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BA, MA, PhD, Dip Library & Information Studies Lond

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CAMPUS PRINCIPAL
Dr. Bhoendradatt Tewarie
BA Northwestern, MA Chicago, PhD Penn

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Prof. Gurmohan Kochhar
BE, MS, PhD, MASHRAE, FAPE, MASME

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BA (Economics & Accounting) Bristol, ACPA, CA (T&T)

CAMPUS LIBRARIAN
Dr. Margaret Rouse-Jones
BA, MA, PhD, Dip Library & Information Studies Lond
MISSION STATEMENT

The Mission of the Faculty of Engineering is to be the provider of a world quality education in Engineering, Geoinformatics and Geosciences and research and development programmes in support of Caribbean business, industry and infrastructure, with its graduates, staff and facilities being at the forefront in propelling growth, development and innovation in the region.
THE DEAN'S WELCOME ADDRESS

As Dean of the Faculty of Engineering, I am extremely pleased that you have chosen The University of the West Indies (UWI) as the institution where you will be furthering your education. To both new and returning postgraduate students, the Faculty is extremely pleased to have you with us for this Academic Year 2004/2005.

I know that many of you are graduate engineers, managers and technologists of a high calibre. The success of The UWI and its reputation are built upon this solid foundation of both a quality input and a quality output. Together, we must therefore work steadily to maintain and enhance this.

Our postgraduate programmes in the Faculty are under constant review so as to meet the advanced skills need of the country and the region. In the last few years, we have introduced new Masters programmes in Regulation Policy (Telecommunications), Geoinformatics, Project Management, etc. We expect to launch new MSc programmes in Civil, Civil and Environmental Engineering and Chemical Engineering shortly, as well as a Masters in Manufacturing Engineering. These will be engineering programmes that are of a high professional level. The Faculty is also steadily reviewing its postgraduate offerings so as to ensure quality, relevance, student-centredness and an enhanced throughput. We are introducing more postgraduate Diplomas, for example, in Petroleum Engineering, Regulations Policy (Telecommunications), etc. The Department of Electrical and Computer Engineering is reviewing its entire suite of postgraduate programmes so as to ensure among other things, clear milestones for students' progress. The Faculty will continue to review and expand its taught postgraduate Diploma/MSc offerings to meet the needs of the professionals we serve in the region.

I recognise that many of you are part-time students trying to cope with demanding jobs, meeting family expectations and at the same time pursuing a higher degree. Managing your time efficiently is therefore extremely crucial to your success. To those returning students who are expected to complete their research projects this year, I urge you to dedicate a few months to this phase. You may wish to consider leave of absence from your place of employment so as to facilitate completion of this final phase of your training. I have seen many students pass their course examinations very comfortably but languish for years on the project! The Faculty is restructuring its MSc project work so as to allow students the option of pursuing a professionally-oriented rather than a research-oriented Project. You may be able to complete your Project requirements on the basis of the professional work you are currently pursuing in industry. Please consult with your Programme Coordinator on this matter.

To those of you who are registering or returning for Postgraduate programmes by research theses (MPhils and PhDs), you are embarking on the first step of an academic career. Develop and plan your research with your supervisor and your Advisory Committee. As much of what you do may be experimental work, forecast your material and equipment needs early. Get to know your Head of Department who can assist you in these areas. Set milestones! Try to achieve your goals and remain focussed. A good research student must feel confident that he or she is in command of the literature in the field - keep reading. This applies to all graduate students. The Faculty is attempting to monitor more closely the progress of its postgraduate research students. We expect such students to meet regularly with their Supervisors and Advisory Committees and to present at regular intervals, progress reports through Seminars on their research.

Postgraduate research and the pursuit of excellence require one to have an indomitable spirit in any environment, and at UWI, we are building a strong postgraduate research capability. I would like your postgraduate experience in the Faculty to be rewarding. We will endeavour to do whatever is possible to support your work. Please come in to see me if there are any troubling, unresolved issues. The Deputy Dean (Research and Postgraduate Student Affairs) as well as your Head of Department are there to support you.

My best wishes to all of you for a fruitful year. Your success is also ours.

