mitigate the risks listed above.
6. Assess the various risk mitigating tools generated by the financial sector that can benefit the operations of the non-financial sectors.
7. Demonstrate an understanding and usefulness as well as the appropriate risk return trade-offs of various financial instruments generated by the financial sector.
8. Explain the key financial, economic, psychological, and business concepts that are essential inputs into corporate financial decision making by tests and examinations, case write-ups and discussions, participation in class discussion and on line forums.
9. Analyse the strengths and weaknesses of financial concepts to 'real-world' risk analysis and management issues by tests & examinations, case write-ups and discussions, participation in class discussion and on line forums.

Course Content

- Introduction to Financial Markets
- Introduction to Depositary Institutions
- Securities Firms and Investment/Merchant Banks
- Mutual and Pension Funds
- Insurance Markets & Companies
- Derivative Markets
- An overview of Risks
- Risk Mitigation Strategies

Assessment

- **Coursework:** **40%**
    - Mid-semester exam 20%
    - Group assignment 20%
      (written and oral presentation)
- **Final Exam** **60%**
    - One three-hour theory paper

SBRM6040 ECONOMICS OF ENTERPRISE RISK MANAGEMENT
(3 Credits) (Semester 1)

Prerequisite
None

Course Description
The Economics of Enterprise Risk Management course provides a broader economic framework and context, whereby risks can be identified and interpreted using economic theory and thought applicable to its interpretation. For example, in a global marketplace, the enterprise must be increasingly conscious about how and when changes in demand and supply of commodities and financial flows in world markets will transmit to their own arena and trigger off a cascade of events that puts the enterprise in jeopardy, if no risk mitigation action is taken. Conversely, opportunities emerging in local and foreign markets may be missed and not included in the enterprise's risk management and strategic plans.

This course equips the student with the requisite tools of economic analysis to effectively recognize, evaluate, measure and manage an array of risks within a comprehensive economic and risk management framework. The Economics of Enterprise Risk management course will be pivotal in informing other coursework relative to fundamental analysis of economic activity affecting the business of the enterprise globally.

Learning Outcomes

On completing this course, students should be able to:

1. Evaluate key risks facing an enterprise and view these risks within a comprehensive economic framework.
2. Critique the international regulatory framework governing the conduct of business that impacts on ERM across a variety of industries.
3. Demonstrate an understanding of the qualitative and quantitative aspects of economic forces and events relative to the world economy and the region by integrating this knowledge within the framework of enterprise risk management.
4. Explain the threats to enterprises arising from global and local events and from natural catastrophes through application of fundamental economic analysis.
5. Demonstrate an understanding of the relevance of risk models within the global economic context and their advantages and limitations by applying them to the meltdown of the U.S. financial markets in 2008 and the contagion to global financial markets.
6. Demonstrate awareness of contagion of risks across global financial and payment systems and markets and interfaces and local and regional networks.
7. Explain in economic terms the mechanisms of transmission of contagion and applicability of countervailing monetary and other economic policy across a spectrum of markets and industries.
8. Explain and integrate key endogenous variables like market price and quantity demanded of goods or financial assets.
9. Understand and integrate into the enterprise risk management considerations, the notion of elasticity and recognize its importance in enterprise risk management.
10. Integrate the ERM framework with the Economics of ERM, Strategic Planning and Strategic Management frameworks of the enterprise and extend to other areas of decision-making not traditionally covered by the study of risk management.
11. Demonstrate the capability (both orally and written) to interface with specialists in economic analysis to further the goals of enterprise risk management

Course Content

1. Economics of ERM: Overview and context
2. Monetary and Fiscal Policy and ERM
3. Global Coordination of Economic Policy and Institutions
4. ERM Framework and Economics
5. Macro-economic policy and ERM

6. Measurement of economic activity – Use of economic data
7. Modelling ERM and econometric modelling
8. Developing world and Caribbean Economic Perspectives on ERM

Assessment

- **Coursework** **40%**
    - Class participation & Group assignment 20%
    - Mid-semester examination 20%
- **Final Project** **60%**
    - One group project

SBRM6050 ENTERPRISE RISK MANAGEMENT GOVERNANCE
(3 Credits) (Semester 1)

Prerequisite
None

Course Description
This course reinforces the role of corporate governance in changing the paradigm of uncontrolled risk exposures and inadequate risk management and develops a broader thematic approach to the establishment of enterprise risk management structures in enterprises, with some attention being paid to current issues of corporate governance and risk in Caribbean enterprises.

To equip the student Enterprise Risk Manager with the requisite knowledge of corporate governance and its inter-relationship with Enterprise Risk Management, as an essential component of a comprehensive and multi-faceted view. The student is expected to better understand the organizational roles and relationships and be able to take a more vigilant stance on risk identification, policies and procedures.

Learning Outcomes
On completing this course, students should be able to:

1. Identify the top challenges facing corporate executives arising from the need to recover and adapt and advance in a changing business environment and propose strategies describe the key responses that strengthen the institutional framework of risk governance.
2. Identify and examine corporate governance issues and structures in ERM scenarios.
3. Define the ERM dimensions of corporate governance and describe the

organizational structures that facilitate the iterative development of risk parameters for individual business units and create policy and mechanisms for cascading the risk appetite down to lower levels of the organization.

4. Develop a process of identifying the level of acceptable risk appetite for each risk across multiple lines of business
5. Evaluate effectiveness of portfolio risk grading systems for monitoring of various risk types
6. Develop an understanding of the use of cross-functional risk identification teams and committees drawn from finance, risk management, technology, compliance, treasury, accounting, and business units and their effectiveness in developing a comprehensive view of enterprise risk
7. Analyze the key Enterprise Risk Management roles and governance responsibilities of the Board of Directors, risk committees of the Board, executive and senior management.
8. Develop an understanding of control limits on risk, escalation triggers, and other provisions and how they are aligned with the enterprise's risk appetite and the necessity for meticulous observation in the execution of strategy.
9. Explain the elevated responsibility of the CRO in developing the risk appetite and driving the discussions between the Board, Business management and Independent Control Groups, and implementation plan development, execution and management
10. Create risk management governance frameworks and business policy frameworks to govern enterprise risks

Course Content

- Enterprise Risk Management roles and governance responsibilities; ERM and Business Strategy; Aligning the risk management framework to Corporate Strategy
- The Risk policy Framework; Establishing the role of the CRO; Outsourcing of risk management functions and implications for risk management governance
- Risk governance and Corporate Treasury oversight; Mechanisms of Risk Management; Governance of use of derivatives instruments and evaluation of systemic risks arising and its implications for risk governance
- Contingency planning: Development of risk management scenarios and firm response mechanisms. Utilizing the output of scenario planning into actionable mechanisms for protecting firm resources under stress. Crisis Governance mechanisms and modalities
- Sources of Enterprise Risk and implications for risk Governance: Developing and incorporating quantitative and qualitative measures of these risks into an integrated framework of risk management. Identifying sources of diagnostic information and early warning signs

- Governance of enterprise exposure management: Role of Asset Liability Management Committee (ALCO); Differentiating the role of the Corporate treasurer in modern Treasury Management
- International Governance and international exposure management: Identifying and managing risks arising from International Business and integration into the ERM framework; Incorporating corporate tax exposures in foreign jurisdictions into risk governance
- Ethics in Risk Governance and Management; Conflict of interest between performance incentives for Executives; Enron Case and its implications for ERM governance
- Risk management governance case review
- Regulatory perspectives on ERM governance
- Institutional perspectives on risk governance

Assessment

- **Coursework** **40%**
    - Group assignment (written and oral presentation) 20%
    - Mid-semester exam, two hours 20%
- **Final Exam** **60%**
    - One three hour exam

SBRM6060 LEGAL AND REGULATORY FRAMEWORK FOR ENTERPRISE RISK MANAGEMENT

(3 Credits) (Semester 1)

Prerequisite

None

Course Description

The course will look at the legal relationships between firms, the state and the wider society and will examine the legal and regulatory environment that business organizations face in Caribbean societies and globally; and the implications for identification, management and mitigation of legal and regulatory risk.

The course explores the legal and regulatory responsibilities of business along with the norms and values developed by firms to meet the challenges of government regulations, community pressures and public demand for accountability.

Learning Outcomes

On completion of this course, students should be able to:

1. Examine the impact of law and the regulatory environment on business.
2. Explain key aspects of the Caribbean legal and regulatory environment and legal issues and heightened awareness of developing country legal perspectives.
3. Apply knowledge of the legal and regulatory framework to the solution of business problems arising in a business context.
2. Analyze the role of law in the promotion and enforcement of business ethics and recognize ethical challenges and conflicts of interests and the linkage to enterprise exposure and risk management
3. Evaluate and apply domestic and foreign laws in light of global trends.
4. Identify and explain potential risk exposures arising from potential or actual legal or regulatory breaches and identify measures to mitigate and manage such legal risk exposures prudently.
5. Analyze and evaluate legal exposures in common transactions and risks arising from deficiencies in legal documentation or due-diligence. These considerations are critical in financial transactions, mergers and acquisitions.
6. Utilize legal concepts in the synthesis of risk management factors and develop new methodologies to avoid or manage the extent of legal exposure. Apply knowledge to the creation of risk management frameworks and processes of corporate governance.

Course Content

1. Introduction to Law, Legal Systems, and the Court System
2. Principles of Contract Law and Principles of Tort Law.
3. Criminal Law and Business
4. Business Regulation
5. Company Law
6. Intellectual Property Law
7. E-Commerce
8. Ethical Issues, Corporate Social Responsibility and Corporate Governance
9. Foreign laws and Regulations and Legal Systems
10. Corporate Structures and tax Avoidance, Asset Protection Mechanisms utilized to shelter assets from expropriation or litigation; by incorporating in off-shore financial centers.
11. Anti-Money Laundering regulations and the legal implications for business in a global environment. Identifying and Managing ethical /legal challenges in an ERM framework

Assessment

- **Coursework:** **40%**
    - Term assignment 20%
    - In class presentation 20%
- **Final Exam** **60%**

SBRM6070 ERM IN THE GLOBAL BUSINESS ENVIRONMENT
(3 Credits) (Semester 1)

Prerequisite
None

Course Description
This course integrates a deeper understanding of the strategies practiced by firms as they enter foreign markets or their business expands over an extended geographical space; with the related challenges of managing the underlying measurable and quantifiable risks. Such risks relate to Credit extension, Foreign exchange trading, off-balance-sheet transactions, Country or Sovereign Risks, Liquidity, Insolvency, Market, Reputational, Operational and other risks. The course also seeks to address the inter-play of these risks across global horizons.

The ERM in the Global Business Environment course also draws upon some of the concepts developed in the Economics of Enterprise Risk Management course that provides a broad economic framework and context, whereby risks can be identified and interpreted using economic theory and thought applicable to its interpretation. As further development and integration of this framework, five key elements of global strategy practiced by enterprises are discussed.

Learning Outcomes
On completing this course, students should be able to:

1. Describe how business strategy integrates with ERM and view the underlying risks identified within a global perspective and global framework.
2. Demonstrate an understanding of the strategic implications of business decisions relative to global markets and integrate this knowledge within the framework of enterprise risk management.
3. Describe the threats to enterprises arising from global and local events and from natural catastrophes through application of fundamental economic analysis.
4. Demonstrate an understanding of the relevance of risk models within the global economic context and their advantages and limitations.

Recognize the risks of contagion caused by events in one market and its translation to other global markets in which the enterprise operates and potential impact on the enterprises business and performance.

5. Develop a heightened awareness of contagion of risks across global financial and payment systems and markets and interfaces and local and regional networks.
6. Explain and integrate 4 key strategies practiced by the entrepreneurial firm in relation to foreign market entry and expansion and correlate and match this with the 4 appropriate Organization structures; in relation to the management of enterprise risks.
7. Conceptualize and develop tools for managing enterprise risks across the globe and relate this to evaluation and measurement of global credit risk profile, foreign exchange profile, global market position management, and related concepts
8. Integrate the ERM framework with the Economics of ERM, Strategic Planning and Strategic Management frameworks of the enterprise and extend to other areas of decision-making not traditionally covered by the study of risk management.
9. Demonstrate the capability (both orally and written) to interface with specialists in global economic and country analysis to further the goals of enterprise risk management

Course Content

- Introduction and Overview
- Foreign Market Entry and ERM
- Multinational Strategizing, Structuring and Learning and ERM
- Managing Global competitive Dynamics and ERM
- Diversification Strategy - ERM Framework
- Strategic alliance and network strategies and ERM
- Economic and Industry data use
- Global supply Chain management and ERM
- Managing Off-balance Sheet risks and risks of foreign operations

Assessment

- **Coursework:** **40%**
  - Group assignment (written and oral presentation) 20%
  - Mid-semester exam, two hours 20%
- **Final Exam** **60%**
  - One three hour exam

SBRM6080 ENTERPRISE RISK MANAGEMENT INTEGRATIVE MODULE
(Leading Issues in ERM: A Project-Based Approach)

(3 Credits) (Semester 1)

Prerequisites
None

Course Description
This primary aim of this course is to help students develop the capability to use the concepts, frameworks and techniques presented in the ERM courses to analyze and integrate the skills and concepts into a practical risk management framework to address enterprise risks confronting a business enterprise and its related Industry. It is also aimed at developing the capability to synthesize technical analyses and risk modeling and present information in a readily understandable form for utilization by senior management engaged in strategy and policy formulation and managerial decision-making as well as the measurement and management of the full spectrum of enterprise risks.

The module project draws on the mathematical and quantitative underpinnings of the ERM courses coupled with the Business Management discipline and is intended to create a functional skill base pivoting on the following basic objectives. These are to: 1) stimulate cross-functional skill integration; 2) foster an awareness of the kinds of adjustments often necessary when applying theoretical concepts and frameworks to analyze actual business problems; and 3) develop students' capability to draw appropriately qualified inferences from numeric data and other factual information, as well as formulate appropriately tailored recommendations.

The integrative module is intended to promote students integration of all facets into a comprehensive risk management program.

Learning Outcomes
On completion of the module project, students should be able to:

1. Explain and demonstrate a command of the concepts and capabilities required to adequately manage enterprise risks in a business organization.
2. Justify the relevance and limitations of concepts, general frameworks and techniques used in execution of the project selected.
3. Demonstrate a sound understanding of the concepts and frameworks used in the project selected.
4. Explain and demonstrate how alternative theoretical concepts, general

frameworks and techniques presented in the courses comprising a module, can be applied to particular problem situations that are related to the project selected.

5. Demonstrate how technical analysis and a large volume of complex information, can be clearly summarized and presented in a form that is easily grasped as an aid to management decision-making.
6. Demonstrate specific knowledge in application of ERM concepts to a specific Industry and business enterprise in the Caribbean, selected from the following Module Themes:
    a. ERM in Depository Financial Institutions
    b. ERM in Insurance
    c. ERM in Manufacturing, Distribution
    d. ERM in other Industries
7. Create risk management governance frameworks and business policy frameworks to govern enterprise risks
8. Explain the top challenges facing corporate executives arising from the need to recover and adapt and advance in a changing business environment and describe the key responses that enterprises are introducing to strengthen the institutional framework of risk governance.
9. Analyze the ERM dimensions of businesses and justify the organizational structures that facilitate the iterative development of risk parameters for individual business units and mechanisms for cascading the risk appetite down to lower levels of the organization.
10. Develop a process of identifying the level of acceptable risk appetite for each risk across multiple lines of business
11. Evaluate effectiveness of portfolio risk grading systems for monitoring of various risk types Develop an understanding of control limits on risk, escalation triggers, and other provisions and how they are aligned with the enterprise's risk appetite and the necessity for meticulous observation in the execution of strategy.
12. Demonstrate understanding of the responsibility of the Chief Risk Officer (CRO) in developing the risk appetite and driving the discussions between the Board, Business management and Independent Control Groups, and implementation plan development, execution and management.

Assessment

- **Coursework** **100%**
    - A project proposal 10%
    - A draft report 20%
    - A final project 60%
    - A project presentation 10%
    - Group 25% plus individual 25%

MPHIL/PHD IN MATHEMATICS

Through our research degrees, students are given the opportunity to undertake in-depth study of a specific area of specialization under the guidance of knowledgeable research supervisor(s) within the department.

A research degree is awarded primarily on the basis of examination by thesis.

Entry Requirements

MPhil Mathematics

Candidates should normally have either a BSc Mathematics degree from a recognized university with at least Upper Second Class Honours, or have successfully completed an MSc in Mathematics from a recognized university.

PhD Mathematics

Candidates should normally have an MPhil Mathematics, or an MSc Mathematics with a research component that makes up at least 25% of the programme credits.

In each case, candidates should identify a supervisor and develop a research proposal as part of the application. Additionally, students have to do taught courses: at least 6 credits for MPhil and 9 credits for PhD.

Duration of Programme

	MPhil Mathematics	***PhD Mathematics***
Full time:	3 years	5 years
Part time:	5 years	7 years

Areas of Research

Research Areas include: Mathematics of Finance; Operations Research; Stochastic Differential/Difference Equations and Applications; Fluid Mechanics; Applied Statistics; Computational Methods; Fuzzy and interval Mathematics; Risk Analysis; Special functions and Applications; Non-linear Differential Equations.

Department of Physics

8

www.mona.uwi.edu/physics

Postgraduate Diploma (PgDip)

PgDip in Medical Physics
PgDip in Renewable Energy Management

Taught Master's Degrees

MSc. Advanced Electronic Systems
MSc. Medical Physics
MSc. Renewable Energy Management
MSc. Renewable Energy Technology

Research Degrees

MPhil in Physics / Applied Physics / Electronics
PhD in Physics / Applied Physics / Electronics

Head of Department: Dr Tanneisha Stephenson
Graduate Coordinator: Dr. Venkateswara Penugonda
Contact: The University of the West Indies
Mona Campus, Kingston 7, Jamaica W.I.
Email: physics@uwimona.edu.jm
Tel: (876) 927-2480
Fax: (876) 977-1595
Ext: 2277-9

MASTER OF SCIENCE: ADVANCED ELECTRONICS SYSTEMS

PROGRAMME OVERVIEW

This program replaces the current Master's in Digital Technology which has been running since 2002. The revamped programme is designed to meet new internal requirements for course credits and course structure. It will introduce areas of specialization in Telecommunications and Power Systems. These areas have been selected given the current trends in their respective industry. The telecommunications/ICT sector continues to grow. Power Engineering encompassing Alternate Energy and Control Systems is also key for the energy and manufacturing sectors which are growing here in Jamaica and the Caribbean.

Programme Objectives

The Master's in Digital Technology began in 2002. With the rapid changes in Technology along with developments in Industry, the Department of Physics decided to revise the courses in order to better align with these changes. Telecommunications and Power were chosen as the main areas as these are key areas of industrial development within the Caribbean.

Graduates from the programme will have a solid theoretical background and practical experience in modern Electrical and Communication systems. This will be done through a mix of theoretical and practical based courses.

Entry Requirements

At least the equivalent of a GPA of 2.5 or a Lower Second Class honours degree (or equivalent) in a Science discipline.

Duration of Programme

The programme is part-time and will be delivered over six (6) semesters (summer included as semester 3), providing students with their master's degree within a minimum of two (2) years.

PROGRAMME STRUCTURE

The programme structure includes a research project, compulsory core courses with a focus on two areas of specialisation from which candidates will select one:

- Telecommunication Systems
- Power Systems

There will be a graduate seminar where students will present a subject that will be the focus of their research project.

Telecommunication Systems Specialization

This area focuses on the current advances in wireless broadband, especially in the development of 4G systems including LTE.

Programme Objectives

- Students should be able to understand how wireless communication systems are built and how their performance affects coverage, capacity and quality.
- This programme should also bring a focus to broadcasting and Digital Television standards and technologies in particular.
- Candidates from the area will be well suited to serve the Mobile Industry, Wired and Wireless operators.

Power Systems Specialization

- This programme prepares students to make practical applications in the generation, transmission, distribution and utilization of electric power and electrical devices such as generators, motors and transformers.
- There is also an emphasis on alternative energy sources inclusive of coal, solar and nuclear.
- Graduates will be able to serve the manufacturing industry

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
DEPARTMENTAL EXAMINATION		
	Panel Interview one-on-one with all applicants	NA
TBC	Word Processing, Presentations, Spreadsheets	0
ELET6500	Introduction to Advanced Electronics Systems	0
ELET6501	Introduction to Power Systems Theory	0
MATH1185	Mathematics for Scientists and Engineers	0
CORE COURSES		
ELET6520	Digital Signal Processing	3
ELET6530	Advanced Embedded System	3
ELET6540	Data Communication Networks	3
ELET6550	Advanced Microcontrollers	3
ELET6560	Programming (C and MATLAB)	3
ELET6570	Control Systems Theory	3
ELET6580	Power Systems	
ELET6590	Advanced Microprocessors	3
MDPH6330	Seminar Series	2
PTMT6007	Essentials of Management for Project Managers	3
TELECOM SYSTEMS		
ELET6510	Research Project	6
ELET6610	RF & Microwave Communication Systems	3
ELET6620	Antennas and Propagation	3
ELET6630	Wireless Communications and Mobile Networks	3
ELET6640	Advanced Communications	3
POWER SYSTEMS		
ELET6510	Research Project	6
ELET6710	Computer Aided Power Systems Analysis	3
ELET6720	Transmission and Distribution	3
ELET6730	Advanced Control Systems Theory	3
RENT6008	Electrical Integration of Renewables	3
TOTAL CREDITS		**48**

COURSE DESCRIPTIONS

ECNG6500 COMPUTER-AIDED POWER SYSTEM ANALYSIS
(Core Course) (3 Credits) (Semester X)

Prerequisite
None

Course Description
This course is designed to revisit fundamental concepts and develop understanding of fundamental techniques employed for power systems analysis.

Learning Outcomes
At the end of this course, students will be able to:

- model the components of power systems;
- statistically assess power systems and their components;
- apply the per-unit system to evaluate power system analyses; understand the power transfer problem;
- calculate symmetrical and asymmetrical fault studies;
- apply numerical techniques to the solution of large networks; and
- apply computer-based applications for power systems analysis.

ELET6500 INTRODUCTION TO ADVANCED ELECTRONICS SYSTEMS
(Core Course) (3 Credits) (Semester 1)

Prerequisite
None

Course Description
Students will receive basic insights into the courses taught in the MSc in Advanced Electronics Systems. They will learn how advanced electronics systems are developed starting from semiconductor theory, to discrete electronics components, integrated circuits, digital and analogue electronics, microprocessors, microcontrollers and computer programming. Students will also be introduced to Digital Signal Processing, Digital Communication systems and Photovoltaic Systems and gain an insight into the types of electronics systems that are suitable for implementing these technologies. At the end of the course each student should

be able to understand the basic concepts of advanced electronics systems and appreciate how they are developed using basic electronics systems.

Learning Outcomes

Upon successful completion of the course each student will be able to:

- Explain the basics of the following disciplines and identify the application of each area in the fields of Telecommunications and Power Systems:
    a. Digital Signal Processing
    b. Communications Systems
    c. Microprocessors
    d. Micro Controllers
    e. Solid State Devices and Solar Photovoltaics
- Develop and implement basic C program applications.

Course Content

1. Advanced Electronics Systems Introduction
2. Mathematics Review
3. Introduction to Digital Signal Processing Signals
4. Systems
5. Linear Time Invariant Systems
6. Fourier Analysis
7. Z Transform
8. Solid State Devices and Photovoltaic Systems
9. Introduction to Semiconductor Theory
10. Introduction to Photovoltaic (PV) Systems
11. Digital Logic basics
12. Introduction to Microprocessor and Microcontrollers
13. Introduction to Communication Systems
14. Introduction to Programming

Assessment

- **Coursework:** **40%**
    - Programming Assignment: 10%
    - Mid-semester Exam: 30%
- **Final Exam:** **60%**

ELET6510 RESEARCH PROJECT

(Core Course) (6 Credits) (Semester X)

Prerequisite

Students must complete their particular preparation course before starting the programme

Course Description

A project based on material taught in the taught courses, supplemented by private study of literature suggested by the supervisor plus practical work where appropriate. The aim of the project is to provide the student with the opportunity to conduct research on an open-ended topic of relevance to the alternative and renewable energy sector.