Clement K. Sankat, FIAgrE, CEng.
Professor and Dean, Faculty of Engineering
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OFFICE OF THE DEAN

Dean
Professor Clement K. Sankat

Deputy Deans

Undergraduate Student Affairs
Dr. Stephan Gift

Research & Postgraduate Student Affairs
Professor Winston Mellowes

Physical Facilities & Administrative, Technical and Service Staff
Dr. Clement Imbert

Distance Education & Outreach
Professor Winston Suite

Senior Administrative Officer
Mrs. Annette Campbell

Administrative Assistants
Ms. Melissa Dattoo (Research & Postgraduate Student Matters)
Mr. Carlyle Maitland
Mrs. Carol Sergeant

Secretary to Dean
Mrs. Margaret Richards

Secretary to Deputy Deans
Mrs. Cindy Lakhan-Hardyal
AN HISTORICAL NOTE

The University of the West Indies was founded in 1948 at Mona, Jamaica as a College in special relationship with the University of London, to serve the British territories in the Caribbean area. It achieved full University status by Royal Charter in 1962, thereby becoming a degree-granting institution in its own right.

A second campus of the University was established in 1960 when the Imperial College of Tropical Agriculture (ICTA) at St. Augustine, Trinidad was incorporated into the University College. On August 25, 1959, a Plan of Operation was signed which provided for a United Nations Special Fund allocation and a Government counterpart contribution for the establishment of a Faculty of Engineering. The then Vice-Chancellor and Principal of the University College, Nobel Laureate Sir Arthur Lewis had the overall responsibility of securing funding for the financing of the Engineering buildings and for expediting the final decision to locate the Faculty of Engineering at St. Augustine.

The initial layout comprised five (5) blocks with a total of 5,400 square metres of floor space of which the laboratories occupied 3,030 square metres.

Construction commenced in 1961 and was completed by the end of 1962. During 1961/62 Academic year (the first year of teaching), the Faculty was housed in temporary accommodation on the campus. The formal opening of the new buildings of the Faculty took place on February 1, 1963.

Initially, undergraduate and graduate research degrees were offered in the main branches of Engineering - Chemical, Civil, Electrical and Mechanical. The Faculty steadily grew over the years with a major expansion of both physical infrastructure and academic programmes in the 1980s with additional disciplines at the BSc level and several specialist MSc degrees. Floor space now occupies close to 50,000 square metres of classrooms, laboratories and offices, with expansion continuing almost on a yearly basis.

Semesterisation was introduced on a phased basis in 1990 at the undergraduate level, followed by the MSc programmes at a later date.

From a modest beginning of 28 students in the Academic year 1961/62, the Faculty has produced up to Academic year 2003/2004, 5604 graduates in fields of Chemical (818), Civil (1,193), Electrical and Computer (1,511), Mechanical (1,393), Industrial (325), Agricultural (79), Biosystems (8), Petroleum (48) and Surveying and Land Information (218). In 2001/2002, the Faculty introduced its BSc (Hons) programme in Petroleum Geoscience, graduating 13 students in 2003/2004.

The Faculty of Engineering continues to dedicate its considerable resources towards the pursuit of excellence in teaching, research and community service.
1.1 Introduction

1.1.1 It is generally accepted that a Bachelor’s degree is only the first step in the learning process that a professional person should continue throughout his/her career.

1.1.2 A first degree is an indication of a basic ability to understand and apply the concepts underlying that discipline. It does not indicate competence as a practitioner of the associated profession. That can only come with experience and training within the profession itself.

1.2 Furthering Knowledge
- MPhil, PhD

1.2.1 One important element of any profession is that one should be devoted to furthering the knowledge and understanding contained within the concepts that define the discipline.

1.2.2 The task of furthering the frontiers of knowledge normally falls upon those in academic fields and specifically upon those undertaking postgraduate studies towards research degrees.

1.2.3 It is therefore critical to both industry and the University that graduates pursue research studies; this is reflected in continuing active enrolment for the MPhil and PhD research degree programmes.

1.2.4 The Faculty of Engineering offers MPhil and PhD research degrees in the following subjects:

i. Agricultural Engineering
ii. Chemical & Process Engineering
iii. Civil Engineering
iv. Construction Engineering & Management
v. Construction Management
vi. Electrical & Computer Engineering
vii. Food Science & Technology
viii. Industrial Engineering
ix. Mechanical Engineering
x. Petroleum Engineering
xi. Surveying & Land Information
1.2.5 It should be noted that these research degrees are not normally considered to be qualifications for professional practice in the broader sense, as they may not necessarily allow for registration as a professional engineer.