The project must be carried out individually and be supervised by an accredited advisor. Assessment will be on the basis of the advisor's report, an individual dissertation, and an oral presentation. Basic guidelines for the Final Project include:

- The development of a research project should consolidate knowledge for future professional practice, research, innovation, education and communication activities.
- Projects must be approved by an accredited advisor.
- Research projects are proposed and developed by the faculty, aiming to transfer knowledge to society, meet specific demands, as well as enable students to carry on high quality research. Such as:
  - Applied research involving computer simulations and field tests, seeking innovative applications of electronic solutions in industrial processes and buildings.
  - Study of policy, planning and regulation of advanced electronic systems, as well as management procedures.
  - Analysis of environmental impacts associated with advanced electronic technologies and the study of appropriate solutions to them.

Learning Outcomes

- Knowledge and Understanding - At the end of the project students should have gained knowledge and understanding of the general RE management principles and the particular problems of application in the chosen subject area.
- Skills and Attributes
  - Intellectual - To understand the needs to formulate objectives

and to plan adequately in terms of both methodology and time management.

- Practical - To design and execute the project to a successful conclusion, while dealing in the process with providers of hardware, software and information.
- Transferable - To analyse experimental data, to solve specific numerical and conceptual problems, and to work with superiors and peers to achieve smooth and timely progression of the project. Use of published information and search engines to identify the state of the art in the chosen subject area.

Assessment

- **Dissertation** **80%**
- **Seminar** **20%**

ELET6520 DIGITAL SIGNAL PROCESSING

(Core Course) (3 Credits) (Semester X)

Prerequisite

ELET6500 Introduction to Advanced Electronics Systems

Course Description

This course introduces advanced concepts of discrete-time statistical signal processing. Topics include least squares digital filter design and realisation, finite word length effects, random processes, adaptive filters, linear prediction, multi-rate signal processing, time-frequency analysis, sub-band transforms and wavelets.

The digital revolution has led to digital signal processing (DSP) becoming particularly important area of study and practice. DSP is the bedrock of modern electronic devices and systems, with a vast array of applications, which include information transmission in communications systems, control systems (industrial, medical, etc.), image acquisition and processing. Individuals with expertise in advanced DSP are in high demand in a variety of industries locally and internationally.

Learning Outcomes

Upon successful completion of the course each student will be able to:

1. Undertake challenging analysis and design problems and find optimal solutions;

2. Decompose a problem into its constituent parts and define the scope of each part;
3. Design digital filters for analytic signal generation;
4. Design digital filters using interpolation and decimation stages;
5. Design digital filters meeting given specifications;
6. Apply basic adaptive filters based on second order statistics;
7. Design and apply optimum filtering algorithms;
8. Be familiar with multi-rate processing and time-frequency analysis techniques.

Course Content

- Frequency domain analysis:
    - Discrete Fourier Transform; Fast Fourier Transform; Discrete Cosine Transform
- Basic Filter Design
    - FIR and IIR filters; Linear phase FIR filters; All Pass filters; Windowing; Iterative Filter Design; Bilinear and Impulse Invariant Transforms
- Implementation of DSP systems
    - Structures for FIR systems; Structures for IIR systems; Coefficient quantization and round-off effects
- Multi-rate DSP
    - Downsampling and upsampling; Polyphase decomposition; Nyquist filters; Sampling-rate conversion; Efficient multirate filtering
- Statistical Signal Processing
    - Amplitude distribution; Signal Mean, Mean-square and Variance; Mean squared error; Power spectrum; Auto-correlation; Cross-correlation
- Adaptive Filtering
    - Weiner filter; Least mean squares filter; Recursive least squares filter; Introduction to Bayesian Estimation; Kalman filter
- Time-Frequency Analysis
    - Short-time Fourier Transform; Wavelets; Transform Coding

Assessment

- **Coursework** **60%**
    - Four assignments (10% each): 40%
    - Mid-semester Exam: 20%
- **Final Exam** **40%**

ELET6530 INTRODUCTION TO MICROCONTROLLERS AND MICROPROCESSORS

(Core Course) (3 Credits) (Semester X)

Prerequisite

None

Course Description

The purpose of this course is to introduce students to the theoretical and practical aspects of the internal operation and design of microprocessors; and the design and development of microcontroller applications. The students will be exposed to the design of combinational and sequential logic devices and how they can be used to develop counters, memory and arithmetic logic unit. Then they will learn how these sub-systems can be used to build a microprocessor. The student will also learn a hardware description language (HDL) and how to implement the aforementioned digital systems on a FPGA. The microcontroller will be introduced and its design using the microprocessor will be examined. Students will be exposed to the use of microcontrollers in the design and development of embedded systems. A particular microcontroller will be selected for the course based on current technology and accessibility of the device. The microcontroller that is currently being used is chosen from the Atmel AVR 8-bit family of microcontrollers. Students will learn about the features of this microcontroller and how to program it using C-programming language, and assembly language to a lesser extent. Students will get hands-on experience during laboratory exercises with microprocessor and microcontroller hardware. At the end of the course each student should be able to: (1) understand the basic design of digital systems on a FPGA using HDL; (2) understand the concept of designing microprocessors and how they can be used to build microcontrollers; (3) design and build basic real world applications using microprocessors and microcontrollers.

Learning Outcomes

Upon successful completion of the course each student will be able to:

1. Explain the basic components of a microprocessor.
2. Explain microcontrollers and how they differ from microprocessors.
3. Write programs in VHDL.
4. Design memory devices using latches and flip-flops in VHDL.
5. Design and implement counters and shift registers using flip-flops in VHDL.
6. Design and Implement Arithmetic Logic Unit in VHDL.
7. Explain the internal components of a microcontroller.

8. Explain the microcontroller peripheral features.
9. Explain how to interface sensors and actuators with a microcontroller.
10. Write assembly language for the microcontroller.
11. Write C programming language for the microcontroller.
12. Conduct simulation using the necessary software tools for the microcontroller.
13. Write application to interface the following devices with the microcontroller: GPS receiver, GSM Modem, Temperature sensor, DC Motor, servo motor, stepper motor, relays and contactors, LCD and Keyboards.
14. Design real world application using the microcontroller.

Course Content

- Introduction to microprocessor and microcontroller technologies and how these devices are used to implement current electronics products.
- Hierarchical Organisation of System Design: Silicon level, Gate level, Register level, Processor level, Software level; What is hardware compilation?
- Number System; Binary number system, Representation of mixed numbers, fixed point representation, representation of negative numbers, fast Addition - carry look-a-head, multiplication and division, floating point representation.
- Combinational Logics (Multiple I/O): Multiple inputs combinational logic design, Boolean Algebra, Karnaugh Maps, Real world application of Logic gate, Multiple inputs Decoders, Encoders, Multiplexers, Demultiplexers, Shifters, P-Shifter, Barrel Shifter,
- Sequential Logics and Circuits (Multiple I/O): Multiple inputs Registers, Shift Register, Counters. Arithmetic Logic Unit Design.
- VHDL Programming: Modules, Simulation and Synthesis, Digital Building Blocks, VHDL language, Finite State Machine.
- Introduction to Processor Design with VHDL: Computer System Components, VHDL Digital building blocks Arithmetic Circuit: Adders, Subtraction blocks, Comparators, ALU, CPU Design Steps, Instruction Set Architecture, Principle of processor performance.
- Memory: Capacity, organisation, access time, Read Only Memory (ROM): Mask ROM, Programmable ROM, Erasable PROM, Electronic Erasable PROM, Flash EPROM. Random Access Memory (RAM): Static RAM, Dynamic RAM, Nonvolatile RAM.
- Microcontroller Internal Operation: Connecting I/O and memory to a CPU, Address bus, Data bus. Von Neumann and Harvard architecture.
- AVR Microcontroller: AVR Architecture, Assembly Language Programming, Branch, Call, and Time Delay Loop.

- AVR Programming: AVR I/O Port Programming, Arithmetic, Logic Instructions
- AVR C Programming: AVR Programming in C, Hardware Connection and Flash Loaders, Timer Programming. Interrupt Handling on the AVR microcontroller.
- AVR Interfacing: AVR Serial Port Programming, LCD and Keyboard Interfacing.
- AVR Data Acquisition: ADC, DAC, and Sensor Interfacing.
- Interfacing with Actuators: PWM, Relay, Optoisolator, and Stepper Motor Interfacing.
- Which Technology to use in my design? Microprocessor, Microcontroller, DSP Processor, FPGA, ASIC.

Assessment

- **Coursework:** **50%**
    - Two laboratories: 20%
    - Mid-semester Exam: 30%
- **Final Exam:** **50%**

ELET6540 DATA COMMUNICATION NETWORKS
(Core Course) (3 Credits) (Semester X)

Prerequisite
None

Course Description
Students will have an improved appreciation for voice and data networks considering multiple access techniques and network protocols for both wired and wireless networks. The area of converged networks will be covered and factors that affect network performance in converged networks will be introduced. Towards the end of the course, there will be a focus on network management and network security, especially for wireless networks.

At the end of the course, each student should be able to design a robust and secure network architecture for both wired and wireless applications, considering the suitable specifications for different applications.

Learning Outcomes
Upon successful completion of this course, students will be able to:

1. Derive key transmission line equations required to perform
2. Show an understanding of key antenna parameters such as gain,

polarization and far field patterns.

3. Appreciate the factors that affect propagation in different environments.
4. Perform link budget analysis.
5. Identify and design appropriate antenna for specific applications.
6. Analyse an antenna's performance given specific characteristics
7. Design a robust and secure network architecture for both wired and wireless applications

Course Content

- Course Introduction: Information Theory: Sources, Source Coding, Channel Capacity, SNR, Error-detection and correction, Digital Transmission;
- Networking Overview: Network Resources, Reference Models (OSI & TCP/IP), Layers and their Functions, Error-control Codes and Modulation Techniques for baseband, DSL and Fibre;
- Network Layer
    - Telecommunication Networks, Network Structure, National and International, Traffic Theory, Poisson Processes, Erlang Distribution, Time and Call Congestion, Grade of Service, Quality of Service
    - Routing Algorithms and Congestion Control Algorithms, IPv4 vs. IPv6, IP Addressing, OSPF, BGP, Mobile IP
- Mobile Data Networks: Types of Wireless Networks, Standards, Wireless Channel Characteristics, Wireless Medium Access Control Techniques; Network Planning, Mobility Management, Radio Resources, Wireless Network Security;
- Mobile Ad-hoc and Sensor Networks
- Network Management
- Network Security Issues

Assessment

- **Coursework** **50 %**
    - One paper and project: 30%
    - Mid-semester exam: 20%
- **Final Exam** **50%**

ELET6550 ADVANCED EMBEDDED SYSTEMS

(Core Course) (3 Credits) (Semester X)

Prerequisite

ELET6530: Introduction to Microcontrollers and Microprocessors

Course Description

The purpose of this course is to introduce students to the theoretical and practical principles involved in the design and development of state of the art embedded systems. During the course students will learn about some advance features of a modern microcontroller and how to use this device in the design and development of advanced embedded systems. The microcontroller that is currently being used in the course is chosen from the Atmel AVR 8-bit family of microcontrollers. The course will cover the programming of well know signalling interfaces and protocols that are used in embedded systems; these include the two wire interface (TWI/I2C), one wire interface, serial peripheral interface (SPI), transmission control protocol internet protocol (TCP/IP) and Hypertext Transfer Protocol (HTTP). The course will also review current microcontroller and microprocessor development platforms such as the Arduino and the Raspberry Pi. Students will be exposed to techniques for designing circuits and writing applications for developing advanced embedded systems in the following areas: Sensors and Measurement Systems, Robotics, Real-time Audio Processing and Wireless Sensor Networks. At the end of the course each student should be able to describe the advanced peripheral features of the microcontroller and how to use them in a C-program. Students should be able to use the microcontroller to design and build advance embedded systems for everyday applications.

Learning Outcomes

Upon successful completion of the course each student will be able to:

1. Explain the implementation of the following signalling interface on the microcontroller:
   SPI Interface
   I2C Interface
   1-Wire Interface
2. Develop and implement C-programs to use the SPI, I2C and 1-Wire interface in applications.
3. Build and design embedded systems to turn on/off electronics appliances in the home (Lights, TV, Fridge or Air Conditioner)
4. Build embedded systems to interface with sensors such as GPS receiver, temperature sensor and acceleration sensor.

5. Use PWM to control the speed and direction of motors.
6. Understand TCP/IP networks and how to design circuits to add embedded systems to this type of network.
7. Understand how to write applications to build obstacle avoidance or flying robots.
8. Understand how to use Arduino and Raspberry Pi to build embedded systems projects.
9. Understand how to use embedded systems to build real time audio processing devices, wireless sensor networks and sensors and measurement systems.

Course Content

- Introduction to Advanced Embedded Systems; effect on our daily lives.
- AVR Timer/Counter Programming; Delay generating, counting, waveform generating, capturing, 8-bits and 16-bis timer.
- Connecting Output devices to the AVR Microcontroller; AVR Fan-out, motors (AC/DC), mechanical and solid state relays, contactors. Circuits for controlling the power to typical electronic appliances found in the home and business (e.g. Air conditioner, Fridge, and Lights)
- AVR PWM Application; PWM for servo and stepper motor control, using PWM for digital to analogue conversion
- AVR SPI Programming; SPI definition, SPI configuration on AVR, SPI programming in C, Interfacing with an SPI device such as: Memory Card (MMC/SD), 7-Segment controller MAX 7921.
- AVR I2C Programming; I2C definition, I2C configuration on AVR, I2C programming in C, Interfacing with an I2C device such as: Temperature Sensor, Gyroscope.
- One Wire interface Overview; 1-Wire definition, 1-Wire configuration on AVR, SPI programming in C, Interfacing with a 1-Wire devices.
- TCP/IP Networks; Introduction to TCP, IP and HTTP protocols, GPRS Networks, Local Area Networks (LAN), How to interface embedded systems to TCP/IP networks.
- Embedded Microcontroller and Microprocessor Development Boards; How to use Arduino and Raspberry Pi in embedded systems application.
- Sensors and Measurement System; Temperature sensor, GPS receiver, magnetometer, accelerometer, gyroscope, Wearable sensors.
- Embedded Systems in Robotics; PID Controller, Obstacle Avoidance Robots, Flying Robot (Quadcopter)
- Wireless Sensor Networks; Wireless embedded radios, WiFi Network, ZigBee protocol, Xbee radios, building a wireless sensor network with

XBee radios.

- Real-time Audio Processing; Nyquist theorem, quantisation error, Digital IIR and FIR Filters, effect of fixed-point implementation on digital filter, AVR processing of audio signal

Assessment

- **Coursework:** **50%**
  - Four Laboratories: 20%
  - Mid-semester Exam: 30%
- **Final Exam:** **50%**

ELET6560 PROGRAMMING IN C/C++ AND MATLAB
(Core Course) (3 Credits) (Semester X)

Prerequisite
N/A

Course Description
Individuals working in technical areas are at a distinct disadvantage if they are unable to design, develop, execute and troubleshoot algorithms in a recognised programming language. This is especially true given the increasing use of software to perform functions previously implemented with hardware.

This course introduces programming in C/C++ and Matlab and provides students with the basic skill and experience to author and manipulate basic to programs using these languages. All exercises and projects will be done in the Linux environment.

Learning Outcomes
Upon successful completion of the course each student will be able to:

- Undertake basic analysis and design problems
- Discuss basic concepts in programming, such as recursion, loops and memory allocation;
- Demonstrate code development using the process of top-down, stepwise refinement;
- Write programs given algorithmic descriptions;
- Develop optimal algorithmic and coding solutions;
- Identify and fix problems in prewritten code;
- Read in, process and output data using C/C++ and Matlab;

Course Content

- Introduction to Matlab: Scripts and Functions in Matlab; Programming in Matlab
- Introduction to C: Basics of C; Scope and Pointers; Pointers and Structures; Structures and Memory; Memory, Files and Bit operation
- Introduction to C++: Object oriented programming in C++; Inheritance and Polymorphism

Assessment

- **Coursework:** **100%**
    - Programming Assignments: 40%
    - Three projects: 60%

ELET6590 DIGITAL SYSTEMS DESIGN WITH VHDL AND FPGAS
(Core Course) (3 Credits) (Semester X)

Prerequisite
ELET6530: Introduction to Microcontrollers and Microprocessors
Course Description
The purpose of this course is to expose students to the use of Field Programmable Gate Array (FPGA) in the design of advance digital systems. Students will learn to program the FPGA using the VHDL programming language. The course will cover the design of combinational and sequential logic circuits on the FPGA, and the use of these building blocks in designing an arithmetic and logic unit (ALU). Students will learn how to develop a custom microprocessor or microcontroller on the FPGA. The course will cover pipelining, cache memory and multicore technology. For the processing of video, audio and other real-time data intensive application FPGAs outperform microprocessors, microcontrollers and DSP processors; therefore students will learn how the FPGA is used to process high speed data signals. At the end of the course each student should be able to: (1) state the differences between FPGA, ASIC, Microcontroller and Microprocessor and indicate which is most suitable for a particular application; (2) design a basic microprocessor or microcontroller on the FPGA; (3) use the FPGA do design applications requiring PS/2 Keyboard and VGA display; and (4) understand the framework for developing video and audio processing applications on the FPGA.

Learning Outcomes
Upon successful completion of the course each student will be able to:

- Write application in VHDL to develop digital systems on an FPGA.

- Design building blocks for digital systems on a FPGA, such as: Addition Circuits, Subtraction Circuits, Arithmetic Logic Unit, Shift Registers and Counters.
- Design the datapath and control unit of the MIPS microprocessor.
- Write VHDL application to implement the MIPS microprocessor.
- State the benefits of pipelining in processor design.
- Understand how to incorporate pipelining in the MIPS microprocessor design.
- State the benefits of cache memory in processor design.
- Understand how to incorporate cache memory in the MIPS microprocessor design.
- Understand how to interface a PS2 Keyboard and Mouse with the FPGA development board.
- Understand how to incorporate UART interfacing with the FPGA development board.
- Understand how to use the FPGA to design circuits for advanced digital applications such as: Microcontrollers, Audio processors, Video processors and Internet data routers.

Course Content

- Introduction to Digital System Design and VHDL Course.
- VHDL Programming Review: Combinational Circuits, Sequential Circuits.
- VHDL Digital building blocks: Arithmetic building blocks, Sequential building blocks, Memory arrays Logic arrays.
- Microprocessor: Introduction, Evolution, Inside the Microprocessor, Basic Microprocessor Instruction, Addressing Modes, Programming Microprocessor, RISC Vs CISC Processor
- MIPS Microprocessor; Instruction operation, Datapath, Single Cycle operation
- Implementing MIPS; Instruction format, Datapath Design, Register File, Control Unit Design
- Processor Performance; Response Time, Throughput, CPU Execution Time, Clock Cycles per Instruction (CPI), Amdahl's Law, Benchmarking, Performance and Power, Energy and Efficiency.
- Pipelining; Serial Execution Vs Pipelining, Synchronous Pipeline, Pipeline performance, pipelined datapath, Data Hazards, Branch Hazard.
- Cache memory; Random Access Memory and its Structure, Memory Hierarchy and the need for Cache Memory, The Basics of Caches, Cache Performance and Memory Stall Cycles, Improving Cache Performance, Multilevel Caches
- Microprocessor Input/output: I/O Configuration, Polling Vs Interrupt, Direct Memory Access, Bus Architecture, Channel Architecture.

- Intel Multi-Core Technology: New Energy Efficiency by Parallel Processing, Intel Turbo Boost technology, Intel Hyper-Threading Technology, Tera-scale computing
- FPGA Development Board Application Examples: UART, PS2 Keyboard and Mouse, Memory interface, VGA Controller
- Building Advanced Digital Systems on the FPGA: (Microprocessor already covered as a proof of concept). Building a Microcontroller on the FPGA, Audio processing application, Video processing application, Internet router. Comparison between FPGA, ASIC, Microcontroller, Microprocessor, and DSP Microprocessor.

Assessment

- **Coursework:** **50%**
    - Two Laboratories: 20%
    - Mid-semester Exam: 30%
- **Final Exam:** **50%**

ELET6610 RF & MICROWAVE COMMUNICATION CIRCUITS
(Core Course) (3 Credits) (Semester 1)

Prerequisite
None

Course Description
This course aims to provide a good background into basic analysis techniques for RF and microwave network analysis. Students should gain a better understanding of receiver design including small-signal RF amplifiers, synthesisers, and the design of power amplifiers.

Learning Outcomes
Upon successful completion of this course, students will:

1. Have a good grasp of theoretical and design concepts of RF circuits.
2. Be competent in the use of at least one RF/microwave circuit design tool.
3. Understand the basic operation of RF and microwave network analysers.

Course Content

- Overview of Analogue and Digital RF Systems
    - Traditional & Modern radio systems, Transmission Lines Review
    - Transmission line analysis, Smith Chart and applications to RF circuit design, Scattering parameters.

- Planar Circuits
    - Microstrip theory and circuit design, Matching circuit theory and design, Lumped component performance at RF, Quarter-wave transformer.
- Noise Modelling
    - Noise in Resistors, Capacitors, Inductors, CMOS Transistors, Noise factor, Noise figure, LNAs.
- RF Filters
    - Review of Filter theory, Lumped element filter design, Distributed element filter design.
- Transistor Circuits
    - Application of BJTs and FETs in RF circuits, Automatic Gain Control and applications.
    - Receivers and Amplifier Design
    - Maximum gain amplifier design, constant gain amplifier design, Broadband amplifiers.
- Mixers
    - Tuned radio, superheterodyne, regenerative receivers. Analogue and digital RF systems. Noise, noise figure, noise matching, Detectors, Intermediate frequency filters, Intermodulation.
- Phase Noise Theory
- Absolute/Residual Phase Noise, Mixers, Mixers as phase detectors, Phase noise effect in mixers.
- Oscillators and Frequency Synthesizers
    - RF/Microwave oscillator theory, Negative-resistance oscillator design, Transistor oscillator design
    - Dielectric resonator oscillator design, Practical examples.
- RF Power Amplifiers (PA)
    - Different classes of Pas, Linearization, Non-linearity, Efficient PA techniques, PA architectures,
    - Reliability and thermal considerations, Digital predistortion, Adaptive biasing.
- Phase-locked Loops (PLL)
    - Phase-locked loop (PLL), Phase noise, Time jitter, Measurement technique.
- RFICs and MMICs
    - Active and passive components for GaAS and Silicon IC design, Circuit topologies.
- Network Analysis
    - Network analyser basics, Applications and capabilities of high-frequency network analysers, Accuracy enhancement and calibration.

Assessment

- **Coursework** **50%**
    - Term paper and simulation exercise 30%
    - Mid-semester exam 20%
- **Final Exam** **50%**

ELET6620 ANTENNAS AND PROPAGATION
(Core Course) (3 Credits) (Semester X)

Prerequisite
None

Course Description
Students will receive basic insights into the field of antennas and propagation. The course will begin with a review of Maxwell's equations and isotropic radiators, as well as Transmission Line theory and the application of the Smith Chart. It will include fundamental antenna characteristics that are important in the design process for various applications. The students will learn how to relate specific parameters to the application(s) for which a particular antenna is suited and will perform exercises requiring the design of different types of antennas, with an emphasis on the radiation patterns and other key parameters. They will also learn how to determine antenna ranges in different environments, and to identify possible sources of errors that affect the performance. The course will also cover RF propagation for fixed link, satellite link, and indoor environments.

At the end of the course, each student should have an understanding of the steps involved in the design of antennas for different applications.

Learning Outcomes
Upon successful completion of this course, students will be able to:

1. Derive key transmission line equations required to perform
2. Show an understanding of key antenna parameters such as gain, polarization and far field patterns.
3. Appreciate the factors that affect propagation in different environments.
4. Perform link budget analysis.
5. Identify and design appropriate antenna for specific applications.
6. Analyse an antenna's performance given specific characteristics

Course Content

- Course Introduction

    - Definition of antenna and justification of importance of design and propagation modelling. Applications. Brief review of Maxwell's equations, Poynting Vector, Plane waves, Hertzian Dipole, Isotropic radiator.
- Transmission Lines Review
    - Derivation of key transmission line equations, Special case of the lossless line, VSWR, Input impedance, and Reflection coefficient, Smith Chart.
- Antenna Fundamentals
    - Gain, directivity, radiation resistance, beam width, effective area, and link budget analysis. Far field criteria, Polarisation, Basic wire antennas: dipole, loop. Helix antennas.
- Antenna Types
    - Basic antenna types and their characteristics (e.g. horn, yagi, loop, reflector antennas), Array antennas and Array factor, Feed structures.
- Propagation Fundamentals
    - Free space propagation, Path loss, Fast fading, Reflection, Refraction, Fresnel coefficients, Snell's Law, Multipath effects.
- Fixed Link Propagation
    - Spherical earth effects, Diffraction, Fresnel zones, Troposphere refraction, Ducting. Line-of-sight, Non line-of-sight.
- Satellite Link Propagation
    - Assessment of tropospheric and ionospheric impairments that affect satellite propagation.
- Indoor Propagation
    - Picocells and Femtocells.
- Antenna Simulations
    - This session will take the form of a demonstration of propagation of different types of antennas.
- Antennas for Base Stations
    - Parameters, Diversity, Arrays, Weather resistance.
- Printed Mobile Antennas
    - Wireless device antennas, Practical issues, SAR considerations.

Assessment

- **Coursework:** **50%**
    - Term paper and project 30%
    - Mid-semester exam 20%
- **Final Exam:** **50%**

ELET6630 WIRELESS COMMUNICATIONS AND MOBILE NETWORKS

(Core Course) (3 Credits) (Semester X)

Prerequisite

None

Course Description

This course aims to provide a good background into the development of wireless communications systems and mobile networks. The course will begin with a review of wireless communications fundamentals, followed by the propagation channel and its effect on signal behaviour. Multiple access techniques are presented, and there is also a focus on established technologies such as Wi-Fi, WiMAX, Bluetooth and Zigbee. Security in Wireless Communications is also addressed as it has become an increasingly important topic in recent years. The course also deals with mobile network architecture and modelling, and mobile security issues are also covered.

Learning Outcomes

Upon successful completion of this course, students will:

1. Have a knowledge of basic and advanced wireless communication theories in the physical, link and network layers.
2. Understand traditional mobile networks and future standards.

Course Content

- Introduction and Background: Wireless and Cellular Environment, Wireless propagation channel.
- Radio Wave Propagation: Path loss, Multipath fading, Shadowing.
- Modulation and Coding for Wireless
- BPSK, QPSK, QAM, OFDM. Multiple Access Techniques – TDMA, CDMA, FDMA, Error control and source coding.
- Diversity Methods: Temporal and Spectral Diversity, Spatial Diversity, Multiple Antenna (MIMO) Communications Systems.
- Wireless Network Technologies: IEEE Standards, IEEE 802.11 Terminology, Protocol Architecture, Network Components and Architecture, IEEE802.15; IEEE802.16 physical layer, MAC sublayer protocol and frame structure.
- Radio Communications: Antennas, Link budget analysis, Satellite Communications.
- Wireless Communication Security: IEEE802.11i Wireless LAN security,

WAP – Programming Model and Infrastructure, WTLS, Handshake Protocol, Cryptographic Algorithms.

- Cellular Networks: Architecture, Multiplexing, Multiple-access, Frequency reuse, Power-control, Handover, Interference, GTDMA-, CDMA- and LTE-based cellular networks, etc.
- Mobile Network Planning
- GSM: Architecture, Physical layer, Channels, Data and Services, GPRS, EDGE
- UMTS: Architecture, Physical layer, Network design
- 4G, 5G
- Security in Mobile Networks
- Wireless Ad-hoc Networks: Principles and characteristics, Applications, Scalability, Routing, Cooperative networking, etc.
- Wireless resource-allocation.
-

Assessment

- **Coursework:** **50%**
    - Term papers and project 30%
    - Mid-semester Exam 20%
- **Final Exam:** **50%**

ELET6640 ADVANCED COMMUNICATIONS

(Core Course) (3 Credits) (Semester X)

Prerequisite

None

Course Description

This course aims to serve as an introduction to advanced communication systems concepts. There will be a focus on optical communications, error detection and correction, interference, multiple access techniques and diversity. Multiple-input multiple-output (MIMO) systems will be analysed. Finally, ad hoc and wireless sensor networks will be covered.

Learning Outcomes

Upon successful completion of this course, students will:

1. Develop a good understanding of the fundamentals and advanced concepts in optical and wireless communications.
2. Design an optical communication network.

3. Understand wireless channel characteristics and modelling for different types of wireless communication systems.
4. Quantify wireless channel capacities for different channel models, e.g. point-to-point and multiple access channels.
5. Understand and apply MIMO channel modelling theory considering capacity, diversity and multiplexing trade-offs to be made.
6. Design and analyse cellular systems considering practical issues that affect deployment and performance.

Course Content

- Optical Communications: Fundamentals, Fresnel Reflection, Snell's law, Losses, Transmitters (LEDs, Lasers), Detectors (pn, pin, avalanche photodiodes, phototransistors), Amplifiers, Optical Device Design, Optical Modulation, Parameters for Optical Fibres.
- Optical Transmission Networks: Bandwidth Considerations, Applications of Optical Fibre Communication Systems, Optical Transmission Links and Subsystems. Unrepeatered Submarine Optical Fibre Links, Optical Networks, Routing in Optical Domain.
- Optical & Microwave Communications: Optical Network Architectures, Fibre-to-the-home (FTTH)/Fibre-to-the-business (FTTB), Fibre-to-the-curb (FTTC), Radio over Fibre (RoF), Optical-wireless Integration, Broadband access systems (wired and wireless), High-speed access to the last-mile access.
- Wireless over Fibre Transmission: Link Analysis, Signal-to-noise Ratio, Link Linearization, Optical Feed-forward Transmitter Circuit, Performance, Eye Diagrams, Single Mode/Multimode Wireless over Fibre Links, Intermediate Frequency (IF), IF over Optical Multimode Fibre (MMF), Digital Signals over MMF, RF over MMF, Frequency Response and Eye Diagrams, Commercial Case Studies.
- Physical Layer: Wireless Channel Characteristics, Radio Channel Models, Low-cost Radio Transceiver Modules, Wireless and Satellite Communications systems. Current Wireless Architectures and Design Approaches and Applications. Point-to-point Communication: Detection, Diversity and Channel Uncertainty, Cellular Systems: Multiple Access and Interference Management, Capacity of Wireless Channels, Multiuser Capacity and Opportunistic Communication.
- Wireless Communications: Modulation and Coding Techniques (BPSK, QPSK, QAM, OFDM), Multiple Access (TDMA, FDMA, CDMA), Source Coding, Error Control, Evolution of Cellular Technologies (GSM, 3G, 3.5G, LTE, LTE-Advanced, 5G).
- Multiple-input Multiple-output: MIMO I: Spatial Multiplexing and Channel

Modelling, MIMO II: Capacity and Multiplexing Architectures, MIMO III: Diversity-multiplexing Trade-off and Universal Space-time Codes.

- Ad hoc and Wireless Sensor Networks: Network Types (Fixed, Cellular and Ad hoc), Protocol Stacks, QoS, Self-organizing Networks, Addressing, Deployment, Performance, Applications, Nodes.
- MAC Layer: MAC Protocols, Energy Efficiency, Contention-based and Contention-free Protocols.
- Routing Protocols: Application to Ad hoc Networks, Energy-based, Position-based and Data-centric Routing, and Implementation.

Assessment

- **Coursework:** **50 %**
    - Term paper, project and lab exercise: 30%
    - Mid-semester exam: 20%
- **Final Exam:** **50 %**

MATH1185 MATHEMATICS FOR SCIENTISTS AND ENGINEERS

(Core Course) (0 Credits) (Semester 1)

Prerequisites

None

Eligibility

CAPE/A-Level Maths or M08B/MATH0100 and M08C/MATH0110

Course Description

MATH1185 introduces students to engineering mathematics. It reinforces the knowledge of complex numbers and differential equations gained from high school mathematics. In addition, the student will be exposed to new methods from linear algebra, differential calculus of functions of one and several variables, systems of differential equations and their engineering applications.

Learning Outcomes

Upon successful completion, students will be able to:

1. Solve linear first order differential equations using separation of variables
2. Solve basic problems in differential calculus of functions of one and several variables.
3. Comprehend the use and application of complex numbers to engineering problems.

4. Comprehend the use and application of vectors to engineering problems.
5. Comprehend the use and application of matrices to engineering problems.

Course Content

- Complex numbers; complex plane; exponential functions; Polar form, de Moivre's formula; fractional powers of complex numbers; systems of linear equations; Gaussian elimination
- Vectors in 3-space (including vector equations of lines and planes); vectors in n-space; generalized vector spaces; span and subspaces; linear independence; bases and dimension
- Matrix Algebra; Transpose; Determinants; Rank and its application to non-homogeneous linear systems; Inverse Matrices; LU-factorization
- Basic differential calculus for functions of one and several variables
- Taylor series for functions of one and several variables; maxima and minima for functions of several variables
- Linear first ordinary differential equations; integrating factors; applications to electrical circuits; separable equations; linear ordinary differential equations of higher order; independence of solutions;
- Homogeneous Equations: general homogeneous equations; constant coefficient homogeneous ode; non-constant coefficient homogeneous ode; solution of non-homogeneous equations by undetermined coefficients; solution of homogeneous first order systems by using eigenvectors

Assessment

- **Coursework:** **25%**
- **Final Exam** **75%**

MDPH6330 SEMINAR SERIES

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

Prerequisite

None

Course Description

A series of seminars given by various industry personnel, government or other relevant energy sector personnel as well as student project proposals. The topics for the seminars will be chosen by the course coordinator based on the implications of what is currently being discussed in the energy sector. Students will get the opportunity to hear what is currently relevant in industry and use this course to refine their research project and sharpen their presentation skills.

Learning Outcomes

1. To create an opportunity for students to practice speaking/presentations and receive feedback from other students, faculty and researchers
2. To sharpen skills that will improve effective seminar presentations in settings such as thesis dissertation defence, professional meetings, or job interviews
3. To facilitate formal interactions among graduate students and faculty members and promote academic exchange and feedback in the department
4. To provide a platform for students to begin planning their final research projects and help them to develop an awareness of research methodologies in the field of Renewable Energy.

Course Content

This is a 2-credit course required for the MSc. in Advanced Electronics Systems graduate degree. It assumes that the student already has some familiarity with the basic concepts and terminologies of renewable energy. All students enrolled in this course are required to give presentations during the graduate seminar courses. Attendance at each seminar is mandatory for all students enrolled.

Assessment

- In-class participation and assessment **20%**
- Coursework/seminar presentations **80%**

PTMT6007 ESSENTIALS OF MANAGEMENT FOR PROJECT MANAGERS

(Core Course) (3 Credits) (Semester X)

Prerequisite

None

Course Description

This course should provide an intensive study of management theories and practices geared toward effective and efficient goal attainment for organizations and projects. Understanding the fundamentals of organizations and management is critical to effective project completion. The course introduces students to the concepts and principles. It builds on major tasks performed and core functions, processes and knowledge areas for managers and project managers in modern times - integrating purpose, tasks, people, situations, problem-solving and decision-making, performance and outcomes. An interactive approach is sought with issues and cases considered, and professionalism in participation expected in lectures, exercises, simulations, student research and presentations.

Learning Outcomes

1. To familiarize students with management theories, concepts and their realistic application to management and projects
2. To explain the linkages between concepts of management and of project management.
3. To allow students to develop their understanding of relevant concepts, theories and processes so as to apply the knowledge in realistic situations.
4. To enable students to develop their awareness of the role and importance of management and organizational context.
5. To encourage critical thinking about management and organizational theory, policy and actual related practices.
6. To develop the students' appreciation of the relationship between the theory and practices in general management and project management.
7. To encourage students to develop an understanding of the importance and relevance of management and project management in a Caribbean context and to explore differences and means for improvement.

Course Content

1. Introduction and the Changing World of Work
2. Managing Organizations and Projects
3. Current Issues in Organizations, Management and Project Management
4. Planning, Decision-Making and Monitoring
5. Organizing Tasks, People and Culture
6. Directing (Organizations and Projects) Leadership, HRM, Motivation and Job Design, Communication
7. Quality, Control, and Evaluation

Assessment

- **Coursework** **100%**
    - Attendance, meaningful participation and professionalism 15%
    - Essay and related Presentation 15%
    - In-class Exercise(s) 10%
    - Group Project 20%
    - Final Coursework Examination 40%

RENT6008 ELECTRICAL INTEGRATION OF RENEWABLES
(Core Course) (3 credits) (Semester 2)

Prerequisite
None

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.

Learning Outcomes
Upon successful completion of this course, students will be able to:

- Explain the principles of operation of island wide utility grids
- Compare embedded generation with distributed generation.
- Describe the benefits and the issues of large-scale embedded generation.
- Perform power system analysis of utility grids in order to understand the implications of the connection of RE systems.
- Identify network faults and devise effective means to minimize their occurrence.
- Differentiate between the various power electronic interface options available.
- Perform detailed experiments and communicate results concisely.

Course Content

- Introduction: Standalone versus grid connected generation; Penetration from renewables; Demand curves; Importance of aggregation and interconnected networks; Energy efficiency; Demand side management-deferrable loads
- Grid characteristics: Structure of electrical energy systems; Requirement for multiple voltages; Generator characteristics and usage by energy source; Centralised generation; Embedded or distributed generation
- Power Systems analysis: Apparent, active and reactive power in AC systems; Conservation of active and reactive power; Transmission line characteristics and equivalent circuits; Transfer of power over high and low voltage transmission lines; The load angle; Connection of RE Sources to Large Networks; Iterative Solutions
- The synchronous generator equivalent circuit; Synchronous generator operating range and control capabilities; Active power characteristic of SG's and stability; The induction generator equivalent circuit and operating range; Comparison between synchronous and induction generators for RE applications; Per-Unit notation
- Network Analysis: Load flow analysis; Network, load and generator data; Unbalanced load flows; Fault analysis-Thevenin equivalent circuits; Calculation of fault currents- short circuit levels; Unsymmetrical faults
- Power System control: Power system operation requirements; Quality of electricity; Active power and frequency control; Power frequency relationship; Power conversion chain-The governor; Frequency control of large and of stand-alone systems; Reactive power and voltage control; Automatic voltage regulators; Reactive power management; The control of RE generators
- Power System Operation: Integrating renewables-the problems; The operation of power systems; Demand forecasting; Generation scheduling and spinning reserve; Contingency analysis; Optimum economic dispatch; Plant generation costs and capabilities; Aggregation; Penetration levels from variable sources; Cycling costs; Reserve costs; Discarded energy; Penalties due to increasing penetration; Combining different Renewable Energy sources; Protection
- Power Electronic Interfaces: Power semiconductor devices; Diode bridge rectifier; Harmonics; Thyristor bridge; Three-phase converters; DC-DC converters; Converter control systems; Grid connected PV inverters; Wind power applications; Soft starters

- Embedded Generation: Point of common coupling; Fault levels and weak grids; Thermal limits; Voltage effects; Steady state voltage rise; Automatic voltage control; Tap-change transformers; Flicker

Assessment

- **Coursework:** **50 %**
    - Laboratory assignment: 30%
    - Term paper: 20%
- **Final Exam:** **50 %**

MASTER OF SCIENCE: CLINICAL MEDICAL PHYSICS

PROGRAMME OVERVIEW

Technological advances and developments in physics and medicine, particularly in radiology, radiotherapy and nuclear medical physics have created a demand for Qualified Medical Physicists to support the current progress in the healthcare sector. Healthcare providers rely heavily on continued education and training of medical physicists in order to achieve and maintain international health standards.

Programme Objectives

The objectives of the M.Sc. in Clinical Medical Physics and PG Diploma in Medical Physics are:

- To develop professionals with competences in diagnostic imaging, nuclear medicine, radiation therapy, and health physics.
- To produce a cadre of Medical Physicists who are competent by virtue of their education and training to practice one or more of the key subfields of Medical and Health Physics: Diagnostic and Therapeutic Radiological Physics, Nuclear Medical Physics, Environmental and Industrial Health Physics.
- To build local and regional capacity for sustainable education, training and research in Medical Physics.
- To equip students with the knowledge and skills required to pursue doctoral studies.
- To facilitate Continuing Professional Development in relation to Clinical Medical Physics

Entry Requirements

The entry requirements for the MSc in Clinical Medical Physics and Diploma in Medical Physics are:

- Bachelor's degree in: Physics or an equivalent relevant physical or engineering science with a minimal cumulative GPA of 2.5 (Lower Second Class Honours) from a university of recognized standing. Students holding overseas degrees are welcome to apply.
- Candidates who do not meet these criteria, but who have at least 3 years of professional experience in a relevant area may also be

admitted under special circumstances consistent with the entry requirements for Specially Admitted Students under The UWI Regulations for Graduate Diplomas and Degrees.

- All applications must be completed on-line using the website http://sas.uwimona.edu.jm:9010. Once the application has been processed and a student is admitted, he/she will be notified by the Office for Graduate Studies and Research. Applicants who have been admitted in the programme must follow the instructions in their letter of admissions regarding the confirmation of acceptance.

Duration of Programme

The MSc programme is offered full-time over 24 months in line with the University's academic year. The duration of the Postgraduate Diploma (PgDip) is 12 months completion of all year-one courses.

PROGRAMME STRUCTURE

Courses will be delivered in block mode on evenings and/or weekends to facilitate working professionals.

MSc in Clinical Medical Physics

The curriculum consists of three modules:

- Level I (core),
- Level II (professional)
- Level III (professional).

A total of 28 credits are required for the award of the degree.

Postgraduate Diploma (PgDip) in Medical Physics

This involves completing the core and professional courses from the MSc programme over three semesters.

A total of 28 credits is needed, with an overall average mark of 50%.

Programme Content

COURSE CODE	COURSE TITLE	CREDITS
CORE COURSES (YEAR 1)/PgDIP		
MDPH6115	Anatomy and physiology for clinical medical Physicists	2
MDPH6135	Fundamentals of Clinical Radiation Physics and Dosimetry	2
MDPH6170	Information Technology and equipment in Radiation Medicine	2
MDPH6180	Biomedical Statistics	2
MDPH6190	Radiation Biology	2
MDPH6215	Diagnostic Radiology: Physics, Equipment and Applications	3
MDPH6230	Nuclear Medicine: Physics, Equipment and Applications	3
MDPH6240	Non-Ionization Radiation: Physics, Equipment and Applications	3
MDPH6260	Radiation Therapy 1: Physics, Equipment and Applications	3
MDPH6270	Radiation Therapy 2: Physics, Equipment and Applications	3
MDPH6280	Radiation Safety and Protection	3
TOTAL CORE (YEAR 1) CREDITS: 28		
CLINICAL RADIOTHERAPY (YEAR 2) **Total Year 2 Credits: 24** **Taken from the courses below**		
MDPH6290	Professional Ethics	1
MDPH6410	Radiation Safety and Protection in Radiotherapy	2
MDPH6420	Imaging Equipment in Radiotherapy	1
MDPH6430	Radiation Dosimetry for External Beam Therapy	4
MDPH6440	Quality Management in Radiotherapy	2
MDPH6450	External Beam Radiotherapy	4
MDPH6460	Brachytherapy	2
MDPH6470	Equipment Specification and Acquisition in Radiotherapy	1
MDPH6480	Clinical Environment and Optimization in Radiotherapy	2
MDPH6610	Medical Physics Clinical Research Project	4
MDPH6620	Seminar	1

CLINICAL DIAGNOSTIC RADIOLOGY AND NUCLEAR MEDICINE (YEAR 2) Total Year 2 Credits: 24 Taken from the courses below		
MDPH6290	Professional Ethics	1
MDPH6510	Radiation Safety and Protection in Diagnostic and Interventional Radiology	3
MDPH6515	Dosimetry, Instrumentation and Calibration in Diagnostic and Interventional Radiology	3
MDPH6520	Performance Testing of Imaging Equipment in Diagnostic and Interventional Radiology	3
MDPH6525	Technology Management in Diagnostic and Interventional Radiology	3
MDPH6530	Image Quality Assessment in Diagnostic and Interventional Radiology	3
MDPH6535	Patient Dose Audits in Diagnostic and Interventional Radiology	3
MDPH6540	Radiation safety and protection in Nuclear Medicine	2
MDPH6545	Technology Management in Nuclear Medicine	1
MDPH6550	Radioactivity measurement and internal dosimetry in Nuclear Medicine	1
MDPH6555	Performance testing of Nuclear Medicine equipment	2
MDPH6560	Preparation and quality control of radiopharmaceuticals	1
MDPH6565	Radionuclide therapy using unsealed sources	1
MDPH6580	Clinical Environment and Optimization in Nuclear Diagnostics	2
MDPH6610	Medical Physics Clinical Research Project	4
MDPH6620	Seminar	1
TOTAL PROGRAMME CREDITS: 52		

COURSE DESCRIPTIONS

MDPH6115 ANATOMY AND PHYSIOLOGY FOR CLINICAL MEDICAL PHYSICISTS

(Core course) (2 Credits) (Year 1)

Prerequisite
NONE

Course Description
This theoretical course is designed to introduce the students to the Anatomy and Physiology of the human body and the aspects essential for the clinical medical physicist. The course outlines gross anatomical structures and regions, discusses their functions and helps students to identify them from a range of diagnostic images. Medical physicists must have a sound understanding of human anatomy in order to be competent partners in the multidisciplinary teams found in radiation medicine facilities. This course provides students with the basic anatomy and physiology knowledge required to operate effectively in such environments.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Describe the major organ systems
2. Distinguish major organ systems on Xray images, CT images, MRI images and nuclear medicine images
3. Relate the anatomical structures and physiological function with the imaging modalities used to view them
4. Distinguish between gross anatomical structures
5. Examine the physiological mechanisms for repair

Course Content

- Anatomical nomenclature:
    - Origin of anatomical names
    - Prefixes and suffixes
    - Anatomical position and body plane terminology
- Structure, Physiology, Pathology, and Radiographic appearance (X ray, CT, MRI and nuclear medicine imaging) of:
    - Bones and Bone Marrow
    - Brain and CNS
    - Thorax
    - Abdomen

- Pelvis
- Respiratory, digestive, urinary, reproductive, circulatory, lymphatic, endocrine systems

Assessment

• **Coursework:**		**40%**
o One In-course test (2 hours)	40%	
• **Final Exam**		**60%**
o One three-hour written paper	60%	

MDPH6135 FUNDAMENTALS OF CLINICAL RADIATION PHYSICS AND DOSIMETRY

(Core course) (2 Credits) (Year 1)

Prerequisite

NONE

Course Description

This course provides an introduction to the production and properties of directly and indirectly ionizing radiation and their interactions with matter. The course explores basic theoretical and experimental aspects of radiation dosimetry. Dosimetry is a fundamental principle upon which Medical Physics is based. A physicist operating in a clinical environment must possess a good knowledge and understanding of the principles of the interaction of radiation with matter and the mechanisms of dose transfer and deposit.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Classify radiation types.
2. Describe radiation interaction with matter.
3. Describe energy transfer and dose deposition.
4. Perform calculations relating to dose transfer and deposit.
5. Perform calculations related to concepts of radioactive decay.
6. Explain the detection and measurement of radiation.