1.2.6 As a consequence, the Faculty of Engineering may allow suitably qualified non-engineering graduates, who obtained their degrees at the Honours level, to register for higher degrees by research.

1.2.7 However, such students may be required to take a qualifying examination within the Department concerned, on topics that would enhance the student’s academic competence in the area of the proposed research.

1.2.8 Applicants wishing to register for the PhD who do not already have a Master’s degree by research will be required to register for the MPhil first and may be allowed to upgrade their registration to the PhD upon satisfying the appropriate regulations.

1.2.9 Candidates who have obtained a Master of Science (MSc) degree with distinction may be allowed to register for the PhD provided a substantial part of the MSc project has been carried out in the relevant area.

1.3 In Career Training - Diploma, MSc, MRP

1.3.1 It has often been demonstrated that the emphasis of the work undertaken by professional engineers changes as their careers progress. Normally their work becomes either more specifically technical within a closely defined subject area, or it becomes more oriented towards management responsibilities rather than technical ones. Sometimes, it involves both.

1.3.2 As a result, professionals often require retraining or further training during the course of their careers. For this purpose, it is important to industry that there is a wide ranging and active programme of postgraduate studies available at the University.

1.3.3 To this end, the Faculty of Engineering offers a range of MSc and Postgraduate Diploma courses which are primarily taught courses. The Faculty also offers a taught Master of Regulation and Policy (MRP) degree programme. The details of these are included in this booklet.

1.3.4 The Faculty of Engineering currently offers the following Postgraduate Diploma programmes through examination by written papers and a project:

- Construction Engineering
- Construction Engineering & Management
- Construction Management (Distance Mode)
- Food Science & Technology
- Land Administration
- Petroleum Engineering
- MRP (Telecommunications)
- Transportation

1.3.5 The Faculty of Engineering currently offers the following MSc degree programmes through examination by written papers and a project:

- Communication Systems
- Construction Engineering & Management
- Construction Management
- Digital Systems
- Energy Systems
- Engineering Management
- Environmental Engineering
- Food Science & Technology
- Geographic Information Systems
- Petroleum Engineering
- Planning & Development
- Production Engineering & Management
- Production Management
- Project Management

1.3.6 The Faculty of Engineering currently offers the following multidisciplinary Master of Regulation and Policy (MRP) degree programme, by distance, assessed by coursework and a project:

- Telecommunications
1.3.7 Normally, entry to such programmes is available to those who have first degrees in the specific subject area or who are graduates in a related area with a record of experience in the subject area.

1.3.8 Students with Pass degrees in the relevant field of study shall only be accepted for admission to an MSc/Diploma programme provided they have obtained at least two years experience in the field and have a satisfactory confidential reference from their employer.

1.4 **Course of Study - MSc/Diploma/MRP**

1.4.1 The courses of advanced study for a postgraduate Diploma or a Master’s degree by examination by written papers include, in addition to the courses of instruction, supervised research development or industry-oriented work culminating in the submission of a Project Report.

1.4.2 Full-time MSc/Diploma students must normally submit their Project Reports nine (9) months after completion of the written examinations, while part-time MSc/Diploma students are required to do so within twelve (12) months. MRP (Telecommunications) students must normally submit their Project Reports three (3) months after completion of final semester assessment exercises. Candidates who fail to submit their Reports in good time shall be removed from the Register of Postgraduate Students.

1.4.3 Candidates failing the examination in any course of the MSc/Diploma/MRP programme may be allowed a second attempt at the examination on the recommendation of the Examiners to the Board for Graduate Studies and Research.

1.4.4 Candidates are not permitted to repeat the examination in any one course on more than one (1) subsequent occasion.

1.4.5 Candidates are not normally allowed oral examinations in more than two (2) full courses per semester.

1.4.6 A proportion of the marks which make up the final result of a particular course examined by a written Paper may be derived from the candidate’s performance in course work assignments, in course tests, etc.

All such assignments must be completed and submitted to the examiners before the date of the written examination.

1.4.7 Candidates whose work is at any time reported by their Supervisors to be unsatisfactory or who do not satisfy the Examiners on Courses or Project Reports that form part of the postgraduate programme may be removed from the Register of Postgraduate Students.

1.4.8 Such students shall not normally be readmitted for at least two years thereafter. Students readmitted to MSc/Diploma programmes shall be eligible for credits for those courses passed creditably during their previous registration, provided that not more than five years have elapsed since the applicants withdrew from the University and that the course content has not changed significantly in the interval.