Course Contents

- Module 1- Radiation Physics
  - Photon interactions
  - Neutron interactions

    - Charged particle interactions
    - Scattering theories
    - Stopping power
- Module 2 - Radiation Dosimetry
    - Quantities and units
    - Charged particle equilibrium
    - Cavity theory
    - Radiation Standards and Calibration
    - Radiation dosimeters

Assessment

• **Coursework:**		**50%**
○ Two In-course test (2 hours each)	40%	
○ Laboratory exercise	10%	
• **Final Exam**		**50%**
○ One three-hour written paper	50%	

MDPH6170 INFORMATION TECHNOLOGY AND EQUIPMENT IN RADIATION MEDICINE
(Core course) (2 Credits) (Year 1)

Prerequisite
NONE

Course Description
This is a theoretical course designed to introduce students to the application of Information technology (IT) for improving the efficiency of the day-to-day activities of modern radiation medicine facilities. The course outlines the use of equipment, information management systems, and the digital standards now commonplace in clinical practice. It is difficult to imagine the world of medicine without the utilization of information technology. IT contributes to all aspects of medicine from simple procedures such as the issuing of medication, to more complex clinical procedures such as cardiac transplants. Today modern radiation medicine facilities rely heavily on IT to improve the quality and efficiency of the services they provide. This new approach impacts largely on medical physicists and their role within the department. Physicists must therefore adapt and be ready to tackle the impending technology and the challenges they will present.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Explain the use electronic communication standards (e.g., Ethernet, FTP, DICOM, DICOM-RT, HL7) in medical information systems
2. Identify the types and applications of databases in Radiation Medicine
3. Apply knowledge of information systems to Radiation Medicine
4. Retrieve relevant information from DICOM Image headers
5. Utilize digital media for clinical use

Course Content

- Medical Informatics
- Hospital Information Systems
- Radiology Information Systems
- Picture archiving and communication Systems
- DICOM Standards

Assessment

- **Coursework:** **40%**
    - One In-course test (2 hour) 20%
    - One Technical Report 20%
- **Final Exam** **50%**
    - One three-hour written paper 50%

MDPH6180 BIOMEDICAL STATISTICS

(Core course) (2 Credits) (Level 1)

Prerequisite

NONE

Course Description

This course provides a starting point for medical physicists to statistics. It is designed to inform and stimulate more thought and investigation for determining the most appropriate statistical methods to use, and the theory and assumptions behind them. A core function of the medical physicist is research. As researchers, medical physicists work in a variety of areas relating to the application of physics to healthcare. Research areas include: Radiation applied to medicine, Physiological measurement, Medical applications of computers, and Developing imaging equipment and technologies. Medical statistics can contribute to good research by improving the design of studies as well as suggesting the optimum analysis of the results.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Apply basic biostatistics models and methods
2. Apply statistical distributions, hypothesis testing, correlations, predictive analysis and the significance tests of the results
3. Critique statistics presented in relation to results in published clinical research
4. Apply the appropriate statistical techniques to the different areas of medical physics
5. Critique the validity of conclusions and limitations of a study

Course Content

- Types of data and presentation.
- Frequency distribution and summary measures.
- Statistical investigations.
- Sampling distributions.
- Hypothesis testing.
- Analysis of variance.
- Curve fitting.
- Regression and correlation.
- Methods based on rank order.
- R introduction and usage.

Assessment

- **Coursework:** **40%**
  - One In-course test (2 hours) 40%
- **Final Exam** **50%**
  - One three-hour written paper 50%

MDPH6190 RADIATION BIOLOGY

(Core Course) (2 Credits) (Year 1)

Prerequisite

NONE

Course Description

The Radiation Biology course emphasizes the interaction of ionizing radiation with biological tissue. The course will introduce students to the concept of radiation and the classification of radiation types. The course explores tools used to model radiation interaction with tissue and the use of these models to predict the effects of ionizing radiation. Radiation Biology is an important framework for clinical radiation therapy as it provides the principle for implementation of new treatment strategies. Knowledge of Radiation Biology is a fundamental requirement for the medical physicist working in a clinical environment.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Discuss the basic connection between interactions of radiation with tissue.
2. Describe molecular interactions, through sub-cellular and cellular levels of organization; general aspects of DNA repair; biological effects of ionizing radiation.
3. Interpret the modelling of radiation interaction with human tissue and how these models are utilized in radiation medicine.
4. Discuss the importance of fractionation schemes to the process of radiotherapy.

Course Outline

- **Module 1 - Classification of Radiation in radiobiology**
  - Classification of radiation in radiobiology
  - Cell-cycle and cell death
  - Effect of cellular radiation, oxygen effect
  - Type of radiation damage (tissue, organ and whole body)
- **Module 2 - Effects of Radiation on Biological Tissue**
  - Cell survival curve
  - Dose-response curve
  - Early and late effects of radiation (deterministic, stochastic and teratogenic); effects on the developing embryo
- **Module 3 - Modelling in Radiobiology**
  - Modelling, linear quadratic (LQ) model, α/β ratio
  - Fractionation, 2 Gy per fraction equivalent total dose (EQD2Gy)
  - Dose rate effect
  - Tumour Control Probability (TCP), Normal Tissue Complication Probability
  - (NTCP), Equivalent Uniform Dose (EUD)

- **Module 4 - Evaluation of Biological Damage**
  - Tolerance doses and volumes, Quantitative Analysis of Normal Tissue Effects in the Clinic (QUANTEC)
  - Normal and tumour cell therapeutic ratio
  - Radio-sensitizers, protectors

Assessment

Coursework:		**40%**
One in-course tests (2 hours)	40%	
Final Exam:		**60%**
One Three-hour written paper	60%	

MDPH6210 RADIATION THERAPY 1: PHYSICS EQUIPMENT AND APPLICATIONS

(Core Course) (3 Credits) (Year 1)

Prerequisite

NONE

Course Description

This course explores the principles and practices of modern radiotherapy procedures. Students are introduced to the main equipment utilized in external beam radiation therapy and the fundamentals of treatment using photon and electron beams. Radiotherapy is one of the major treatment options in cancer management. In accordance with modern data and practices, 50% of patients should receive radiotherapy at least once during the treatment of their cancer. Together with surgery and chemotherapy radiotherapy plays an important role in the treatment of 40% of those patients who are cured of their cancer. Radiotherapy is also a highly effective treatment option for palliation and symptom control in cases of advanced or recurrent cancer. This is a core course for the qualification of clinical medical physicists.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Apply the clinical radiotherapy process and procedures
2. Describe the principles and functions of the main equipment used in radiotherapy
3. Discuss the purpose, advantages and challenges of a range of beam modifiers and treatment techniques in modern radiotherapy.

4. Discuss the purpose, advantages and challenges of a range of devices and methods used for patient and tumour localization.
5. Implement a range of external beam treatment techniques.
6. Apply methods of monitoring and controlling sources and levels of uncertainty in geometry and dose during patient treatment delivery.
7. Perform basic radiotherapy treatment planning and dose calculation.

Course Content

Overview of clinical radiotherapy and radiobiological basis

- Radiation therapy equipment
- Basic photon radiation therapy
- Basic electron radiation therapy
- Patient setup, including positioning and immobilization
- Simulation, virtual simulation, digitally reconstructed radiographs (DRRs)
- Dosimetric functions and basic treatment planning
- Dose calculation algorithms and heterogeneity corrections
- Prescribing, recording and reporting according to the ICRU Reports 50, 62 and 83

Assessment

Coursework:		**50%**
Two in-course tests (2 x 1 hour)	20%	
Three Practical Exercises	30%	
Final Exam:		**50%**
One Three-hour written paper	50%	

MDPH6215 DIAGNOSTIC RADIOLOGY PHYSICS, EQUIPMENT AND APPLICATIONS

(Core Course) (3 Credits) (Year 1)

Prerequisite

NONE

Course Description

This course is designed to provide exposure to the principles and instrumentation of radiology, and computed tomography medical imaging systems. Special attention is paid to the analysis of the relations between imaging system design, image quality, and safety. Measurement techniques for the evaluation of medical imaging systems are reviewed. Medical physicists plays an essential role in the radiology department. They ensure all measures are in place to yield quality diagnostic images with available imaging modalities and that the modalities are safe to use clinically. A good understanding of the principles of radiology is mandatory for physicists to fulfil clinical duties.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Describe the production of X-rays
2. Describe the various modalities used for diagnostic imaging
3. Differentiate between film-screen and digital images
4. Evaluate the quality of medical images 5. Evaluate the optimization of the imaging process and patient dose

Course Content

- **Module 1- X-ray production**
  - X-ray production
  - Energizing and controlling the X-ray tube
  - X-ray tube heating and cooling
  - X-ray image formation and contrast
  - Scattered radiation and contrast
- **Module 2 - X-ray detectors**
  - Radiographic receptors
  - The photographic process and film sensitivity
  - Film contrast characteristics
- **Module 3 - Image Characteristics**
  - Radiographic density control
  - Blur, resolution, and visibility of detail
  - Image noise
- **Module 4 - Modern Diagnostic Techniques and Equipment**
  - Digital imaging systems and image processing
  - Fluoroscopic imaging systems
  - Computed tomography image formation and quality
  - Mammography
  - Digital subtraction angiography (DSA)
  - Dual-energy-X-ray absorptiometry (DEXA)

Assessment

- **Coursework:** **50%**
  - Two in-course tests (2 x 1 Hour) 30%
  - Two Practical Exercises 20%
- **Final Exam:** **50%**
  - One Three-hour written paper 50%

MDPH6230 NUCLEAR MEDICINE: PHYSICS, EQUIPMENT AND APPLICATIONS

(Core Course) (3 Credits) (Year 1)

Prerequisite

NONE

Course Description

The aim of the course is to discuss basic physics in radionuclide imaging and the principle of tracers in nuclear medicine

Learning Outcomes

The objectives are to recall and differentiate between the ideal characteristics of various radionuclides for diagnosis and for therapy. To discuss the common uses and limitations of the nuclear medicine modalities: rectilinear scanners, gamma cameras, positron emission tomography (PET) systems, single photon emission computed tomography (SPECT) systems, and newer technology systems such as PET/CT systems, Technetium generator and radiopharmaceuticals.

Course Contents

- The Gamma Camera
- Radionuclide image quality
- Radionuclide tomographic imaging: Positron Emission Tomography (PET), PET-CT, Single Photon Emission Computed Tomography (SPECT)
- Statistics: counting error
- Patient exposure and protection
- Personnel exposure and protection
- Radiation measurement
- Principles of radiochemistry, radio-immunoimaging, and the radio-pharmacy
- Quality Control issues in nuclear medicine.

Assessment

- **Coursework: 100%**
    - Two in-course tests (2 x 1 hour) 50%
    - One Two hour Written Paper 30%
    - Practical 20%

MDPH6240 NON-IONIZATION RADIATION: PHYSICS, EQUIPMENT AND APPLICATIONS

(Core Course) (3 Credits) (Year 1)

Prerequisite

NONE

Course Description

The aim of the module is to present to the students the theoretical and practical basis of non-ionisation radiation: principles, instrumentations and their medical applications for diagnostic and therapy.

Learning Outcomes

On successful completion of the course, students should be able to: In part A, students should demonstrate an understanding of the principles of magnetic resonance imaging (MRI) physics. The emphasis is not on the more advanced MRI techniques, but on the development of a solid understanding and application of the basics of image formation and spatial accuracy, image contrast clinical applications, and safety. In part B students should demonstrate an understanding of the principles of Ultrasound (US) imaging. Emphasis is on the application of the principles of acoustic physics, interaction of ultrasound with tissue, ultrasound transducers and arrays, and ultrasound imaging and Doppler instrumentation. Students in Part C should exhibit an understanding of basic laser biophysics and laser-tissue interaction. They should be able to explain how lasers work, and differentiate between the characteristics of lasers. They should be able to evaluate and apply the pertinent energy, optical and fiber concepts that are applicable to medical laser use. Discuss concepts of risk, including the evaluation of radiation risks, risk-benefit analysis, and index of harm. Apply methods to minimize dose to sites of risk such as the fetus, lenses and gonads.

Course Content

- **Magnetic Resonance Imaging**
    - Basic principles
    - Hardware
    - Basic image quality issues
    - Basic pulse sequences
    - Artifacts and methods for artifact rejection/reduction
    - Safety and bioeffects
    - Quality Control
- **Ultrasound Imaging**
    - Ultrasound plane waves

  - Propagation of sound waves through tissue
  - Single element transducers
  - Transducer arrays
  - Pulse Echo equipment signal processing
  - B-Mode imaging
  - Continuous wave and pulsed Doppler
  - Flow imaging with ultrasound
- **Medical Applications of Lasers**
  - Laser biophysics: spontaneous and stimulated emission, unique laser characteristics, Energy and pulsing concepts.
  - Laser /Tissue interactions
  - Clinical laser applications
  - Laser safety

Assessment

- One Two-hour Written Paper **70%**
- Three in-course tests (3x1 hour) **30%**

MDPH6270 RADIATION THERAPY 2: PHYSICS EQUIPMENT AND APPLICATIONS

(Core Course) (3 Credits) (Year 1)

Prerequisite

NONE

Course Description

This course investigates the principles and practices of modern radiotherapy procedures. Students are introduced to advanced techniques in external beam radiation therapy, brachytherapy and the fundamentals of quality assurance in a radiation oncology facility. The advancements in radiotherapy technologies have resulted in variety of complex treatment options that offers unique benefits to patients of varying caner types. The medical physicist must have a good understanding of these treatment options to complement the multidisciplinary oncology teams. This is a core course for the qualification of clinical medical physicists.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Apply the principles and competencies required in brachytherapy.
2. Implement concepts of advanced radiotherapy treatment planning and dose calculation.

3. Explain the use of ionization chambers for relative and absolute determination of absorbed dose to water in radiotherapy beams.
4. Assess factors influencing a dose measurement.
5. Apply concept and principles of an acceptance testing and commissioning programme.
6. Implement a quality assurance programme

Course Contents

- Image guidance and verification in radiotherapy
- Image registration
- Brachytherapy including the ICRU Report 38 and the AAPM TG 43 formalism
- Inverse Planning and optimization for intensity modulated radiation therapy (IMRT)
- Ultrasound (US), portal imaging, in-vivo dosimetry (IVD)
- Principles of quality management in radiation oncology

Assessment

- **Coursework:** **50%**
  - Two in-course tests (2 x 1 hour) 20%
  - Three Practical Exercises 30%
- **Final Exam:** **50%**
  - One Three-hour written paper 50%

MDPH6280 RADIATION SAFETY AND PROTECTION

(Core Course) (3 Credits) (Year 1)

Prerequisite

NONE

Course Description

This course discusses the principles of radiation safety and explores the application of these principles for the protection of patients, staff and the general public. The content includes national and international regulatory frameworks, shielding calculations and occupational monitoring for workers exposed to radiation. The risks of excess radiation exposure are significant, potentially leading to a variety of health issues, from cataracts and hair loss to birth defects and the development of cancers. Knowledge and application of the best radiation safety practices, therefore, is beneficial both for patients and healthcare workers. Knowledge of radiation Safety and Protection is a core requirement for medical physicists.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Evaluate the application of current laws, regulations and recommendations as applied locally.
2. Describe the local organization of radiation protection: responsibilities, process of authorization, and protection standards.
3. Implement the principles for effective protection from radiation using time and shielding.
4. Perform shielding calculations for radiology and oncology facilities.
5. Discuss concepts of risk, including the evaluation of radiation risks, risk-benefit analysis, and index of harm.
6. Apply methods to minimize dose to sites of risk such as the fetus, lenses and gonads.

Course Content

- Introduction, historical perspective and sources of radiation
- Radiation protection detection and measurement (Geiger-Mueller counters, proportional counters, scintillators, TLDs, ionization chambers, neutron detectors)
- Exponential attenuation, half-value layer (HVL), inverse square law, tenth value layer (TVL)
- Operational dosimetry, e.g., equivalent dose, effective dose, etc.
- Legal framework for radiation protection
- As low as reasonably achievable (ALARA) concept
- Occupational, public exposure and annual limits
- Shielding calculations
- Radioactive transport and waste management
- Risk assessment and communication of risk
- Emergency procedures

Assessment

- **Coursework:** **50%**
    - One in-course tests (2 hours) 20%
    - Two Practical Exercises 20%
    - One Technical Report 10%
- **Final Exam:** **50%**
    - One Three- hour written paper 50%

YEAR 2: CLINICAL RADIOTHEAPY

MDPH6410 RADIATION SAFETY AND PROTECTION IN RADIOTHERAPY
(Clinical Radiotherapy) (2 Credits) (Year 2)

Prerequisite
MDPH6280

Course Description
Clinical Training course designed primarily for health physicists, medical physicists and other radiation protection professionals to facilitate the design and management of radiation protection programmes for radiotherapy facilities. The course is designed to equip the student with the necessary skills to recommend safety actions, train hospital staff, to plan and design new radiotherapy facilities and to remodel existing facilities. Radiation safety is a concern for patients, physicians, and staff in radiotherapy departments. Appropriate knowledge and practice of radiation protection helps to reduce unnecessary exposure with a goal to minimize the harmful effects of ionizing radiation.

Learning Outcomes
On successful completion of the course, students should be able to:
1. Design a local radiation protection management
2. Apply local protection regulations and publications
3. Handle radiation sources used in Radiation Oncology
4. Implement protection measures for radiation treatment rooms for external beam therapy and brachytherapy
5. Organize provisions required for protection against medical exposure, occupational and public exposure
6. Carry out emergency procedures
7. Train other staff members on safe handling and use of radiation sources and generators

Course Content
- International and national regulatory frameworks
- Occupational and public exposure in radiotherapy
- Design of a facility
- Shielding calculations for all radiation bunkers
- Special procedures
- Emergency procedures
- Radiation Safety in Brachytherapy
- Radiation Protection Programmes

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluation **60%**

MDPH6420 IMAGING EQUIPMENT IN RADIOTHERAPY
(Clinical Radiotherapy) (1 Credits) (Year 2)

Prerequisite
MDPH6215, MDPH6260, MDPH6240

Course Description
Clinical Training course designed to introduce the student to the practical use and integration of the main imaging equipment found in typical radiation oncology departments. Students will be actively involved in the use of CT simulators and fluoroscopic x-ray equipment for the acquisition of patient images in radiotherapy. The advancement of medical imaging has been critical to the development of radiotherapy. Computed tomography (CT) is pivotal in treatment planning and remains the primary three-dimensional imaging modality used for dose calculation. Newer image modalities, such as magnetic resonance (MR) imaging and positron emission tomography (PET), are also used secondarily in the treatment-planning process. They supplement the CT ability to visualize and characterize tumors. Clinical medical physicists must become familiar with imaging equipment to optimize their use, and to advise on acquisition as part of a multidisciplinary team.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Use CT-Simulators to acquire images in radiotherapy
2. Explain the requirements for a CT simulator to be used for radiotherapy
3. Use Fluoroscopic x-ray equipment to acquire images in brachytherapy
4. Explain the requirements for Fluoroscopic x-ray equipment to be used for imaging in brachytherapy

Course Content

- Fluoroscopic simulator
- Ultrasound
- Computed Tomography (CT)
- Film processors
- Computed Radiography,
- Digital Radiography

Assessment

- One Written Report (2000 words) **20%**
- Clinical Evaluation **80%**

MDPH6430 RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY
(Clinical Radiotherapy) (4 Credits) (Year 2)

Prerequisite
MDPH6135, MDPH6260, MDPH6270

Course Description
Clinical Training course designed to expose students to best practices in radiation dosimetry using modern equipment and techniques. Students will be actively involved in the calibration and dosimetry of treatment beams using equipment such as ionization chambers and water phantoms. Students will be exposed to commonly used relative dosimeters such as TLDs and Film. Quantification of dose has been an important factor in the development of modern radiotherapy. Physically based treatment planning, using metrics such as radiation dose, is successful because these metrics are measurable, and thus the treatment plan is directly verifiable by good dosimetry. To achieve a good clinical outcome a certain accuracy in the dose delivered to patients is required. Medical physicists are tasked with routine dosimetry of radiotherapy systems to guarantee the quality of the services provided.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Use ionization chambers to perform absolute determination of absorbed dose to water under reference conditions for radiotherapy beams following a standard dosimetry protocol.
2. Use a range of dosimetry systems and phantom materials for the measurement of relative dose and dose distributions of radiotherapy beams.
3. Perform dose verification procedures.
4. Perform dosimetric checks for individual patients, patient groups, standard treatment techniques, and special or new treatment techniques.
5. Implement recommendations for quality assurance of dosimetry equipment in a radiotherapy department.

Course Content

- Dosimetry Operations using Ionization Chambers
- Dosimetry Operations using Other Methods
- Absolute Absorbed Dose Measurements
- Relative Dose Measurements
- Patient Dose Verification
- In-vivo Dosimetry
- QA in Dosimetry

Assessment

• One Written Report (2000 words)	**30%**
• Clinical Evaluation	**70%**

MDPH6440 QUALITY MANAGEMENT IN RADIOTHERAPY
(Clinical Radiotherapy) (2 Credits) (Year 2)

Prerequisite
MDPH6240, MDPH6260, MDPH6270

Course Description
Clinical Training course designed to increase the capacity of the student to effectively manage the quality of the radiotherapy process. Students will be actively involved in the quality management programme for radiotherapy to include: Equipment management, Quality control checks of all equipment, and Acceptance testing and Commissioning where possible. Each step of the process of radiation treatment involves significant potential for errors and uncertainties. Such errors lead to actual exposures which are different from those prescribed. Effective quality management programs help to reduce the occurrence of these errors and increase confidence in the radiotherapy process. The quality management process in radiotherapy is a primary responsibility of the medical physicist.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Manage: Equipment, Projects, and Staff, including liaising with other professional groups.
2. Design a quality management programme.
3. Perform quality control checks for orthovoltage and megavoltage therapy units and treatment simulators.

4. Design the physical aspects of a QA programme for treatment planning.
5. Design the physical aspects of a QA programme for brachytherapy equipment and Sources
6. *Perform and design acceptance testing procedures for orthovoltage and megavoltage therapy units and simulators.
7. *Perform commissioning procedures for orthovoltage and megavoltage therapy units and treatment simulators.
8. *Perform and design acceptance testing procedures in brachytherapy.
9. *Perform commissioning procedures of brachytherapy equipment and services.

* where conditions allow

Course Content

- Institutional policies and procedures
- Quality Management Systems
- Quality Management for the Implementation of New Equipment
- Performing and documenting QC
- Quality Assurance in Brachytherapy

Assessment

- One Written Report (2000 words) **20%**
- Clinical Evaluation **80%**

MDPH6450 EXTERNAL BEAM RADIOTHERAPY
(Clinical Radiotherapy) (4 Credits) (Year 2)

Prerequisite
MDPH6260, MDPH6270

Course Description
Clinical training course designed to expose the student to the most common modalities utilized in modern external beam radiotherapy. Students will be actively involved in patient immobilization, positioning and image acquisition. Students will also engage in treatment planning and treatment delivery. In clinical radiotherapy it is important to know the dose received by a patient irradiated by one or more beams. To find the best solution for a clinical problem, physicists must possess the requisite skills to calculate in an object representative of the patient the absolute and the distribution of the absorbed dose due to irradiation. The use of modern treatment planning systems to estimate the dose delivered to

a target for both simple and advanced treatment techniques is now commonplace in radiotherapy. The ability to use such systems is a primary expectation of the medical physicist.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Use the equipment employed in Radiation Oncology for treatment.
2. Perform a range of external beam treatment techniques.
3. Develop operational procedures for external beam equipment.
4. Monitor and control sources of uncertainty in geometry and dose during patient treatment delivery.
5. Acquire patient data for treatment planning.

Course Content

- Acquisition of patient anatomical information
- Positioning, Immobilization and patient mark up
- 1D cases: direct set up, simulation, manual and computerized planning
- Computerized Treatment Planning (TP)
- Contours (manual or single slice) and hand planning
- Establishing margins for PTV definition
- 2D - 3D treatment planning cases (with beam modification devices)
- Treatment delivery

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluation **60%**

MDPH6460 BRACHYTHERAPY

(Clinical Radiotherapy) (2 Credits) (Year 2)

Prerequisite

MDPH6270

Course Description

Training course designed to expose the resident to the most common techniques utilized in modern brachytherapy. Students will be actively involved in the preparation and calibration of brachytherapy sources, and the image acquisition and treatment planning of patients undergoing brachytherapy. Brachytherapy

(BT) has long been among the treatment options, for cancer patients especially with regard to local boost applications. In terms of the effectiveness of treatment, studies have shown that brachytherapy is comparable to external beam radiotherapy and surgery when treating many types of cancer, while patients generally experience fewer side effects after brachytherapy compared with other treatment options. The medical physicist should possess good practical knowledge of brachytherapy to perform the required day to day functions.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Perform the calibration of brachytherapy sources.
2. Acquire patient images and source data for brachytherapy treatment planning.
3. Perform brachytherapy treatment planning and dose calculation.
4. Carry out quality control checks of sealed radiation sources for brachytherapy

Course Content

- Calibration of Brachytherapy sources
- Source preparation
- Image and source data for treatment planning
- Treatment Planning

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluation **60%**

MDPH6470 EQUIPMENT SPECIFICATION AND ACQUISITION IN RADIOTHERAPY

(Clinical Radiotherapy) (1 Credits) (Year 2)

Prerequisite

NONE

Course Description

Course designed to expose the student to the requirements for adequately equipping a radiotherapy department based on the treatment needs. Students will be actively involved in the quality management and maintenance of radiotherapy equipment. The medical physicist plays an integral role in the procurement and maintenance of the equipment used in radiotherapy. The physicist is typically responsible for the quality assurance of the equipment found in the department and is charged with the design and implementation of equipment maintenance programmes. Appropriate knowledge is necessary to provide suitable advice.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Prepare specifications and advice for the acquisition of new equipment in association with other professional and technical staff.
2. Develop quality management programmes required for the clinical implementation of new equipment.
3. Develop life cycle management plans new and existing equipment.
4. Apply knowledge of personal computers (PC), interfacing, networking, data storage, and information systems to the use of equipment in a radiotherapy department.
5. Communicate effectively with service engineers for the maintenance of radiotherapy equipment.

Course Content

- Specification and Acquisition of New Equipment
- Procurement of a treatment planning computer
- Procurement of Brachytherapy equipment
- Information Technology

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluations **60%**

MDPH6480 CLINICAL ENVIRONMENT AND OPTIMIZATION IN RADIOTHERAPY

(Clinical Radiotherapy) (2 Credits) (Year 2)

Prerequisite

NONE

Course Description

This course is designed to help the student consolidate the yearlong clinical experience and optimize the procedures generally employed in radiotherapy.

The course will consolidate the roles and responsibilities of the medical physicist along the patient treatment pathway and explore tools and techniques for optimization at each step. Medical physicists are involved in every step of the radiotherapy process from the imaging of the patient to the delivery of the treatment. It is important for the physicist to have a broad understanding of each aspect of the treatment process, and to be able to optimize routine procedures leading to more efficient management of patient loads and better clinical outcomes.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Explain each step of the patient treatment pathway in Radiotherapy
2. Explain the role of each multidisciplinary professional in Radiation therapy.
3. Assess radiation risk to the patients
4. Assess the main factors that affect treatment quality and patient radiation dose
5. Use clinical audits as a tool to optimize the overall quality of processes and services

Course Content

- Workflow of a radiotherapy department
- Patient related clinical experiences
- Optimization of Procedures
- Clinical audits

Assessment

- Written Report (2000 words) **50%**
- Presentations **50%**

MDPH6290 PROFESSIONAL ETHICS

(Clinical Radiotherapy) (1 Credits) (Year 2)

Prerequisite

NONE

Course Description

Course designed to outline the ethical responsibilities of professionals operating within a healthcare facility. The course includes principles of ethical conduct to help medical physicists perform their duties and conduct themselves in a professional way, and guidelines to help medical physicists interpret and implement the principles. As part of the multidisciplinary healthcare teams, medical physicists have ethical obligations towards themselves, fellow colleagues and patients as they perform professional, educational and research related activities. A good understanding of the fundamental ethical principles, and the implementation guidelines is necessary.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Communicate effectively within a multidisciplinary team, with patients and the general public.
2. Discuss the principles of professional conduct.
3. Participate effectively in activities related to professional awareness.

Course Content

- Effective communication in healthcare
- Principles of professional conduct in healthcare
- Guidelines for professional conduct in healthcare

Assessment

Written Report (2000 words)	**50%**
Presentations	**50%**

MDPH6610 MEDICAL PHYSICS CLINICAL RESEARCH PROJECT
(Clinical Radiotherapy) (4 Credits) (Year 2)

Prerequisite
Year 1 courses MSc. Clinical Medical Physics

Course Description
This research project is an individual, but guided research study in Medical Physics with graduate faculty supervision. Written and oral presentations of a research study are required. In many respects the individual research project is the culmination of the students' learning experience during the degree programme. The dissertation offers an opportunity to study in depth a problem or issue which is of personal interest, and which can be explored using the knowledge acquired during the clinical training.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Formulate a research question, hypothesis or statement of purpose
2. Conduct a literature review and synthesis
3. Apply detailed methodology for conducting the study
4. Apply data collection and analysis strategies
5. Interpret findings
6. Present research findings

Course Content

- Identification and development of research topics.
- Critical assessment and summaries of literature.
- Development of effective research methodology
- Data collection and analysis
- Writing technical reports
- Presentation of results

Assessment

- Coursework and controlled assessment **20%**
- Written Report **70%**
- Oral Presentation **10%**

MDPH6620 SEMINAR

(Clinical Radiotherapy) (1 Credits) (Year 2)

Prerequisite

Level I, II, III MSc. Clinical Medical Physics

Course Description

This seminar course is designed for students to provide updates on the progress of their research project. All students enrolled in this course are required to give presentations during the graduate seminar courses. Attendance at each seminar is mandatory for all students enrolled. The graduate seminar course will integrate lectures, class discussions, assigned readings, case study analysis, oral and written presentations to help the students complete the research project.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Identify areas of need and design targeted research projects around them.

2. Concisely present research methodologies and findings in project reports.
3. Participate in intellectual discourse in matters relating to clinical medical physics

Course Content

- Seminar presentations.
- This course uses synchronous and asynchronous technology for delivery over a 6-week period of the semester. Teaching methods may include the following:
    - Presentations and
    - Discussions on the preparation and progress of research projects.

Assessment

• Discussions	**20%**
• Presentations	**80%**

YEAR 2 – CLINICAL DIAGNOSTIC RADIOLOGY AND NUCLEAR MEDICINE

MDPH6510 RADIATION SAFETY AND PROTECTION IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

(Clinical Diagnostic Radiology and Nuclear Medicine) (2 Credits) (Year 2)

Prerequisite

MDPH6280

Course Description

This Clinical Training course is designed primarily for health physicists, medical physicists and other radiation protection professionals to facilitate the design and management of radiation protection programmes for radiology facilities. The course is designed to equip the student with the necessary skillset to recommend safety actions, train hospital staff, to plan and design new radiology facilities and to remodel existing ones. Radiation safety is a concern for patients, physicians, and staff in radiology departments. Appropriate knowledge and practice of radiation protection helps to reduce unnecessary radiation exposure with a goal to minimize the harmful effects of ionizing radiation.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Implement a personnel dosimetry service at a local level.
2. Perform a hazard assessment of procedures and facilities for staff and members of the public.
3. Apply dose reduction techniques for radiology staff, other employees and members of the public.
4. Implement a response to an unintended or accidental exposure occurring in a radiology department affecting staff, patients or members of the public.
5. Identify shielding for an x ray facility using diagnostic x ray imaging systems for energies between 15 and 150 kVp. Facilities include hospitals, clinics, mobile systems, and dental installations.
6. Perform assessments of MRI radiation safety.
7. Investigate accidents and incidents involving MRI

Course Content

- Design of a facility
- Radiation hazard assessment
- Personnel dosimetry
- Unintended and accidental exposure in diagnostic radiology
- Safety in MRI imaging

Assessment

- One Written Report **40%**
- Clinical Evaluations **60%**

MDPH6515 DOSIMETRY, INSTRUMENTATION AND CALIBRATION IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

(Clinical Diagnostic Radiology and Nuclear Medicine) (2 Credits) (Year 2)

Prerequisite

MDPH6215

Course Description

This Clinical Training course is designed to guide students through best practices in dosimetry using modern equipment and techniques. Students will be actively involved in the calibration and dosimetry of diagnostic radiology using equipment such as ionization chambers. Students will be exposed to commonly used relative dosimeters such as TLDs and Film. Accurate dosimetry is required to optimize image quality and guarantee the safety of patients and practitioners.

The optimization of dose while retaining good image quality is an important component to the clinical experience for medical physicists.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Apply diagnostic radiology dosimetry for ionizing radiation, including the use of dosimetric phantoms.
2. Apply the principles and safety of non-ionizing radiation as used in diagnostic radiology.
3. Operate radiological test equipment.
4. Apply principles needed to maintain traceability of equipment calibration and the skills to perform necessary calibrations.

Course Content

- Ionizing radiation dosimetry and principles of measurement
- Non-ionizing radiation quantities and principles of measurement
- Radiological test equipment, measurement, and practice
- Dosimetry system calibration

Assessment

- One Written Report **40%**
- Clinical Evaluations **60%**

MDPH6520 PERFORMANCE TESTING OF IMAGING EQUIPMENT IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

(Clinical Diagnostic Radiology and Nuclear Medicine) (2 Credits) (Year 2)

Prerequisite

MDPH6210

Course Description

This Clinical Training course is designed to introduce the resident to the practical use and evaluation of the main imaging equipment found in typical radiology departments. Students will be actively involved in the use and performance evaluation of CT, X-ray and fluoroscopic x-ray equipment used for the acquisition of patient images. Medical physicists are required to undertake testing, use and optimization of all the imaging devices found in a radiology department.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Perform QC tests on photographic processors and associated darkroom equipment.
2. Perform acceptance and QC tests on display and printing devices.
3. Perform acceptance and QC tests on plain film and digital systems.
4. Perform acceptance and QC tests on general radiographic equipment, conventional and digital fluoroscopic equipment, CT scanners and mammography systems.
5. Perform acceptance and QC tests on dental radiographic imaging equipment Proposal for the
6. Perform acceptance and QC tests on Magnetic resonance imaging (MRI) equipment.
7. Perform acceptance and QC tests on ultrasound scanners.

Course Content

- Screen-film systems
- Film processing and darkroom
- General radiography
- Conventional and digital fluoroscopy
- Computed radiography and digital radiography
- Automatic Exposure control devices
- Mammography
- Computed tomography
- Magnetic resonance imaging
- Ultrasound
- Dental radiography
- Display and printing devices and viewing condition

Assessment

- Two Written Report **30%**
- Clinical Evaluations **70%**

MDPH6525 TECHNOLOGY MANAGEMENT IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite

MDPH6215

Course Description

This Clinical Training course is designed to increase the capacity of the student to effectively manage the technology found in diagnostic and interventional radiology. Students will be actively involved in the quality management and maintenance of radiology equipment. Adequate management of the technology found within a radiology department is critical to the optimization of the services provided. The physicist is typically responsible for the quality assurance of the equipment.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Discuss principal requirements and elements for a quality management system in diagnostic radiology.
2. Implement the management of all diagnostic imaging equipment.
3. Implement acceptance and commission of diagnostic imaging equipment.
4. Implement management of all the aspects of a routine radiological quality control programme.
5. Implement basic imaging informatics in digital imaging environments.

Course Content

- Quality management of systems in radiology
- Acceptance Testing and Commissioning of radiology equipment
- Routine testing and Quality control of radiology equipment
- Imaging informatics

Assessment

- One Written Report **40%**
- Clinical Evaluations **60%**

MDPH6530 IMAGE QUALITY ASSESSMENT IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite

MDPH6215

Course Description

This Clinical Training course is designed to expose the student to the best practices for image assessment in diagnostic radiology departments. Students will be actively involved in the assessment of image quality for a range of modalities of digital and film screen systems. Medical physicists must be able to judge the fidelity of the image in an attempt to answer the question "How accurately does the image portray the body or the bodily function?" This judgement falls under the rubric of 'image quality'.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Apply the theory of image quality assessment through the use of objective (physical or parametric) tests.
2. Perform image quality evaluation using non-clinical, phantom images.
3. Perform image quality evaluation in the clinical setting.

Course Content

- Assessment of image quality through objective tests
- Assessment of image quality with phantoms
- Assessment of image quality of clinical patient images

Assessment

- One Written Report (2000 words) **20%**
- Clinical Evaluations **80%**

MDPH6535 PATIENT DOSE AUDITS IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite

MDPH6280

Course Description

This Clinical Training course is designed to expose the students to systematic methods for reviewing medical radiological procedures. Students will be actively involved in the dose audits for adults, children and pregnant women. Clinical dose audits are integral parts of the overall quality improvement process and should be considered as an integral part of quality management and clinical governance. The physicist is required to estimate patient doses when necessary.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Assess patient doses from x ray procedures, and to perform patient dose surveys and compare with DRLs and other relevant data.
2. Perform patient dose audits in paediatric radiology.
3. Estimate the approximate dose to the conceptus/foetus from a

diagnostic x-ray examination.

4. Determination of risk to the conceptus/foetus from a diagnostic x-ray examination.

Course Content

- Dose audits
- Paediatric dosimetry
- Fetal dose

Assessment

- One Written Report (2000 words) **20%**
- Clinical Evaluations **80%**

MDPH6540 RADIATION SAFETY AND PROTECTION IN NUCLEAR MEDICINE

(Clinical Diagnostic Radiology and Nuclear Medicine) (2 Credits) (Year 2)

Prerequisite

MDPH6280

Course Description

This Clinical Training course is designed primarily for health physicists, medical physicists and other radiation protection professionals to facilitate the design and management of radiation protection programmes for nuclear medicine facilities. The course is designed to equip the resident with the necessary skillset to recommend safety actions, train hospital staff, to plan and design new nuclear medicine facilities and to remodel existing ones. Radiation safety is a concern for patients, physicians, and staff in nuclear medicine departments. Appropriate knowledge and practice of radiation protection helps to reduce unnecessary radiation exposure with a goal to minimize the harmful effects of ionizing radiation.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Implement the reduction measures in relation to exposure from unsealed sources and how to handle spills and accidents
2. Apply ALARA and radiation protection regulations in nuclear medicine clinical practice
3. Apply radiation protection regulations in nuclear medicine clinical practice
4. Implement the general design requirements of the department

5. Implement facility design for radiation protection
6. Execute all aspects of regulatory compliance

Course Content

- Design of a facility
- Exposure from unsealed Sources and the Risk of Contamination
- Radiation hazard assessment
- Personnel dosimetry
- Unintended and accidental exposure in nuclear medicine

Assessment

• One Written Report (2000 words)	**40%**
• Clinical Evaluations	**60%**

MDPH6545 TECHNOLOGY MANAGEMENT IN NUCLEAR MEDICINE
(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite
MDPH6230

Course Description
This is a Clinical Training course designed to increase the capacity of the physicist to effectively manage the technology found in nuclear medicine. Students will be actively involved in the quality management and maintenance of nuclear medicine equipment. Adequate management of the technology found within a nuclear medicine department is critical to the optimization of the services provided. The physicist is typically responsible for the quality assurance of the equipment.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Explain principal requirements and elements for a quality management system in nuclear medicine.
2. Implement the concepts and principles of acceptance and commissioning of equipment.
3. Execute methods for the clinical implementation and supervision of a quality control programme.
4. Apply basic imaging informatics in digital imaging environments.

Course Content

- Quality management of systems in nuclear medicine

- Acceptance Testing / Commissioning
- Routine testing / Quality control
- Imaging informatics

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluations **60%**

MDPH6550 RADIOACTIVITY MEASUREMENT AND INTERNAL DOSIMETRY IN NUCLEAR MEDICINE

(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite

MDPH6230

Course Description

This course is designed to help the student carry out dosimetric activities for radiopharmaceuticals and to calculate the energy deposited in the organs following administration of a radiopharmaceutical. The patient organ dose assessment is not a trivial problem, and is influenced by multiple factors. Detailed knowledge of dose estimation is a critical requirement of physicists working in Nuclear Medicine.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Perform quality assurance principles for radioactivity measurement in nuclear medicine.
2. Apply established formalisms for internal dosimetry calculations.
3. Use look-up tables for estimating absorbed and effective dose from diagnostic nuclear medicine procedures.
4. Derive quantitative information from nuclear medicine images.
5. Appraise when patient-specific dosimetry is required and how to perform it.

Course Content

- Use of Traceable Standards for Radioactivity Measurements
- Formalism and Application of Internal Dosimetry
- Quantitative Nuclear Medicine Imaging
- Patient-specific dosimetry

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluations **60%**

MDPH6555 PERFORMANCE TESTING OF NUCLEAR MEDICINE EQUIPMENT
(Clinical Diagnostic Radiology and Nuclear Medicine) (2 Credits) (Year 2)

Prerequisite
MDPH6230

Course Description
This is a Clinical Training course designed to introduce the resident to the practical use and evaluation of the main imaging equipment found in typical nuclear medicine departments. Students will be actively involved in the use and performance evaluation of SPECT-CT. Medical physicists are required to undertake testing, use and optimization of all the imaging devices found in a nuclear medicine department.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Manage all aspects of a routine nuclear medicine quality control programme.
2. Perform all dose calibrator quality control procedures needed to ensure accurate measurements of radioactivity.
3. Perform quality control procedures for the scintillation probe and well counter.
4. Perform SPECT QC procedures.
5. Appraise factors affecting image quality on display monitors and hard copy devices.

Course Content

- Dose calibrators
- Scintillation probes and well counters
- Gamma camera and SPECT
- Display and printing devices, Viewing conditions

Assessment

- Two Written Report (2000 words) **40%**
- Clinical Evaluations **60%**

MDPH6560 PREPARATION AND QUALITY CONTROL OF RADIOPHARMACEUTICALS

(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite
MDPH6230

Course Description
This is a Clinical training course designed to expose the student to principles and techniques of radiopharmaceutical preparation and the associated quality control procedures. Radiopharmaceuticals are critical to the nuclear imaging process. Adequate knowledge of the production of these products as well as the steps required to ensure their quality is an important characteristic for the physicist working in a nuclear medicine department.

Learning Outcomes
On successful completion of the course, students should be able to:

1. Implement the principles of radiopharmaceutical production and preparation for clinical nuclear medicine imaging.
2. Implement the quality control in the radiopharmaceuticals

Course Content

- Use of Traceable Standards for Radioactivity Measurements
- Formalism and Application of Internal Dosimetry
- Quantitative Nuclear Medicine Imaging
- Patient-specific dosimetry

Assessment

• One Written Report (2000 words)	**20%**
• Clinical Evaluations	**80%**

MDPH6565 RADIONUCLIDE THERAPY USING UNSEALED SOURCES

(Clinical Diagnostic Radiology and Nuclear Medicine) (1 Credits) (Year 2)

Prerequisite
MDPH6230

Course Description

This Clinical Training course is designed to expose the student to principles and practices of Radionuclide therapy. Students will be actively involved in the planning and delivery of nuclear procedures for therapeutic purposes. Radionuclide therapy is a rapidly expanding cancer treatment modality, both in terms of the number and range of procedures given. The role of the physicist in radionuclide therapy encompasses radiation protection, imaging and dosimetry.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Implement the principles of radionuclide therapy
2. Implement facility design for therapy using unsealed sources
3. Apply treatment protocols with an appreciation of the rationale of the therapy
4. Implement fundamental principles of individual radiopharmaceutical treatment
5. Estimate radiation absorbed doses for therapy procedures involving radionuclide
6. Perform an audit on radiation safety of unsealed radionuclide sources used in therapy

Course Content

- Treatment Procedures using radionuclides
- Selection of Radiopharmaceuticals for Nuclear Medicine Therapy
- Dosimetry for radionuclide therapeutic procedures
- Radiation safety precautions for therapy using unsealed radionuclide source

Assessment

- One Written Report (2000 words) **40%**
- Clinical Evaluations **80%**

MDPH6580 CLINICAL ENVIRONMENT AND OPTIMIZATION IN NUCLEAR DIAGNOSTICS

(Clinical Diagnostic Radiology and Nuclear Medicine) (2 Credits) (Year 2)

Prerequisite

NONE

Course Description

This course is designed to help the student consolidate the yearlong clinical experience and optimize the procedures generally employed in Nuclear Medicine and diagnostics. The course will consolidate the roles and responsibilities of the medical physicist along the diagnostic and treatment pathways and explore tools and techniques for optimization at each step. It is important for the physicist to have a broad understanding of each aspect of the imaging and treatment processes in Diagnostic Radiology and Nuclear Medicine. Optimization results in more efficient management of patient loads and better clinical outcomes. Routine optimization of diagnostic and treatment procedures is a crucial part of managing a Nuclear Medicine department.

Learning Outcomes

On successful completion of the course, students should be able to:

1. Explain each step of the patient treatment pathway in a Nuclear Medicine or Diagnostic facility
2. Explain the role of each multidisciplinary professional in a Nuclear Medicine or Diagnostic facility
3. Assess radiation risk to the patients
4. Assess the main factors that affect image quality and patient radiation dose
5. Use clinical audits as a tool to optimize the overall quality of processes and services

Course Content

- Workflow of a diagnostic medicine department
- Clinical activities and factors that affect patient care
- Optimization of Procedures
- Clinical audits
-

Assessment

- One Written Report (2000 words) **50%**
- Presentations **50%**

MASTER OF SCIENCE: MEDICAL PHYSICS

PROGRAMME OVERVIEW

Technological advances and developments in physics and medicine, particularly in radiology, radiotherapy and nuclear medical physics have created a demand for Qualified Medical Physicists to support the current progress in the healthcare sector. Healthcare providers rely heavily on continued education and training of medical physicists in order to achieve and maintain international health standards.

Programme Objectives

The MSc in Medical Physics was developed to:

- provide education and clinical training for graduate students and to prepare them for careers in areas of diagnostic imaging, nuclear medicine, radiation therapy, and health physics.
- produce Qualified Medical Physicists who are competent by virtue of their education and training to practice independently one or more of the key subfields of Medical and Health Physics: Diagnostic and Therapeutic Radiological Physics, Nuclear Medical Physics, Medical, Environmental and Industrial Health Physics.
- build local capacity for sustainable education, training and research in Medical Physics.

Entry Requirements

- Bachelor of Science, Engineering or Medicine degree with a minimal cumulative GPA of 2.0 from a university of recognized standing. Students holding overseas degrees are welcome to apply.
- Candidates who do not meet these criteria, but who have sufficient professional experience in a relevant area may also be admitted under special circumstances.
- All successful applicants for the MSc in Medical Physics will be interviewed by the Selection Committee to assess their background in physics and science. The interview process may require an oral presentation or a written test to allow the Selection Committee to assess these skills.

Programme Duration

The MSc programme is offered full-time over 12 months (three semesters) or part-time for 24-months in line with the University's academic year. The duration of the Postgraduate Diploma (PgDip) is 9 months (2 semesters).

PROGRAMME STRUCTURE

Courses will be delivered in block mode on evenings and/or weekends to facilitate working professionals.

MSc in Medical Physics

The curriculum consists of three modules:

- Level I (core),
- Level II (professional)
- Level III (speciality & practical).

A total of 48 credits are required for the award of the degree with an overall average mark of 50% and at least 50% in the Research Project.

Postgraduate Diploma (PgDip)

This includes the Level I and Level II courses from the MSc programme taken over two semesters.

A total of 24 credits is needed, with an overall average mark of 50%.

Programme Content

COURSE CODE	COURSES TITLE	CREDITS
	CORE COURSES (LEVEL 1)	
MDPH6110	Anatomy and Physiology for Medical Physicists	3
MDPH6120	Physics of The Human Body	2
MDPH6130	Fundamentals of Radiation Physics and Dosimetry	4
MDPH6140	Basic Medical Electronics and Instrumentation	3
MDPH6150	Biomedical Statistics and Informatics	2
MDPH6160	Radiation Biology and Protection	2
	PR OFESSIONAL (LEVEL 2)	
MDPH6210	Diagnostic Radiology: Physics and Equipment	4
MDPH6220	Radiation Therapy: Physics and Equipment	6

MDPH6230	Nuclear Medicine: Physics, Equipment and Applications	3
MDPH6240	Non-Ionization Radiation: Physics, Equipment and Applications	3
MDPH6250	Environmental and Industrial Health Physics	4
MDPH6320	Medical Physics Research Project	3
	Elective course*	2
SPECIALTY & PRACTICAL (LEVEL 3)		
MDPH6320	Medical Physics Research Project	8
MDPH6330	Graduate Seminar	2
ELECTIVE COURSES		
MDPH6301	Digital Signal and Image Processing	2
MDPH6302	Modelling in Health Physics	2
MDPH6303	Reactor Health Physics	2
MDPH6304	Special Topics in Medical Physics	2
	Total credits	**48**

COURSE DESCRIPTIONS

MDPH6110 ANATOMY AND PHYSIOLOGY FOR MEDICAL PHYSICISTS

(Core course) (3 Credits) (Semester x)

Prerequisite

None

Course Description

A strong understanding of anatomy and physiology (and associated terminology) is essential for a medical physicist. The aim of this course is to present the theoretical knowledge on the structure of the human body and the basic mechanisms of its function.