1.5 **Distinctions - MSc/Diploma/MRP**

1.5.1 A Distinction may be awarded for a Postgraduate Diploma or MSc degree provided that the candidate obtains 70% or more in EACH component of the course of study, i.e., (i) written Papers and (ii) Research Project.

1.5.2 A Distinction may be awarded for the MRP (Telecommunications) degree provided that the candidate obtains 70% or more in EACH component of the course of study, i.e., (i) Coursework and (ii) Project.

1.5.3 Candidates who repeat the examination in any course shall not be eligible for the award of a diploma or degree with distinction.

1.6 **Completion Time - MPhil/PhD**

1.6.1 A candidate for the MPhil degree shall submit a thesis for examination within five (5) calendar years of initial registration for full-time studies, or seven (7) calendar years for part-time studies.
1.6.2 A candidate for the PhD degree shall submit a thesis for examination within six (6) calendar years of initial registration for full-time studies, or eight (8) calendar years for part-time studies.

1.7 Research Seminars

1.7.1 All students registered for research degrees are required to present a seminar on their research topic within the first two (2) years if registered full-time and within three (3) years if registered part-time.

1.7.2 This seminar is assessed, normally by the Supervisor of the student’s studies, and is reported as being satisfactory or unsatisfactory on the student’s annual Progress Report. It is intended to:

i. provide a forum for the critical appraisal of the objectives, methodology, direction and progress of the research being undertaken.

ii. create a wider awareness in the University community of the research activities within the Faculty.

iii. provide additional means of monitoring the progress of postgraduate students doing research theses.

iv. create and foster an appropriate research culture within the Faculty.

1.8 Procedural Guidelines for the Upgrading of an MPhil to the PhD

1.8.1 Postgraduate students who are registered for the MPhil Degree and who are contemplating the upgrading of their registration status to that of the PhD are urged to do so within two (2) or three (3) years of first registration.

1.8.2 The following are the procedural guidelines for upgrading of one’s registration status.

i. The student should consult with his Supervisor(s) on this matter.

ii. The student will apply through his Supervisor(s) to the Head of Department, formally seeking upgrading, copying both the Assistant Registrar (Student Affairs) and the Chairman, Faculty Sub-committee on Graduate Studies.

iii. The Head of Department, if in agreement, consults with the Supervisor and Chairman, Faculty Sub-committee on Graduate Studies and Research and establishes an Upgrading Assessment Committee.

iv. The Upgrading Assessment Committee should normally comprise the Supervisor(s) plus two independent Assessors.

v. Assessors should be chosen on the basis of their knowledge and experience at the appropriate level in the area of the student’s research and may be drawn from outside of The University of the West Indies.

vi. The Chairman, Faculty Sub-committee requests from the student, a copy of his Proposal for upgrading for each of the Assessors, and a mutually agreed date is set for the oral presentation by the student of his:

1. Report on work done under MPhil registration, and

2. Research proposal to upgrade the work to PhD.

vii. The Chairman, Faculty Sub-committee chairs the oral presentation by the student of his Research proposal and later receives from each Assessor, a report with a recommendation regarding the requested upgrading.

viii. The Faculty Sub-committee reviews the Reports and forwards a recommendation on upgrading to the Campus Committee on Higher Degrees, through the Faculty Board.
1.9 **Theses and Project Reports**

1.9.1 The form of presentation of Theses and Project Reports must conform to the University’s General Regulations governing Higher Degrees. Students should consult the University Library on this matter as well as the University’s publication “Theses and Research Papers.”

1.9.2 The maximum length of thesis shall be as follows: -

- MPhil - 250 pages including Appendices.
- PhD - 500 pages including Appendices.
- MSc/Diploma Project Reports - 200 pages.

1.9.3 Essential elements/components constituents of the proposed MSc Project Report should include the following:

- Introduction
- Background
- Motivation
- Scope and limitations
- Underlying principles/literature review/theory and fundamentals
- Methods/approach adopted/used and why
- Results
- Discussion of results/review of methodology
- Conclusions and recommendations
- Closure/comment on the significance of the findings from work, its contribution to knowledge in the area, and the lessons that should be learned from the project experience

The above items are listed in typical sequence. The sequence itself is not fixed, and may be adjusted to some extent as appropriate to each particular case.
2.1 Research

2.1.1 The Department of Chemical Engineering is part of the single campus Faculty of Engineering with a commitment to providing national and regional service to the process industries. These industries include the full spectrum available in the Caribbean including petroleum and petrochemicals, bauxite, sugar and food-processing. The Units of Food Science & Technology and Petroleum Engineering are included in the Department of Chemical Engineering with specific remits to serve those industries.