Learning Outcomes

After completing this material, the student should be able to:

- distinguish between gross anatomical structures (especially on CT images used in treatment planning),
- define the major organ systems and describe the physiological mechanisms for repair, maintenance, and growth
- correlate the anatomical structures and physiological function with the imaging modalities used to view them.

- compare the major levels of organization in living organisms and discuss the significance of homeostasis.

Course Content

- Anatomical nomenclature
- Bones and bone marrow
- Brain and CNS
- Thorax
- Abdomen
- Respiratory system
- Digestive system
- Urinary system
- Reproductive system
- Circulatory system

Assessment

- **Coursework:** **40%**
    - One In-course test (1 hour) 40%
- **Final Exam** **60%**
    - One two hours written paper

MDPH6120 PHYSICS OF THE HUMAN BODY

(Core course) (2 Credits) (Semester x)

Prerequisite

NONE

Course Description

The purpose of this course is to show how physics is applied in health sciences. This course is designed for students to gain an understanding of how the body works and to apply principles of physics in the health sciences and in the human body.

Learning Outcomes

At the end of the course the students will be able to:

- describe the elasticity of soft and hard biological tissue, mechanics of trauma and vascular diseases;
- discuss how the lungs and heart operate and outline various diseases;
- describe the nerve action potential and transmission, electrical conduction system of the nerves, heart and muscles;

- discuss the system of eye/ear and determine how the eye/ear is able to convert electromagnetic/sound waves into electrical current;
- perform calculations related to these principles of physics.

Course Contents

- Biomechanics of the human body, related pathology, diagnostic measurement methods and treatment.
- Biofluid dynamics of the human body, related pathology, diagnostic measurement methods and treatment.
- Electrical properties of the body, related pathology, diagnostic measurement methods and treatment.
- Physics of the speaking and audition, related pathology, diagnostic measurement methods and treatment.
- Physics of the vision, related pathology, diagnostic measurement methods and treatment.

Assessment

- **Coursework:** **40%**
    - One In-course test (1 hour)
- **Final Exam** **60%**
    - One two hours written paper

MDPH6130 FUNDAMENTALS OF RADIATION PHYSICS AND DOSIMETRY
(Core course) (4 Credits) (Semester x)

Prerequisite
NONE

Course Description
The course aims to present the theoretical and practical foundations for a new medical physics recruit to the basis of radiation physics, radiation measurements and dosimetry.

Learning Outcomes
After finishing this material, the student should be able to:

- describe and perform calculations related to concepts of radioactive decay, photons and electrons interactions with matter, radiation field, radiation dose with emphasis on exponential attenuation under both narrow-and broad-beam conditions, energy transfer and dose deposition

- explain the detection and measurement of radiation, radiation dosimetry, the production of radionuclides and its use in tracer techniques and brachytherapy.

Course Content

- Atomic and nuclear structure
- Classification of radiations
- Quantities and units used for describing radiation fields and the interaction of ionizing radiation with matter
- Indirectly ionizing radiations: photon beams
- Exponential attenuation
- Photon interactions with matter
- Directly ionizing radiations and interactions with matter
- Radioactive decay.
- Charged particle and radiation equilibrium.
- Radiation dosimetry
- Calorimetric dosimetry
- Chemical (Fricke) dosimetry
- Bragg-Gray cavity theory
- Ionization chambers
- Calibration of photon and electron beams with ionization chambers
- Relative dosimetry techniques

Assessment

- **Coursework:** **50%**
  - Two In-course test (2 x 1 hour) 30%
  - Lab/Practical 20%
- **Final Exam** **50%**
  - One two hours written paper

MDPH6140 BASIC MEDICAL ELECTRONICS AND INSTRUMENTATION
(3 Credits) (Semester x) (Level 1)

Prerequisite
N/A

Course Description
To introduce/to explore the impact of electronic technology on today's modern digital instrumentation, control and communication systems applied to medical physics.

Learning Outcomes

After completing the course, the student should be able to:

- understand the need for and role of electronics in designing process and presentation tools in medical field
- discuss the importance of electronics today, which provides the world with an infinite amount of information
- describe the physical design and maintenance of different biomedical instrument used in medical field
- interpret, evaluate and perform simple calculations using physics principles with respect to bioelectric signal recording, physiological assist devices, operation, and theatre equipment

Course Content

- Analog electronics.
- Biopotential electrodes and transducers for biomedical applications.
- Biomedical amplifiers.
- Digital electronics.
- Bioelectric signal recording.
- Nonelectric signal recording.
- Physiological assist devices.
- Clinical and operation theatre equipment

Assessment

- **Coursework:** **50%**
    - Two In-course test (2 x 1 hour) 30%
    - Lab/Practical 20%
- **Final Exam** **50%**
    - One two hours written paper

MDPH6150 BIOMEDICAL STATISTICS AND INFORMATICS

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

Prerequisite

None

Course Description

To provide the student with the useful applications of statistics in medical diagnostics, therapy, and health facilities. To provide an introduction to some of the basic components of the hospital information system.

Learning Outcomes

After completing the course, the student should be able to:

- discuss the basics of biostatistics models and methods:
- evaluate and apply the appropriate statistical techniques to the different areas of medical physics.
- describe and demonstrate competency in basic computer architecture, periphery and programmes for patient records, coding, and data presentation.

Course Outline

- Biomedical statistics
    - Types of data and presentation.
    - Frequency distribution and summery measures.
    - Statistical investigations.
    - Sampling distributions. Hypothesis testing.
    - Analysis of variance. Curve fitting.
    - Regression and correlation.
    - Methods based on rank order.
    - SPSS introduction and usage.
- Biomedical informatics
    - Health electronic records.
    - Decision support applications.
    - Medical imaging applications.
    - Medical and biological signal applications.
    - Databases, digital libraries and literature retrieval.
    - Telehealth and telemedicine.
    - Computer-aided surgery, medical robotics and virtual reality.
    - Medical and health software systems.
    - Languages and development platforms.
    - Internet eProjects.
    - Clinical research informatics.
    - Standards, coding and nomenclature.

Assessment

- **Coursework:** **40%**
    - Two in-course tests (2x1 hour)
- **Final Exam:** **60%**
    - One 2 hour written paper

MDPH6160 RADIATION BIOLOGY AND PROTECTION

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

Prerequisite

N/A

Course Description

The aim is to explore the effects of ionizing radiation on biological material and to include the application of radiation biology in radiation protection and safety.

Learning Outcomes

After completing the course, the student should be able to:

- identify and discuss the basic connection between interactions of radiation with tissue
- describe molecular interactions, through sub-cellular and cellular levels of organization; general aspects of DNA repair; biological effects of ionizing radiation (stochastic and non-stochastic effects)
- identify and discuss concepts of risk, including the evaluation of radiation risks, risk-benefit analysis, and index of harm
- synthesize and present in a cohesive and consistent manner the data for radiation therapy physics, imaging physics, radiation protection and safety, and nuclear medicine

Course Content

- Radiation biology
    - Radiation Injury to DNA. Repair of DNA damage
    - Radiation-induced chromosome damage and repair
    - Survival curve theory.
    - Cell death: concepts of cell death (apoptosis and reproductive cell death)
    - Cellular recovery processes
    - Cell cycle
    - Modifiers of radiation response — sensitizers and protectors
    - Linear energy transfer (LET); Relative biological effectiveness (RBE); Oxygen enhancement ratio (OER)
    - Cell kinetics
    - Radiation injury to tissues; Acute and late effects.
- Tumour radiobiology.
    - Time, dose, and fractionation
    - Radiation genetics: radiation effects of fertility and mutagenesis

    - Drug radiation interactions
- Radiation Protection
    - Introductions and historical perspective
    - Interaction physics as applied to radiation protection
- Operational dosimetry
    - Radiation detection instrumentation
    - Shielding: properties and design
    - Statistics
    - Radiation monitoring of personnel

Assessment

- **Coursework:** **50%**
    - Two in-course tests (2 x 1 Hour) 30%
- **Final Exam:** **50%**
    - One 2 hour written paper

MDPH6210 DIAGNOSTIC RADIOLOGY: PHYSICS AND EQUIPMENT
(4 Credits) (Semester x) (Level 2)

Prerequisite
Level 1

Course Description
The aim of this module is to present to the students the basic physical principals of: (a) Conventional planar X-Ray Imaging; (b) Digital X-Ray Imaging and Computed Tomography.

Learning Outcomes
After completing the course, the student should be able to:

- Produce conventional planar imaging topics include radiography and fluoroscopic imaging: production of X-rays, X-ray interaction with the patient
- Produce images using film-screen systems or image intensifiers, and processing of x-ray films.
- Produce images using Digital X-ray imaging and Computed Tomography
- Address image quality issues
- discuss recent advances in hardware and applications: multi-slice detectors, cone beam technology, etc.
- Use axial, helical multi-slice, and cone-beam CT for diagnosis.

Course Content

- Conventional planar X-ray imaging
    - X-ray production.
    - Energizing and controlling the X-ray tube.
    - X-ray tube heating and cooling.
    - X-ray image formation and contrast.
    - Scattered radiation and contrast.
    - Radiographic receptors.
    - The photographic process and film sensitivity.
    - Film contrast characteristics.
    - Radiographic density control.
    - Blur, resolution, and visibility of detail.
    - Radiographic detail.
    - Image noise.
    - Fluoroscopic imaging systems.
- Digital X-ray imaging and Computed Tomography
    - Digital imaging systems and image processing.
    - Computed tomography image formation.
    - Computed tomography image quality.
    - Mammography.
    - Digital subtraction angiography (DSA).
    - Dual-energy-X-ray absorptiometry (DEXA)

Assessment

- **Coursework:** **50%**
    - Two in-course tests (2 x 1 hour) 30%
    - Lab/Practical 20%
- **Final Exam:** **50%**
    - One 2 hour written paper 50%

MDPH6220 RADIATION THERAPY: PHYSICS AND EQUIPMENT
(6 Credits) (Semester x) (Level 2)

Prerequisite
Level 1

Course Description
The aim of the module is to present the physical rationale for the clinical radiotherapy, the main features and characteristics of the radiotherapy equipment and to provide dosimetric methods and physical procedures of quality assurance.

Learning Outcomes

Students should be able to recall, discuss, formulate, design, and perform relevant calculations related to:

1. External high-energy photon and electron beams – characterization, related fundamental dosimetric quantities, methods of delivering dose, resultant dose distributions in tumours and normal tissue.
2. Brachytherapy (short distance treatment radiotherapy) – physical characteristics, dose distribution, clinical methodology at interstitial, intracavitary, surface application.
3. Neutrons, Protons, and Light Ions.
4. Treatment Planning processes in the regions of clinical interest, dose prescription criteria, dose modelling, and dose distribution.
5. Methods of calculation the dose.
6. The physical design, maintenance, and quality assurance (QA) procedures.

Course Contents

- External Electron and photon beam radiation therapy.
- Brachytherapy.
- Treatment planning.
- Clinical Electron and photon beams: Dose modeling and treatment planning.
- Patient data acquisition.
- Radiation therapy devices.
- Quality control/Quality Assurance (QC/QA). Phantoms.

Assessment

- **Coursework:** **50%**
    - Three in-course tests (3 x 1 hour) 30%
    - Lab/Practical 20%
- **Final Exam:** **50%**
    - One 2 hour written paper 50%

MDPH6230 NUCLEAR MEDICINE: PHYSICS, EQUIPMENT AND APPLICATIONS

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

Prerequisite

Level 1

Course Description

The aim of the course is to discuss basic physics in radionuclide imaging and the principle of tracers in nuclear medicine.

Learning Outcomes

After completing the course, the student should be able to:

- recall and differentiate between the ideal characteristics of various radionuclides for diagnosis and for therapy.
- discuss the common uses and limitations of the nuclear medicine modalities: rectilinear scanners, gamma cameras, positron emission tomography (PET) systems, single photon emission computed tomography (SPECT) systems, and newer technology systems such as PET/CT systems. Technetium generator and radiopharmaceuticals.

Course Content

- The Gamma Camera.
- Radionuclide image quality.
- Radionuclide tomographic imaging: Positron Emission Tomography (PET), PET-CT, Single Photon Emission Computed Tomography (SPECT).
- Statistics: counting error.
- Patient exposure and protection.
- Personnel exposure and protection.
- Radiation measurement.
- Principles of radiochemistry, radio-immunoimaging, and the radio-pharmacy.
- Quality Control issues in nuclear medicine.

Assessment

- **Coursework:** **50%**
    - Two in-course tests (2 x 1 hour) 30%
    - Lab/Practical 20%
- **Final Exam:** **50%**
    - One 2 hour written paper 50%

MDPH6240 NON-IONIZATION RADIATION: PHYSICS, EQUIPMENT AND APPLICATIONS

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

Prerequisite

Level 1

Course Description

The aim of the module is to present to the students the theoretical and practical basis of non-ionisation radiation: principles, instrumentations and their medical applications for diagnostic and therapy. In Part A, the emphasis is not on the more advanced MRI techniques, but on the development of a solid understanding and application of the basics of image formation and spatial accuracy, image contrast clinical applications, and safety. In Part B, the emphasis is on the application of the principles of acoustic physics, interaction of ultrasound with tissue, ultrasound transducers and arrays, and ultrasound imaging and Doppler instrumentation. In Part C, we examine lasers, how they work, their characteristics and medical use.

Learning Outcomes

After completing the course, the student should be able to:

- demonstrate an understanding of the principles of magnetic resonance imaging (MRI) physics.
- demonstrate an understanding of the principles of Ultrasound (US) imaging. exhibit an understanding of basic laser biophysics and laser-tissue interaction.
- explain how lasers work, and differentiate between the characteristics of lasers.
- evaluate and apply the pertinent energy, optical and fibre concepts that are applicable to medical laser use.

Course Contents

- Magnetic Resonance Imaging
- Ultrasound Imaging
- Medical Applications of Lasers

Assessment

- **Coursework:** **30%**
    - Three in-course tests (3 x 1 hour) 30%
- **Final Exam:** **70%**
    - One 2-hour written paper 70%

MASTER OF SCIENCE: RENEWABLE ENERGY MANAGEMENT

PROGRAMME OVERVIEW

The energy sector is the most critical sector for all the islands of the Caribbean region and in most cases represents a major source of economic vulnerability. All other forms of economic activity hinge upon having a reliable and cost effective energy supply. Improvements are required in the capacity of the human resource to properly manage the more efficient use of energy, and facilitate the uptake rate of renewable energy technologies. The technical expertise in the implementation of renewable energy technologies and networking into the existing energy framework is required in order to make the essential transition to utilizing a more distributed indigenous renewable energy resource.

There is consequently a great current demand in the market, for executives and other professionals with specialization in the area of sustainable energy systems. A multidisciplinary knowledge of energy sources, distribution technologies and efficient use in buildings and industrial processes, together with social issues and environmental impacts, is an essential tool for project management in this area.

Programme Objectives

This programme is intended to meet the needs of a broad range of professionals whose activities are related to energy affairs and sustainable development. The programme will target natural scientists, engineers and technical-related professionals, as well as those from the social sciences such as administrators, policy makers or lawyers. This programme is an existing programme, consisting of existing courses, which are currently being offered at the Cave Hill campus. This programme is being offered at Mona for the first time. It has been developed in tandem with another master's course, an MSc in Renewable Energy Technology which is currently being offered at the St. Augustine Campus and is being proposed to be hosted at Mona. Some of the courses are common to both masters' programmes.

Entry Requirements

Admission requirements for this course are as follows:

- First degree in economics, engineering, management or natural sciences
- First degree in any discipline plus relevant experience working in a related field

- Significant work experience in a management environment
  (Degrees must be from a recognized University with a GPA of 2.5 or a Lower Second Class Honours degree or its equivalent)

It is expected that the majority of entrants to the course will be from the following sectors:

- Recent graduates seeking to upgrade their qualifications for work in an energy-related field
- Workers in any field seeking to retool or upgrade their skills and qualifications
- Managers in any field seeking to implement aspects of renewable energy in their environment

Duration of Programme

- 18 months (full time)
- 36 months (part time)

PROGRAMME STRUCTURE

All students must take 29 credits of Core courses, 9 core elective credits (all 3-credit courses with the exception of the seminar course which is 2 credits) and a 9-credit Final Research Project – totalling 47 credits.

Optional Preliminary Study

Currently, the Mona Campus offers an Alternative Energy Certificate Course during the summer which may be used to fulfil the Prerequisite standard for students who do not have a background in Renewable Energy.

Programme Content

COURSE CODE	COURSE TITLE	SEMESTER	CREDITS
	CORE ENERGY COURSES		
MDPH6330	Seminar Series	1	2
RNEM6010	Energy Economics	1	3
RNEM6015	Energy Sources and Clean-Energy Systems		
RNEM6020	Energy Use and Energy Auditing	2	3
RNEM6025	Shaping Sustainable Energy Systems	1	3
RNEM6030	OESH & Public Policy for RE in Industry		

CORE MANAGEMENT COURSE			
ENVR6403	Environmental Impact Assessment	1	3
SBCO6310	Transformational Leadership and Management		3
SBCO6520	Quantitative Methods & Statistical Techniques		3
SBSC6000	Principles and Practices of Project Management		3
ELECTIVES			
MGMT6024	IT Project Management		3
RNEM6055	Solar Energy Conversion*		3
RNEM6035	Applied Informatics in Energy Planning		3
RNEM6040	Physics for Renewable Energy (PRE)		3
RNEM6045	Wind Energy I*		3
RNEM6050	Bioenergy 1*		3
SBCO6110	Financial and Managerial Accounting		3
RESEARCH PROJECT			
RNEM6060	Renewable Energy Research Project		9
		TOTAL CREDITS	47

COURSE DESCRIPTIONS

ENVR6403 ENVIRONMENTAL IMPACT ASSESSMENT
(3 Credits) (Semester 1)

Course Description
This course provides an overview of the variety of environmental assessment tools available with the selection of the EIA for in depth treatment. It aims to help students understand what impact assessment is attempting to achieve and what constitutes a good EIA and EIS. The course will introduce participants to the fundamental principles and philosophy of EIA, including practical demonstrations for illustrative purposes. The course will expect students to reflect deeply on the limitations and key issues of EIA as it is currently practiced, and suggest creative solutions to advance the effectiveness of EIA as an environmental management tool.

Learning Outcomes
The student who successfully completes this course will be able to:

- Understand the variety of environmental assessment tools available and their key functions

- Describe the role and intentions of EIA in environmental management for sustainable development
- Explain processes, principles and supporting legislation
- Define the objectives of EIA
- Critically assess the quality of EIA processes and EIA documents, especially TORs and EIS
- Explain the limitations of EIA in environmental management and issues that require further development to improve the contribution of EIA to sustainable development

Course Content

- General overview environmental assessment tools currently available; introduction to Environmental Impact Assessment (EIA) including definition, goals, objectives and purpose; definition of key terms, history of the EIA; legislative, policy and institutional framework for EIA.
- Description of the EIA process, with emphasis on biodiversity conservation and sustainable use; development of Terms of Reference (TOR) including screening, scoping and public participation; and assessment of project impacts, including understanding the ecosystem, assessment of significant impacts of the project and impact management.
- EIS reporting and Environmental Management Plans, review of the EIS, linked to the TOR; and follow-up monitoring, auditing, adaptive management and enforcement; public participation, EIA standards, EIA for islands, and Strategic Environmental Assessments.

Assessment

- **Coursework** **50 %**
  - Project 25%
  - Essay 25%
- **Final Exam** **50 %**
  - One two-hour examination

MDPH6330 SEMINAR SERIES

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

Prerequisite

None

Course Description

A series of seminars given by various industry personnel, government or other relevant energy sector personnel as well as student project proposals. The topics for the seminars will be chosen by the course coordinator based on the implications of what is currently being discussed in the energy sector. Students will get the opportunity to hear what is currently relevant in industry and use this course to refine their research project and sharpen their presentation skills.

Learning Outcomes

5. To create an opportunity for students to practice speaking/presentations and receive feedback from other students, faculty and researchers
6. To sharpen skills that will improve effective seminar presentations in settings such as thesis dissertation defence, professional meetings, or job interviews
7. To facilitate formal interactions among graduate students and faculty members and promote academic exchange and feedback in the department
8. To provide a platform for students to begin planning their final research projects and help them to develop an awareness of research methodologies in the field of Renewable Energy.

Course Content

This is a 2 credit course required for the MSc. in Advanced Electronics Systems graduate degree. It assumes that the student already has some familiarity with the basic concepts and terminologies of renewable energy. All students enrolled in this course are required to give presentations during the graduate seminar courses. Attendance at each seminar is mandatory for all students enrolled.

Assessment

- In-class participation and assessment **20%**
- Coursework/seminar presentations **80%**

MGMT6024 IT PROJECT MANAGEMENT

(Elective) (3 Credits) (Semester X)

Prerequisite

None

Course Description

The reported statistics on information technology (IT) projects are depressing for IT specialists: by most accounts at least one in four projects ends in failure. Entire books are now devoted to IT project failure. The Standish Group reported the results of a study of over 8,000 software development projects, revealing that only 16% were completed on time and on budget. Most of the remaining projects, if they were completed at all, came in over-budget and behind schedule, with fewer functions and features than originally specified. These out-of-control projects, in many cases, are in need of redirection. In this course, we shall examine a range of IT projects, the challenges they encounter and how to recognize the warning signs associated with failing projects and to avert or avoid IT project failures. Students will be exposed to project management tools and associated software that can help you to better plan and manage IT projects.

Learning Outcomes

Upon completion of the course, students should be able to:

1. Explain similarities and differences between IT projects and other types of projects.
2. Develop methodology for aligning IT projects with strategic objectives of organizations.
3. Justify an IT project by establishing a business case
4. Demonstrate their understanding of the fundamentals of IT project management and its applicability in industry by critically evaluating given scenarios
5. Demonstrate an understanding of the context (organizational factors or constraints) in which IT projects are executed
6. Develop a project charter
7. Develop a project management plan
8. Develop a work breakdown structure for an IT project
9. Develop project network diagrams and project schedules
10. Estimate task durations and assign resources
11. Establish task interdependencies
12. Use earned value management to monitor cost and schedule performance of projects.
13. Draw and analyse a network diagram
14. Identify and explain IT project risks and develop risk mitigation strategies
15. Perform and evaluate a post-project audit

Course Content

This course examines the defining characteristics of IT projects and introduces students to a variety of project management techniques that can be applied in an IT projects. Specifically, it focuses on disciplined, proven approaches used in the management of the deployment of information technology projects and for delivering software intensive systems. Students will learn several project management techniques that are applicable to a variety of IT project contexts and will be exposed to the project management body of knowledge (PMBOK - fifth edition) as a basis for considering the management elements and challenges involved in executing IT projects. The course will cover management issues associated with different alternatives for sourcing information systems and acquiring infrastructure components.

Assessment

- **Coursework** **40 %**
- **Final Exam** **60 %**

RNEM6010 ENERGY ECONOMICS
(Core course) (3 Credits) (Semester 1)

Prerequisite
None

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.

Learning Outcomes
Upon successful completion of this course, students will be able to:

1. Discuss the basic concepts of the different energy markets
2. Analyse energy accounting and market theory
3. Demonstrate the possible contributions of the different energy sources to a sustainable energy supply
4. Apply fundamental economic principles to the pricing of renewable energy resources
5. Discuss economic theories and realities both verbally and in written

format

Course Content

1. Energy Accounting and Analysis
2. Market Theory
3. Economic Principles and Analysis
4. Pricing of Renewable Energy Resources
5. Economic Aspects and Life Cycle Costing Equipment
6. Energy Flows in the
7. Energy Accounting and Audit Framework
8. Overview of Basic Econometric Methods
9. Economic Operation of Power Systems
10. Economics of Power System Reliability

Assessment

- **Coursework** **50%**
  - Two term papers 30%
  - Mid-semester exam 20%
- **Final Exam** **50%**
  - One three hours written paper

RNEM6015 ENERGY SOURCES AND CLEAN-ENERGY SYSTEMS

(Core Course) (3 Credits) (Semester X)

Prerequisite

None

Course Description

This course is intended to provide students with a concise description of available fossil and renewable fuel sources commonly used to generate electricity and other forms of energy in modern society. The availability of the various energy sources, clean technologies, efficiency and cost will be explored in detail for the most typical forms. This will allow students enough detail on energy options such that alternatives to oil and other fossil-based fuels may be reasonably examined.

Learning Outcomes

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

- Identify and describe different types of fossil fuels and specify their sources
- Identify and characterize different types of clean technologies and renewable energy sources;
- Give detailed description of some of the most commonly utilized renewable energy processes, viz. hydro, bio, ocean (wave and ocean-

thermal), wind, photovoltaics, solar thermal and geothermal.
- Identify the economic and non-economic benefits associated with the various energy sources.
- Discuss the environmental impact and cost of the various technologies

Course Content

1. Energy Sources
2. Clean Energy Systems for Buildings and Communities
3. Energy efficiency
4. Clean Energy Systems for Industry

Assessment

- **Coursework:** **50%**
    - Two term papers 40%
    - Laboratory report 10%
- **Final Exam** **50%**
    - One three hours written paper

RNEM6020 ENERGY USE AND ENERGY AUDITING

(Core Course) (3 Credits) (Semester 2)

Prerequisite

None

Course Description

This course will enable students to assess the energy efficiency of small and medium premises, carry out energy audits and propose appropriate energy saving measures.

Learning Outcomes

On successful completion of the course, students will be able to:

1. Discuss the trends in energy usage in the Caribbean and
2. Illustrate the relevance of energy efficiency as a resource in sustainable energy systems
3. Appropriately choose between different energy efficient technologies for small and medium scale residential and commercial premises
4. Access and critically assess information on energy efficiency through internet, literature and personal contacts
5. Apply fundamental energy auditing methodologies
6. Assess the energy efficiency of small and medium-sized premises
7. Conduct basic energy audits
8. Propose appropriate energy-saving measures

9. Write and present an energy audit report

Course Content

1. Energy Efficiency
2. Demand Side Management
3. Lighting
4. Ventilation and Air Conditioning
5. Practical Exercise: Energy Audit in a small building

Assessment

- **Coursework:** **100 %**
  - individual contribution 60%
  - team report 40%

RNEM6025 SHAPING SUSTAINABLE ENERGY SYSTEMS

(Core course) (3 Credits) (Semester 1)

Prerequisite

None

Course Description

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. Sustainable Development is the framework within which Renewable Energy Management must be placed.

Learning Outcomes

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

1. Analyse in detail, relevant present and future energy systems for properties relevant to sustainable development.
2. Critically assess the advantages and disadvantages of different energy systems.
3. Make informed decisions about future energy scenarios.
4. Evaluate the technical implications of planning, legal and economic systems.
5. Solve conceptual and numerical problems and develop project management skills.
6. Demonstrate competence in problem solving, analytical thinking, conflict solving skills and project organising skills.

Course Content

1. Sustainable development and its relation to properties of the energy

systems
2. Identification of major problems of present energy systems towards sustainable development
3. Basic scenario techniques
4. Analysis of driving factors of the development of energy systems
5. Analysis of existing status quo scenarios
6. Analysis of existing sustainable energy scenarios
7. Building a general consistent energy scenario
8. Building a consistent energy scenario for a developing country in the Caribbean
9. Analysis of internal and external costs of the different scenarios
10. Analysis of the necessary energy policies to secure a sustainable energy system
11. Instruments for delivery of a sustainable energy system

Assessment

- **Coursework** **50 %**
  - Group Project (seminars and final written report by each team, Presentations, Final report
- **Final Exam:** **50 %**
  - three hours final exam

RNEM6030 OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH (OESH) AND PUBLIC POLICY FOR RENEWABLE ENERGY

(Core Course) (3 Credits) (Semester 1)

Prerequisite

None

Course Description

To develop an understanding of the complex, dynamic and delicate relationship between business pursuits, public interests and public policy.

Learning Outcomes

On successful completion of the course, student will be able to:

1. Discuss, analyse and evaluate the principle inputs to public policy decisions
2. Communicate the local, national and international responsibilities for risk management to an organization
3. Communicate the results of risk assessments to workers and surrounding

communities

4. Discuss and explain the legal basis for OESH litigation, and serve as expert witnesses
5. Develop a viable business model for OESH consulting and ownership

Course Content

In this course students will:

- Explore and analyse the process of public policy development, formulation and implementation with reference to implementation of RE technologies
- Explore and assess the impact of public policies on business pursuits, trade and human rights etc.
- Analyse the cost-benefit of OESH public policies
- Explore, analyse, evaluate and communicate complex OESH risk issues to the public and specialized audiences
- Fundamentals of public policy-definition, goals and objectives of public policies (regulations, legislation)
- Initiation, mobilization of public support for, promulgation, implementation and enforcement of public policies
- Cost-benefit analyses of OESH public policies
- Other public policies (national and global) that impact OESH policies and programmes (trade and market access/barriers)
- Risk assessment and communication
- Entrepreneurship and Innovation: science-technology-innovation connectivity, market, economic and cultural factors; promoting
- OESH cultures
    - The national legal system as a context for OESH litigation and the legal basis for OESH complaints
    - Ethical principles of OESH work and the precautionary principle

Assessment

- **Coursework** **50 %**
    - In-course test
- **Final Exam:** **50 %**
    - (Three hours written paper)

RNEM6035 APPLIED INFORMATICS IN ENERGY PLANNING

(Core Course) (3 Credits) (Semester 1)

Prerequisite

None

Course Description

The goal of the course is to enable students to assess renewable energy supply and demand scenarios with the help of state-of-the-art computer software for analysis.

Learning Outcomes

Upon successful completion of this course students will be able to:

1. Understand and analyse energy statistics
2. Understand and apply the basic parameters for power planning, such as capacity factors, availability, capacity credits, load curves, merit orders etc.
3. Develop demand projections applying econometric and end use models
4. Appreciate energy accounting, use optimisation and simulation software
5. Apply various relevant software

Course Content

Introduction into the basic terms of energy modelling and some of the most common modelling software: emphasis on the elaboration of a case study applying the LEAP software.

- Introduction into energy statistics and energy data sources
- Introduction into energy modeling and energy modeling software
- Overview of accounting, optimisation and simulation software such as LEAP, MARKAL, ENPEP-BALANCE and technical software such as RETScreen
- Energy Demand: Hierarchical accounting of energy demand (activity levels, energy intensities)
- Energy Conversion: Simulation of electric generation sector (transmission and distribution)
- Exogenous and endogenous modeling of capacity expansion
- Systems Costs: capital, O&M, fuel, costs of saving energy, environmental externalities
- Emissions and direct impacts of energy systems
- Scenarios and evaluation of scenarios; Case study: selection of a country for the case study and identification of energy data of the home countries of the participants.

- Organising the energy data for the case study, filling gaps
- Elaborating a reference demand and supply scenario
- Elaborating alternative scenarios
- Comparing and analysing alternative scenarios
- Alternative scenarios developed in small groups 3-4 students

Assessment

- **Coursework** **50 %**
    - Group Project 50%
- **Final Exam:** **50 %**
    - Three hours written paper

RNEM6040 PHYSICS FOR RENEWABLE ENERGY
(Elective) (3 Credits) (Semester X)

Prerequisite
None

Eligibility
Enrolled in the MSc in RE Management

Course Description
The course comprises lectures and tutorials designed for those students who do not have the equivalent of University Year 1 Physics or Engineering. It aims to provide students with the necessary background to enable them to understand and apply the physics of various RE technologies, particularly wind, solar thermal, solar PV and bioenergy. Graduates of this programme must be able to understand the essential physics and mathematics of various renewable energy technologies.

Learning Outcomes
On successful completion of the course, student will understand the physics relevant to the renewable energy technologies that are, or will be, of importance in the Caribbean region.

Course Content

- ***Electricity***
    - DC circuits: DC network analysis
    - AC theory; Power in AC circuits; Electrical machines
    - Semi-conductors
- ***Mechanics***

  - Velocity and acceleration; Mass, force and acceleration;
  - Work, power and energy
  - Normal stress, shear stress and bending moment
- ***Biomass***
  - The cell as the basis for life
  - Cell biochemistry
  - Biochemical pathways
  - Photosynthesis
- ***Fluid mechanics***
  - The properties of fluids
  - Forces on static fluids
  - Fluid dynamics; Movement of real fluids
  - The Bernoulli equation
  - The momentum equation
  - Laminar and turbulent flow
- ***Heat and Thermodynamics***
  - Conduction, convection and radiation
  - The laws of thermodynamics
- ***Mathematics***
  - Taylor series
  - Complex numbers
  - 1st and 2nd order Differential equations
  - Fourier transform
  - Matrices and Eigen value analysis
  - Applied probability

Assessment

- **Coursework:** **40 %**
  - A two-hour mid-sessional examination
- **Final Exam** **60%**

RNEM6045 WIND ENERGY I

(Elective) (3 Credits) (Semester 1)

Prerequisite

None

Course Description

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. Accordingly, 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.

Learning Outcomes

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

1. Explain the basic theories of the wind resource and its assessment.
2. Discuss the aerodynamics of the main types of wind turbines.
3. Compare different methods of wind turbine control.
4. Assess the economical, environmental and institutional factors of wind energy.
5. Assess the potential for wind energy in the Caribbean region.
6. Identify the critical parameters involved in the effective design of small scale wind power system.
7. Utilise commercial software to optimize wind farm performance. Perform detailed wind energy-based experiments and communicate results concisely.
8. Discuss complex theories both verbally and in written format.

Course Content

1. Nature of atmospheric winds
    a. Averaging periods
2. Wind resource assessment
    a. Anemometry
    b. Siting
    c. Basic statistics
    d. Weibull distribution
3. Wind turbine aerodynamics
4. Wind turbine control
5. Small scale wind power
6. Economics aspects
7. Environmental aspects

Assessment

- **Coursework:** **50 %**
    - Laboratory assignment: 20%
    - Term Paper: 10%
    - Mid-semester Exam: 20%
- **Final Exam:** **50%**
    - 3-hour final exam

RNEM6050 BIOENERGY I

(Elective) (3 Credits) (Semester 1)

Prerequisite

None

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.

Learning Outcomes

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

1. Discuss the role of biomass in nature and for human societies
2. Formulate the sustainable utilization of biomass
3. Categorize the various sources and uses of bioenergy
4. Explain the fundamental processes of the bioenergy system
5. Describe different waste-to-energy systems and justify their utilization under differing operating conditions.
6. Differentiate between various process routes for the generation of biofuels
7. Analyse the complex biology of anaerobic digestion
8. Distinguish between first, second and third generation biofuels and appropriately propose their respective usage
9. Perform detailed biomass to energy conversion experiments and communicate results concisely

Course Content

1. Bioenergy
2. Biomass fundamentals – properties and metabolisms
3. Bioenergy conversion technologies
4. Global bioenergy applications
5. Biomass production and utilization pathways
6. Energy from waste
7. Bioenergy resources for combustion

8. Wastewater treatment - Anaerobic digestion
9. Liquid Biofuels – Bioethanol
10. Liquid Biofuels - Synfuels and Biodiesel
11. Biorefineries

Assessment

- **Coursework:** **50 %**
    - Laboratory Assignment: 20%
    - Term Paper: 10%
    - Mid-semester Exam: 20%
- **Final Exam** **50 %**

RNEM6060 RENEWABLE ENERGY RESEARCH PROJECT
(9 Credits)

Prerequisite
None

Eligibility
Enrolled on the MSc Renewable Energy course

Course Description
A project based on material taught in the taught courses, supplemented by private study of literature suggested by the supervisor plus practical work where appropriate. The aim of the project is to provide the student with the opportunity to conduct research on an open-ended topic of relevance to the alternative and renewable energy sector.

The project must be carried out individually and be supervised by an accredited advisor. Assessment will be on the basis of the advisor's report, an individual dissertation, and an oral presentation.

Learning Outcomes
1. Knowledge and Understanding - At the end of the project students should have gained knowledge and understanding of the general RE management principles and the particular problems of application in the chosen subject area.
2. Skills and Attributes
    (i) Intellectual - To understand the needs to formulate objectives and to plan adequately in terms of both

methodology and time management.

(ii) Practical - To design and execute the project to a successful conclusion, while dealing in the process with providers of hardware, software and information.

(iii) Transferable - To analyse experimental data, to solve specific numerical and conceptual problems, and to work with superiors and peers to achieve smooth and timely progression of the project. Use of published information and search engines to identify the state of the art in the chosen subject area.

Course Content

The project may take any of several forms: it may be hardware or software based, theoretical/practical or a combination; it will focus on RE management issues, or on the economic, social and/or policy issues related to the development of renewable energy technology; it should be predominantly of a research nature and aim to make a small but unique contribution to the chosen subject area.

Assessment

- Dissertation 80%
- Seminar 20%

RNEM6055 SOLAR ENERGY CONVERSION

(Core Course) (3 Credits) (Semester 1)

Prerequisite

B.Sc. Physics or permission from Head of Department

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.

Learning Outcomes

Upon successful completion of this course students should be able to:

1. Identify the major forms of renewable energy technologies and discuss the technical and economic issues related to their use.
2. Describe and analyse solar energy systems
3. Distinguish between solar thermal and solar PV
4. Describe harnessing techniques for solar energy
5. Describe the solar energy conversion techniques
6. Identify different materials used for PV conversion
7. Apply information on new PV materials to estimate conversion efficiencies
8. Outline the scientific principles and methodology involved in using solar energy for cooling
9. Evaluate and discuss the economics of solar energy systems
10. Use RETScreen for modelling solar energy systems, including feasibility studies and expected results

Course Content

- 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; Solar spectra; Design, construction and operating principles of a solar collector; Efficiency of glazing/absorber system; Radiation exchange between surfaces; Concentrating Solar Power (CSP); Solar Cooling
- Photovoltaics (PV): Photoelectric effect; Materials used for PV cells; Photovoltaic cell, module, array; Factors influencing performance of PV cells; PV energy systems; PV design, including Electrical and Mechanical design; Categories of PV modules; PV Grid connection; Modeling techniques: RETScreen Analysis; Economic analysis and applications; Socio-economic impacts of renewable energy education, dissemination and applications.

Assessment

- **Coursework** 50 %
  - Laboratory Assignment and Field Trip: 15%
  - Research Project: 20%
  - Mid-semester Exam: 15%
- **Final Exam:** 50 %

- Three hours written paper

SBCO6110 FINANCIAL AND MANAGERIAL ACCOUNTING
(Elective) (3 Credits) (Semester X)

Prerequisite
None

Course Description
Financial and managerial accounting is important at all levels of an organization, regardless of the type of business, whether large corporations or micro, small and medium-sized enterprises (SMSEs). Participants will be exposed to the core concepts, principles and tools of financial and managerial accounting application to day-to-day decision-making. There will also be opportunities to examine the impact of unethical behaviour on the financial outcome of organizations and the shareholders thereof.

This course is divided into two sections of approximately equal weighting: Financial Accounting and Managerial Accounting. The Financial Accounting section introduces the basic concepts and methods used by entrepreneurs as well in corporate financial reporting for external users of financial information such as investors, suppliers, banks, government agencies and other stakeholders. The Managerial Accounting section of the course will deal with issues relating to the analysis and interpretation of financial information to assist in the decision-making process for entrepreneurs as well as corporate executives. Some of the topics to be covered include Budgeting, Break Even Analysis, Variance Analysis, and Standard Costing.

Learning Outcomes
On completion of the course, participants should be able to:

1. Demonstrate a good understanding of the process behind the preparation of financial reports, their strengths and weaknesses.
2. Use financial information to analyze business transactions.
3. Carry out a fairly comprehensive analysis of financial statements.
4. Use financial statements to evaluate company performance and prospects from the point of view of the investor, the company director and the analyst.
5. Use costing information to make short-term decisions regarding alternative uses of resources.
6. Prepare and interpret cash and operating budgets.
7. Use management information to assess operational performance.
8. Make written presentations using accounting information.

9. Create financial information for inclusion in business plans or proposals

Course Content

1. Introduction to Financial Accounting
2. Financial Statements - Income Statement
3. Financial Statements - Statement of Financial Position
4. Financial Statements - Statement of Cash Flows
5. Interpreting Financial Statements
6. Functions of Management Accounting
7. Break-even Analysis
8. The Budgeting Process
9. Standard Costing
10. Performance Evaluation and Feedback

Assessment

- **Coursework** **40 %**
  - Coursework 1: Group analysis of a mini case 5%
  - Coursework 2: Group analysis 20%
  - Class participation 5%
  - Coursework 3: In class test 10%
- **Final Exam:** **60 %**

SBCO6310 TRANSFORMATIONAL LEADERSHIP AND MANAGEMENT

(Core Course) (3 Credits) (Semester 1)

Prerequisite

None

Course Description

This course is designed to influence the views and behaviours of participants in relation to leadership for transformation. It focuses on principle-centred behaviour, the ability to inspire self and others', creative thinking, and problem solving as the driving forces for influencing and managing change in an organizational environment. The philosophy of the course is that managers should seek to move themselves from day-to-day, functional management to a 'higher ground' of serving others, while involving themselves and others in innovative, developmental and ethical actions for the success of an enterprise.

Learning Outcomes

1. Students should have knowledge and understanding of:
   a. The global forces that demand transformation of business practices and

transformational leadership
b. Characteristics that distinguish transactional and transformational leadership
c. Skills and attributes of transformational leaders
d. Variables in leadership effectiveness, including their own leadership profiles and the relevance of these to their leadership effectiveness

2. Students should be able to:
   a. Critically assess a range of approaches to the application of leadership, power and influence.
   b. Make an assessment of likely leadership needs within the context of their own organizations and others.
   c. Apply principles of leadership to the evaluation of their own developmental needs and chart a course for personal development.
   d. Apply transformational leadership skills and techniques to the solution of problems and issues in work teams

Course Content

1. Context of Transformational Leadership
   - The process of Globalization
   - Leadership issues in the Caribbean region
2. Ethical and Inspirational leadership
   - Developing and maintaining a culture of ethical behaviour and principle-centred leadership.
   - The role of/need for inspiration in the leadership process.
3. Leadership as a Transformational Process
4. Skill Requirements for Transformational Leaders

Assessment

- **Coursework** **50 %**
- **Final Exam** **50 %**

SBCO6320 QUANTITATIVE AND STATISTICAL TECHNIQUES FOR MANAGERIAL DECISION MAKING

Prerequisite
None

Course Description
The course is delivered in two complimentary modules. The first of these is

designed to introduce students to the principles of statistics and their application to managerial decision making, while the main objective of the second is to provide an introduction to a selection of quantitative techniques that are commonly used to structure and analyse business decision problems. The content and conduct of each of the modules is described below.

In the broad coverage of the relevant theory for both modules, an emphasis will be placed on the application of the principles and techniques of the types of problems that graduates will encounter in the business environment. Computer based techniques are introduced and applied where relevant; with an emphasis on the use of Microsoft Excel®. It should also be noted that part of the course will be offered online.

Module 1: Statistical Techniques for Managerial Decision Making
Upon the completion of the module, students should be capable of formulating a problem for statistical analysis, computing the required statistics using appropriate techniques and using these in interpreting statistical output.

More specifically, upon completion of Module 1, students should be able to:

1. Use descriptive statistics to summarize quantitative data, including the use of frequency distributions, charts, graphs.
2. Describe data sets using various measures of central tendency and measures of variability.
3. Demonstrate their understanding of the rules and use of basic probability theory by the appropriate use of these rules in solving specific classes of managerial problems.
4. Explain the difference between probabilistic and non-probabilistic sampling designs and be able to recommend the appropriate sampling method for specific problems.
5. Distinguish between different types of discrete and continuous probability distributions.
6. Draw inferences about population parameters from sample statistics using the techniques of estimation and hypothesis testing.
7. Demonstrate their understanding of constructing and interpreting interval estimates by competing class exercises.
8. Explain, in their own words, the difference between type I and type II errors.
9. Use sample estimates to evaluate the credibility of propositions made about one or two populations.
10. Evaluate qualitative and small sample data.
11. Use Excel® to generate statistics, formulate and estimate statistical

models and interpret Excel® output.

Module 2: Quantitative Techniques for Managerial Decision Making

Module 2 will provide an introduction to a selection of quantitative techniques that are commonly used to structure and analyse business decision problems. An emphasis will be placed on the application of the techniques to the types of problems that students will encounter in the business environment. Computer-based techniques are introduced and applied where relevant.

Students should be able to:

1. Discuss the relevance of the "modelling" process and the application of quantitative techniques in business decision making
2. Formulate quantitative models using linear programming, decision trees and forecasting techniques
3. Use appropriate computer software such as Excel® to improve their efficiency in modelling and solving larger problems which are more representative of those they are likely to encounter in practice
4. Interpret the output of the models/techniques and use them to assess risk and guide management decision making
5. Recommend the appropriate modelling technique for different classes of business decision making problems
6. Evaluate business scenarios and choose the "best" model to apply in solving business problems

Assessment

- **Coursework** **40 %**
  - Module quiz 2x 10%
  - In-Class Presentation 5%
  - Final Case Reports 2x10%
- **Final Exam:** **50 %**
  - (One two hours written paper)

SBSC6000 PRINCIPLES AND PRACTICES OF PROJECT MANAGEMENT

(Core Course) (3 Credits) (Semester X)

Prerequisite

None

Course Description

As the business environment becomes more competitive, organisations are faced with the challenge of changing the mode of operation to meet the organisation's objectives within a shorter time frame and in a cost-effective manner. Organisations achieve this through new and innovative ways of doing things. Project Management offers the principles and practices for organisations to make the quantum leap. The use of Project Management has a proven track record of creating the required changes within an organisation.

This Project Management training course is designed to equip participants with the required tools to manage projects allowing their organisations to make the quantum leap. No prior knowledge of Project Management is assumed. However, participants are expected to have a laptop for use during the course.

Learning Outcomes

At the end of this course, participants will be equipped to:

1. Initiate, plan, execute, monitor and control, and close a project;
2. Define a project using a Project Charter;
3. Identify and manage stakeholders through a Stakeholder Register and Stakeholder Management Strategy;
4. Develop a Project Management Plan to guide the execution, monitoring and controlling, and closing of a project;
5. Use various project management tools and techniques; and
6. Use Microsoft® Project to develop a project schedule.

Course Content

1. Introduction to Project Management
2. Project Integration Management
3. Project Scope Management
4. Project Communications Management
5. Project Time Management
6. Project Cost Management
7. Introduction to Microsoft® Projects
8. Project Quality Management
9. Project Human Resource Management
10. Project Risk Management
11. Project Procurement Management

Assessment

- Participants who achieve an overall grade of 50% or more on each individual and group assignment will be issued a Certificate of Achievement.
- Participants who achieve an overall grade of less than 50% will be

issued a Certificate of Participation.

- In addition, to be eligible for either certificate, participants must be present for at least 32/36 contact hours.

In providing Certificates of Achievement, MSB will be attesting to the fact that participants have been tested to demonstrate competence in the subject matter. The programme will therefore include the following individual and group assignments:

Assignment	***Type***	***Points***
Project Charter	Group	10
Quiz 1	Individual	5
Stakeholder Register & Stakeholder Management Strategy	Group	10
Quiz 2	Individual	15
Project Management Plan	Group	50
	Total Points	**100**

MASTER OF SCIENCE: RENEWABLE ENERGY TECHNOLOGY

PROGRAMME OVERVIEW

The energy sector is the most critical sector for all the islands of the Caribbean region and in most cases represents a major source of economic vulnerability. All other forms of economic activity hinge upon having a reliable and cost-effective energy supply. Improvements are required in the capacity of the human resource to properly manage the more efficient use of energy, and facilitate the uptake rate of renewable energy technologies. The technical expertise in the implementation of renewable energy technologies and networking into the existing energy framework is required in order to make the essential transition to utilizing a more distributed indigenous renewable energy resource.

There is consequently a great current demand in the market, for executives and other professionals with specialization in the area of sustainable energy systems. A multidisciplinary knowledge of energy sources, distribution technologies and efficient use in buildings and industrial processes, together with social issues and environmental impacts, is an essential tool for project management in this area.

Programme Objectives

This Programme is intended to meet the needs of a broad range of professionals whose activities are related to energy affairs and sustainable development. The programme will target natural scientists, engineers and technical-related professionals, as well as those from the social sciences such as administrators, policy makers or lawyers. This programme is an existing programme, consisting of existing courses, which are currently being offered at the St. Augustine campus. This programme is being offered at Mona for the first time. It has been developed in tandem with another master's course, an MSc in Renewable Energy Management which is currently being offered at the Cave Hill Campus and is being proposed to be hosted at Mona. Some of the courses are common to both masters' programmes.