2.1.2 The Department recognises the need to promote industrial linkages, applied research, fundamental research and the continuing education of persons in the relevant disciplines. The research efforts are essentially geared to the solving of problems relevant to the region as a whole.

2.1.3 Research in the Department of Chemical Engineering is aimed at the development of the indigenous resources of the Caribbean region. The broad areas of research in the Department are as follows:

- Agricultural Crop Processing
- Enhanced Oil Recovery
- Food Science & Technology
- Industrial Pollution Control
- Mineral Processing
- Natural Gas Engineering
- Petroleum Processing Technology
- Process Design, Optimisation and Control
- Reaction Engineering
- Reservoir Engineering
- Sugar Technology
- Utilisation of Biomass

The Department offers programmes of study by research leading to the MPhil and PhD degrees in Chemical Engineering.
2.2 **Staff in the Department**

The principal teaching and research interest of the academic members of staff in the Department are as follows:

**PROFESSORS EMERITUS**

- **David R. McGaw,**
  BSc, MSc (Wales), PhD (UWI), FIChemE, CEng, MAIChemE, MAPETT
  (Separation Processes, Particle Technology)

- **George M. Richards,**
  CM, MSc (Manch), PhD (Cantab), ARIC, AMCST, FInstPet, MAPE, CEng
  (Transport Phenomena, Petroleum Technology)

**PROFESSORS**

- **Adebayo Aina,**
  BSc (Ibadan), MSc (London), PhD (Ife)
  (Geophysics)

- **John Akingbala,**
  BSc (Ibadan), MSc, PhD (Texas A&M), MNIFST, MIFST, MAACC
  (Food Chemistry & Food Processing)

- **Richard Dawe,**
  BA, MA, DPhil (Oxford), Eur Eng, CEng, FInstE, CChem, FRSC
  Trinidad & Tobago Methanol Chair in Petroleum Engineering
  (Reservoir Engineering, Hydrocarbon Thermodynamics)

- **Joseph Hamilton,**
  BSc (Lond), DPhil (Oxford)
  Professor of Petroleum Geology
  (Isotope Geochemistry)

- **Winston A. Mellowes,**
  BSc (Eng), MSc, PhD (UWI), MICheM E, CEng, MAIChemE, MCarIFST, MIFST, REng
  (Transport Phenomena, Sugar Technology, Biomass Utilisation)

**SENIOR LECTURERS**

- **Clyde Abder,**
  BSc (Mech Eng)(UWI), Dual MS (Penss), CQE, CQA, CPIM, CIRM (USA), MAPE, MSPE
  (Drilling & Completions, Production Engineering)

- **Gail S.H. Baccus-Taylor,**
  BSc (Agric), Dip, MSc (UWI), MSc (Reading), PhD (Wis-Madison), MCarIFST, MIFT, MPSA
  (Food Microbiology, Food Quality Assurance)

- **Hamid Farabi,**
  BSc (Aria-Mehr), MSc, PhD (Aston), MAIChemE, MAPETT, HonMSFOM, MNSC, MEMAS
  (Process Control, Safety and Loss Prevention)

- **Michael Foley,**
  BSc (Hons) (Queen’s), MSc (Alberta), PhD (Queen’s)
  (Process Control)

- **Angelus C. Pilgrim,**
  BSc (SpHons) (Chem), BSc (Eng), PhD (UWI), REng, MAPETT
  Head of Department
  (Sugar Technology, Industrial Chemistry Engineering Materials, Biomass Utilisations)

* **Sydney Thomas,**
  BSc (UWI), MSc (New Brunswick), PhD (McMaster), MAIChemE, MAPETT
  (Reaction Engineering, Petroleum & Natural Gas Processing)

**LECTURERS**

- **Tennyson Jagai,**
  BSc (UWI), MPhil (UWI), PhD (UWI), MSPE, MAIChemE
  (Reservoir Engineering, Enhanced Oil Recovery)