Duration of Programme

- 18 months (full time)
- 36 months (part-time)

PROGRAMME STRUCTURE AND CONTENT

COURSE CODE	COURSE TITLE	SEMESTER	CREDITS
CORE ENERGY COURSES			
RNEM6010	Energy Economics	1	3
RNEM6020	Energy Use and Energy Auditing	2	3
RNEM6025	Shaping Sustainable Energy Systems	1	3
RNEM6045	Wind Energy I	1	3
RNEM6050	Bioenergy I	1	3
RNEM6055	Solar Energy Conversion	1	3
RENT6008	Electrical Integration of Renewables	2	3
RENT6009	Hydro and Marine Power	2	3
MDPH6330	Seminar Series	1	2
CORE MANAGEMENT COURSE			
SBSC6000	Principles and Practices of Project Management		3
ELECTIVES			
RENT6010	Geothermal Energy	2	3
RENT6011	Energy Storage	2	3
RENT6012	Advanced Solar Energy	2	3
RENT6013	Wind Energy II	2	3
RENT6014	Bioenergy II	2	3
RESEARCH PROJECT			
RNEM6060	Renewable Energy Research Project		9
TOTAL CREDITS			

COURSE DESCRIPTIONS

MDPH6330 SEMINAR SERIES

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

Prerequisite

None

Course Description

A series of seminars given by various industry personnel, government or other relevant energy sector personnel as well as student project proposals. The topics for the seminars will be chosen by the course coordinator based on the implications of what is currently being discussed in the energy sector. Students will get the opportunity to hear what is currently relevant in industry and use this course to refine their research project and sharpen their presentation skills.

Learning Outcomes

1. To create an opportunity for students to practice speaking/presentations and receive feedback from other students, faculty and researchers
2. To sharpen skills that will improve effective seminar presentations in settings such as thesis dissertation defence, professional meetings, or job interviews
3. To facilitate formal interactions among graduate students and faculty members and promote academic exchange and feedback in the department
4. To provide a platform for students to begin planning their final research projects and help them to develop an awareness of research methodologies in the field of Renewable Energy.

Course Content

This is a 2 credit course required for the MSc. in Advanced Electronics Systems graduate degree. It assumes that the student already has some familiarity with the basic concepts and terminologies of renewable energy. All students enrolled in this course are required to give presentations during the graduate seminar courses. Attendance at each seminar is mandatory for all students enrolled.

Assessment

- In-class participation and assessment **20%**
- Coursework/seminar presentations **80%**

RENT6008 ELECTRICAL INTEGRATION OF RENEWABLES

(Core Course) (3 Credits) (Semester 2)

Prerequisite

None

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.

Learning Outcomes

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

1. Explain the principles of operation of island wide utility grids
2. Compare embedded generation with distributed generation.
3. Describe the benefits and the issues of large-scale embedded generation.
4. Perform power system analysis of utility grids in order to understand the implications of the connection of RE systems.
5. Identify network faults and devise effective means to minimize their occurrence.
6. Differentiate between the various power electronic interface options available.
7. Perform detailed experiments and communicate results concisely.

Course Content

1. Stand-alone versus grid connected generation
2. Penetration from renewables
3. Energy efficiency
4. Grid characteristics
5. Power Systems analysis
6. Network Analysis
7. Power System control
8. Power System Operation
9. Power Electronic Interfaces
10. Embedded Generation

Assessment

- **Coursework:** **50 %**
    - Laboratory Assignment 30%
    - Term Paper 20%
- **Final Exam:** **50 %**
    - three hour final exam

RENT6009 HYDRO AND MARINE POWER

(Core Course) (3 Credits) (Semester 2)

Prerequisite

None

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.

Learning Outcomes

1. Upon successful completion of this course, students will be able to:
2. Give a detailed overview of the various waterpower options and their specific availability in the Caribbean region
3. Discuss large and small-scale hydropower options and intricacies
4. Categorize turbine designs and discuss their site-specific applicability
5. Describe and select appropriate wave power technologies from the wide range of options available for onshore, near shore and offshore situations
6. Critically assess various ocean thermal technologies (including OTEC and sea water cooling/heating) and their potential impact in the Caribbean and Worldwide
7. Perform detailed wave & current based experiments and communicate results concisely

Course Content

1. Hydropower overview
2. Hydropower
3. Wave power
4. Ocean thermal devices
5. Tidal Power

Assessment

- **Coursework:** **50 %**
    - Laboratory Assignments 20%
    - Term Paper 10%
    - Mid-semester Exam 20%
- **Final Exam:** **50 %**
    - three-hour final exam

RENT6010 GEOTHERMAL ENERGY

(Core Course) (3 Credits) (Semester 2)

Prerequisite

None

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.

Learning Outcomes

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

1. Describe the underlying geological setting, hydrology, and Geochemistry of Geothermal systems.
2. Analyse the chemical compositions of samples from surface manifestations and wells.

3. Apply the theories of thermodynamics to the analysis of hydrothermal systems
4. Perform geophysical surveys.
5. Use modelling tools for geothermal reservoir investigations
6. Critically assess the environmental impacts of geothermal systems.

Course Outline

1. Geophysics
2. Geothermal Geoscience
3. Geothermal Geochemistry
4. Mathematical Systems
5. Geothermal Reservoir Modelling
6. Geothermal Systems Modelling
7. Geothermal Reservoir Engineering
8. Geothermal Reservoir Engineering (Cont'd)
9. Geothermal Energy and the Environment

Assessment

- **Coursework:** **50%**
  - Laboratory Assignment 20%
  - Term Paper 10%
  - Mid-semester Exam 20%
- **Final Exam:** **50%**
  - Three-hour final exam

RENT6011 ENERGY STORAGE
(Core Course) (3 Credits) (Semester 3)

Prerequisite
None

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.

Learning Outcomes

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

1. Differentiate between the various forms of electrochemical systems
2. Categorize the different forms of electrochemical storage options available
3. Explain the principles of construction and operation of the various options for hydrogen fuel cell technologies.
4. Elaborate on the technical challenges of a Caribbean wide super grid
5. Perform detailed hydrogen cell experiments and communicate results concisely via a written report.

Course Content

1. Storage in the fuel distribution system
2. Thermal Energy Storage
3. Reversible Chemical Reactions
4. Mechanical energy storage
5. Electromagnetic energy storage
6. Hydrogen production
7. Hydrogen storage and distribution
8. Fuel Cells
9. Transport sector

Assessment

- **Coursework:** **50%**
    - Laboratory Assignment 20%
    - Term Paper 10%
    - Mid-semester Exam 20%
- **Final Exam:** **50%**
    - (Three hours written exam)

RENT6012 ADVANCED SOLAR ENERGY

(Core Courses) (3 Credits) (Semester 2)

Prerequisite

None

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.

Learning Outcomes

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

1. Apply advanced solar thermal principles to passive solar design.
2. Utilise the heat transfer characteristics for flat plate collectors to determine the heat absorbed by solar thermal systems.
3. Utilise solar radiation data and the heat transfer characteristics of walls and glazing to determine the heat gain in different rooms.
4. Explain the detailed underlying semiconductor physics of solar PV systems
5. Estimate conversion efficiencies of new PV materials, based on the underlying semiconductor physics.
6. Estimate the cooling load requirement for the design of solar assisted/based air-conditioned or refrigerated spaces
7. Discuss the various cooling cycles, identify appropriate system components and apply appropriate scientific principles and methodology to solar (or solar assisted) cooling
8. Evaluate and discuss the economics of solar energy systems
9. Predict the future direction of solar technologies
10. Perform precise wind tunnel-based measurements of an operating wind turbine and write a technical report discussing the resulting performance characteristics in a detailed and concise manner.

Course Content

1. Physics and design of PV devices
2. Manufacturing and application
3. Advanced solar thermal
4. Solar cooling
5. Solar cooling
6. PV technology
7. Applications

Assessment

- **Coursework:** **50%**
  - Laboratory Assignment 20%
  - Term Paper 10%
  - Mid-semester Exam 20%
- **Final Exam:** **50%**
  - Three hour final exam

RENT6013 WIND ENERGY II
(Core Course) (3 Credits) (Semester 2)

Prerequisite
None

Course Description
Building on wind energy I, this module aims to cover in depth (a) the advanced statistics and modelling 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 modelling and setting up of a wind farm.

Learning Outcomes
Upon successful completion of this course, students will be able to:

1. Analyse wind resource statistics and explain how they are affected by atmospheric turbulence.
2. Discuss the advanced aspects of wind turbine loading and limits.
3. Explain the intricate power system aspects of wind turbine and wind farm design.
4. Discuss noise propagation issues caused by modern wind turbines.
5. Describe the detailed electrical design aspects of wind turbines.
6. Perform precise wind tunnel-based measurements of an operating wind turbine and be able to write a report in a detailed and concise manner.

Course Content

1. Wind statistics
2. Advanced wind turbine aerodynamics
3. Forces and dynamics of wind turbines
4. System aspects
5. Electrical Aspects of wind turbines
6. Noise from wind turbines

Assessment

• **Coursework:**		**50%**
○ Laboratory Assignment	20%	
○ Term Paper	10%	
○ Mid-semester Exam	20%	
• **Final Exam:**		**50%**
○ three hour final exam		

RENT6014 BIOENERGY II
(Core Course) (3 Credits) (Semester 2)

Prerequisite
None

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 bio digesters 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.

Learning Outcomes
Upon successful completion of this course, students MUST be able to:

1. Explain the various methods of deriving alcohol fuels from biomass feedstock

2. Describe the process of clean incineration of waste to generate electricity
3. Determine under what situations advanced conversion technologies such as pyrolysis and gasification should be utilized.
4. Explain how biogas is produced from anaerobic digestion processes
5. Identify the key elements of steam and gas turbine cycle technologies and explain their principle of operation in biogas systems.
6. Perform detailed biogas/biomass experiments and communicate results concisely
7. Discuss complex theories both verbally and in written format

Course Content

1. Biodigesters
2. Advanced conversion technologies
3. Electricity generation from bioenergy
4. Gasification
5. Pyrolysis
6. Biodiesel
7. Micro algae feedstock
8. Economics of biomass-to-electricity systems
9. Environmental impact of bioenergy
10. Revision

Assessment

- **Coursework:** **50%**
    - Laboratory Assignment 20%
    - Term Paper 10%
    - Mid-semester 20%
- **Final Exam:** **50%**
    - three hour final exam

RNEM6010 ENERGY ECONOMICS
(Core course) (3 Credits) (Semester 1)

Prerequisite
None

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.

Learning Outcomes

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

1. Discuss the basic concepts of the different energy markets
2. Analyse energy accounting and market theory
3. Demonstrate the possible contributions of the different energy sources to a sustainable energy supply
4. Apply fundamental economic principles to the pricing of renewable energy resources
5. Discuss economic theories and realities both verbally and in written format

Course Content

1. Energy Accounting and Analysis
2. Market Theory
3. Economic Principles and Analysis
4. Pricing of Renewable Energy Resources
5. Economic Aspects and Life Cycle Costing Equipment
6. Energy Flows in the
7. Energy Accounting and Audit Framework
8. Overview of Basic Econometric Methods
9. Economic Operation of Power Systems
10. Economics of Power System Reliability

Assessment

- **Coursework:** **50%**
    - Two term papers 30%
    - Mid-semester exam 20%
- **Final Exam** **50%**
    - One three hours written paper

RNEM6020 ENERGY USE AND ENERGY AUDITING

(Core Course) (3 Credits) (Semester 2)

Prerequisite

None

Course Description

This course will enable students to assess the energy efficiency of small and medium premises, carry out energy audits and propose appropriate energy saving measures.

Learning Outcomes

On successful completion of the course, students will be able to:

1. Discuss the trends in energy usage in the Caribbean and
2. Illustrate the relevance of energy efficiency as a resource in sustainable energy systems
3. Appropriately choose between different energy efficient technologies for small and medium scale residential and commercial premises
4. Access and critically assess information on energy efficiency through internet, literature and personal contacts
5. Apply fundamental energy auditing methodologies
6. Assess the energy efficiency of small and medium-sized premises
7. Conduct basic energy audits
8. Propose appropriate energy-saving measures
9. Write and present an energy audit report

Course Content

1. Energy Efficiency
2. Demand Side Management
3. Lighting
4. Ventilation and Air Conditioning
5. Practical Exercise: Energy Audit in a small building

Assessment

- **Coursework:** **100 %**
    - individual contribution 60%
    - team report 40%

RNEM6025 SHAPING SUSTAINABLE ENERGY SYSTEMS

(Core course) (3 Credits) (Semester 1)

Prerequisite

None

Course Description

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. Sustainable Development is the framework within which Renewable Energy Management must be placed.

Learning Outcomes

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

1. Analyse in detail, relevant present and future energy systems for properties relevant to sustainable development.
2. Critically assess the advantages and disadvantages of different energy systems.
3. Make informed decisions about future energy scenarios.
4. Evaluate the technical implications of planning, legal and economic systems.
5. Solve conceptual and numerical problems and develop project management skills.
6. Demonstrate competence in problem solving, analytical thinking, conflict solving skills and project organising skills.

Course Content

1. Sustainable development and its relation to properties of the energy systems
2. Identification of major problems of present energy systems towards sustainable development
3. Basic scenario techniques
4. Analysis of driving factors of the development of energy systems
5. Analysis of existing status quo scenarios
6. Analysis of existing sustainable energy scenarios
7. Building a general consistent energy scenario
8. Building a consistent energy scenario for a developing country in the Caribbean
9. Analysis of internal and external costs of the different scenarios
10. Analysis of the necessary energy policies to secure a sustainable energy system
11. Instruments for delivery of a sustainable energy system

Assessment

- **Coursework** **50 %**
  - Group Project (seminars and final ritten report by each team, Presentations, Final report)
- **Final Exam:** **50 %**
  - three hours final exam

RNEM6045 WIND ENERGY I
(Elective) (3 Credits) (Semester 1)

Prerequisite
None

Course Description
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. Accordingly, 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.

Learning Outcomes
Upon successful completion of this course, students MUST be able to:

1. Explain the basic theories of the wind resource and its assessment.
2. Discuss the aerodynamics of the main types of wind turbines.
3. Compare different methods of wind turbine control.
4. Assess the economical, environmental and institutional factors of wind energy.
5. Assess the potential for wind energy in the Caribbean region.
6. Identify the critical parameters involved in the effective design of small-scale wind power system.
7. Utilise commercial software to optimize wind farm performance. Perform detailed wind energy-based experiments and communicate results concisely.
8. Discuss complex theories both verbally and in written format.

Course Content

1. Nature of atmospheric winds
    a. Averaging periods
2. Wind resource assessment
    a. Anemometry
    b. Siting
    c. Basic statistics
    d. Weibull distribution

3. Wind turbine aerodynamics
4. Wind turbine control
5. Small scale wind power
6. Economics aspects
7. Environmental aspects

Assessment

- **Coursework:** **50 %**
  - Laboratory assignment: 20%
  - Term Paper: 10%
  - Mid-semester Exam: 20%
- **Final Exam:** **50%**
  - three hour final exam

RNEM6050 BIOENERGY I
(Elective) (3 Credits) (Semester 1)

Prerequisite
None

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.

Learning Outcomes
Upon successful completion of this course, students will be able to:
1. Discuss the role of biomass in nature and for human societies
2. Formulate the sustainable utilization of biomass
3. Categorize the various sources and uses of bioenergy
4. Explain the fundamental processes of the bioenergy system
5. Describe different waste-to-energy systems and justify their utilization under differing operating conditions.

6. Differentiate between various process routes for the generation of biofuels
7. Analyse the complex biology of anaerobic digestion
8. Distinguish between first, second and third generation biofuels and appropriately propose their respective usage
9. Perform detailed biomass to energy conversion experiments and communicate results concisely

Course Content

1. Bioenergy
2. Biomass fundamentals – properties and metabolisms
3. Bioenergy conversion technologies
4. Global bioenergy applications
5. Biomass production and utilization pathways
6. Energy from waste
7. Bioenergy resources for combustion
8. Wastewater treatment - Anaerobic digestion
9. Liquid Biofuels – Bioethanol
10. Liquid Biofuels - Synfuels and Biodiesel
11. Biorefineries

Assessment

- **Coursework:** **50 %**
    - Laboratory Assignment: 20%
    - Term Paper: 10%
    - Mid-semester Exam: 20%
- **Final Exam** **50 %**

RNEM6060 RENEWABLE ENERGY RESEARCH PROJECT
(9 Credits)

Prerequisite
None

Eligibility
Enrolled on the MSc Renewable Energy course

Course Description
A project based on material taught in the taught courses, supplemented by private study of literature suggested by the supervisor plus practical work where appropriate. The aim of the project is to provide the student with the opportunity

to conduct research on an open-ended topic of relevance to the alternative and renewable energy sector.

The project must be carried out individually and be supervised by an accredited advisor. Assessment will be on the basis of the advisor's report, an individual dissertation, and an oral presentation.

Learning Outcomes

1. Knowledge and Understanding - At the end of the project students should have gained knowledge and understanding of the general RE management principles and the particular problems of application in the chosen subject area.
2. Skills and Attributes
   - (i) Intellectual - To understand the needs to formulate objectives and to plan adequately in terms of both methodology and time management.
   - (ii) Practical - To design and execute the project to a successful conclusion, while dealing in the process with providers of hardware, software and information.
   - (iii) Transferable - To analyse experimental data, to solve specific numerical and conceptual problems, and to work with superiors and peers to achieve smooth and timely progression of the project. Use of published information and search engines to identify the state of the art in the chosen subject area.

Course Content

The project may take any of several forms:

- it may be hardware or software based, theoretical/practical or a combination;
- it will focus on RE management issues, or on the economic, social and/or policy issues related to the development of renewable energy technology;
- it should be predominantly of a research nature and aim to make a small but unique contribution to the chosen subject area.

Assessment

- Dissertation 80%
- Seminar 20%

RNEM6055 SOLAR ENERGY CONVERSION
(Core Course) (3 Credits) (Semester 1)

Prerequisites
B.Sc. Physics or permission from Head of Department

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.

Learning Outcomes
Upon successful completion of this course students should be able to:

1. Identify the major forms of renewable energy technologies and discuss the technical and economic issues related to their use.
2. Describe and analyse solar energy systems
3. Distinguish between solar thermal and solar PV
4. Describe harnessing techniques for solar energy
5. Describe the solar energy conversion techniques
6. Identify different materials used for PV conversion
7. Apply information on new PV materials to estimate conversion efficiencies
8. Outline the scientific principles and methodology involved in using solar energy for cooling
9. Evaluate and discuss the economics of solar energy systems
10. Use RETScreen for modelling solar energy systems, including feasibility studies and expected results

Course Content

- 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; Solar spectra; Design, construction and operating principles of a solar collector;

Efficiency of glazing/absorber system; Radiation exchange between surfaces; Concentrating Solar Power (CSP); Solar Cooling

- Photovoltaics (PV): Photoelectric effect; Materials used for PV cells; Photovoltaic cell, module, array; Factors influencing performance of PV cells; PV energy systems; PV design, including Electrical and Mechanical design; Categories of PV modules; PV Grid connection; Modeling techniques: RETScreen Analysis; Economic analysis and applications; Socio-economic impacts of renewable energy education, dissemination and applications.

Assessment

- **Coursework:** **50%**
  - Laboratory Assignment and Field Trip: 15%
  - Research Project: 20%
  - Mid-semester Exam: 15%
- **Final Exam:** **50%**
  - Three hours written paper

SBSC6000 PRINCIPLES AND PRACTICES OF PROJECT MANAGEMENT
(Core Course) (3 Credits) (Semester X)

Prerequisite
None

Course Description
As the business environment becomes more competitive, organisations are faced with the challenge of changing the mode of operation to meet the organisation's objectives within a shorter time frame and in a cost effective manner. Organisations achieve this through new and innovative ways of doing things. Project Management offers the principles and practices for organisations to make the quantum leap. The use of Project Management has a proven track record of creating the required changes within an organisation.

This Project Management training course is designed to equip participants with the required tools to manage projects allowing their organisations to make the quantum leap. No prior knowledge of Project Management is assumed. However, participants are expected to have a laptop for use during the course.

Learning Outcomes

At the end of this course, participants will be equipped to:

1. Initiate, plan, execute, monitor and control, and close a project;
2. Define a project using a Project Charter;
3. Identify and manage stakeholders through a Stakeholder Register and Stakeholder Management Strategy;
4. Develop a Project Management Plan to guide the execution, monitoring and controlling, and closing of a project;
5. Use various project management tools and techniques; and
6. Use Microsoft® Project to develop a project schedule.

Course Content

1. Introduction to Project Management
2. Project Integration Management
3. Project Scope Management
4. Project Communications Management
5. Project Time Management
6. Project Cost Management
7. Introduction to Microsoft® Projects
8. Project Quality Management
9. Project Human Resource Management
10. Project Risk Management
11. Project Procurement Management

Assessment

- Participants who achieve an overall grade of 50% or more on each individual and group assignment will be issued a Certificate of Achievement.
- Participants who achieve an overall grade of less than 50% will be issued a Certificate of Participation.
- In addition, to be eligible for either certificate, participants must be present for at least 32/36 contact hours.

In providing Certificates of Achievement, MSB will be attesting to the fact that participants have been tested to demonstrate competence in the subject matter. The programme will therefore include the following individual and group assignments:

Assignment	***Type***	***Points***
Project Charter	Group	10
Quiz 1	Individual	5
Stakeholder Register & Stakeholder Management Strategy	Group	10
Quiz 2	Individual	15
Project Management Plan	Group	50
	Total Points	**100**

MPHIL/PHD IN PHYSICS

PROGRAMME OVERVIEW

The masters and doctoral programmes of the department are oriented towards fundamental and applied research and reflect the specialties of the faculty. The objectives of the programs are to give students advanced training for further research in universities or the private sector.

Programme Objectives

- to provide advanced knowledge in Physics/Applied Physics/Electronics beyond that obtained in undergraduate programmes
- to develop competence in conducting of research, within the framework of Physics/Applied Physics/Electronics
- to provide opportunities for the design of discipline-based research projects that meet the needs and interests of individuals

Entry Requirements

The prerequisite for entry to the MPhil (Physics) program is a BSc degree in Physics or related field with a GPA $\geq$ 3.00. Initially, all students register for the MPhil Degree, unless they already have an equivalent research degree or an MSc with at least a B+ average. The upgrade of registration to the PhD is allowable after one year based on all the following criteria:

1. The submission of an acceptable upgrading proposal
2. The presentation of a satisfactory Seminar to the Department, relating to the work done and the work proposed
3. An independent assessment by an Upgrading Assessment Committee

Areas of Research

Our Graduate students, here in the Department of Physics, have the opportunity to conduct cutting-edge research in various areas such as Materials Science, Climate Science, Telecommunications, Renewable Energy, Medical Physics and others.

Further information on the Physics Research Groups can be found online at https://www.mona.uwi.edu/physics/research-groups.

Duration of Programme

	MPhil	*PhD*
Full time:	3 years	5 years
Part time:	5 years	7 years

COURSE LISTING BY PROGRAMME

BIOTECHNOLOGY

NATURAL RESOURCE MANAGEMENT

FOOD AND AGRO-PROCESSING TECHNOLOGIES

OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH

MPHIL/PHD IN CHEMISTRY

COMPUTER SCIENCE

AGRICULTURAL ENTREPRENEURSHIP

MPHIL/PHD IN LIFE SCIENCES

MATHEMATICS

ENTERPRISE RISK MANAGEMENT

ADVANCED ELECTRONIC SYSTEMS

CLINICAL MEDICAL PHYSICS

MEDICAL PHYSICS

RENEWABLE ENERGY MANAGEMENT

RENEWABLE ENERGY TECHNOLOGY

UWI

MONA CAMPUS
JAMAICA, WEST INDIES

Inspiring Excellence , Producing Leaders

FST

The Dean's Office | Faculty of Science and Technology | 5 Anguilla Close
The University of the West Indies, Mona
Tel: (876) 977-1785; 618-0922-3 | Extns: 2401; 2962
Website: http://www.mona.uwi.edu/fst
Email: fst@uwimona.edu.jm