- **Ian A. A. Lambert,**
  BSc (Hons)(UWI), MSc (Reading), PhD (Rutgers), MCarIFST, MIFST (UK), MIFT (US)
  (Food Process Engineering, Food Chemistry)

- **Jill Marcelle-De Silva,**
  BSc, MSc (UWI), Eng (Stanford)
  (Reservoir Engineering)

- **Carmen Riverol,**
  BSc, MSc (Chem Eng) (Simon Bolivar), PhD (Vigo), CIV, EUSFLAT
  (Process Design & Economics)
• **Manas R. Sahoo**,  
  *BSc (Ut Kal), MSc, MTech, PhD (IIT)*  
  (Structural Geology)

• **Jeffrey Smith**,  
  *BSc (Hons) (UWI), MSc (Toronto), MAPETT*  
  (Chemical Thermodynamics & Transport Phenomena)

• **Jeremy Wilson**,  
  *BSc, MSc, PhD (Wales)*  
  (Palaeontology & Geology)

**PART-TIME LECTURERS**

* **Brian Baptiste**,  
  *BSc (Mona), Dip Man Studies, MSc (Pet Eng) (UWI)*  
  (Petroleum Geology, Petroleum Engineering Management)

* **Donald Charles**,  
  *BSc (Psychology), BSc (Geology) (Mona), NWxT (Petrophysics)*  
  (Petrophysics)

* **Arnold Corneal**,  
  *MSc (Educ) (Nova Southeastern Univ),  
  BA (Communication) (Florida)*  
  (Communication)

* **Tyrone Kalpee**,  
  *BSc, MPhil, PhD (UWI)*  
  (Health, Safety & Environment)

* **Wilson Lalla**,  
  *BSc, MSc (Geology) (Mona)*  
  (Petroleum Geology)

• **Heather Okuns**,  
  *BSc (UWI), PhD (Sheffield)*  
  (Applied Chemistry)

• **Alfred Ollivierra**,  
  *BSc, MPhil (UWI)*  
  (Petroleum Production)

* **Krishna Persad**,  
  *BSc, PhD (Geology) (Mona)*  
  (Petroleum Geology Management)

* **Winston Rajpaulsingh**  
  *BSc (Geology) (Mona), PG Dip (Man. Studies),  
  MPhil (Pet Eng) (UWI)*  
  (Petroleum Geology)

* **Anthony Ramlackhansingh**,  
  *BSc (Geology) (Manitoba)*  
  (Structural, Development & Exploration Geology)

* **Clement Ramroop**,  
  *BSc, MSc (Rheinisch)*  
  (Petroleum Geoscience)

* **Kirton Rodriguez**,  
  *BSc, PhD (Geology) (Mona), MSc (Env Studies) (Toronto)*  
  (Geochemistry)

* **Allan Russell**,  
  *BSc (Maths) (UWI), Dip, MSc (Pet Eng)*  
  (Petroleum Engineering Management)

• **Liaquat A. Shah**,  
  *BSc (Eng), MSc (UWI), MSc (Rutgers)*  
  (Process Design, Biotechnology)

* **John Shepherd**,  
  *BSc, PhD (UMIST)*  
  (Seismic Research)

* **Grant Wach**,  
  *BA (Geography) (Ontario), MSc (Geology) (South Carolina),  
  DPhil (Geology) (Oxford)*  
  (Sedimentology)

* **Victor Young On**,  
  *BSc (Geophysics), BSc (Geomatics) (Toronto)*  
  (Geophysics)

**VISITING FELLOWS**

* **Wayne Bertrand**,  
  *BSc (UWI), MSc (Brit. Col), SPE, CSPG,  
  GSTT, AEGG*  
  (Petroleum Geoscience)

* **Rodney Jagai**,  
  *BSc (UWI), MS (Univ. of Tulsa), SPETT,*  
  (Hydrocarbon Studies)
GRADUATE ASSISTANTS

• Omar Davis,
  BSc (Eng) (UWI)
  (Chemical Engineering)

* Roger Deo,
  BSc (Eng) (UWI)
  (Chemical Engineering)

• Neisha Kydd,
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• Ricardo Ramirez,
  BSc (Agric) (UWI), MSc (Food Tech) (UWI)
  (Food Technology)

• Iannie Roopa,
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  (Petroleum Engineering)

* Nisha Singh,
  BSc (Eng) (UWI)
  (Chemical Engineering)

• Marion Watson,
  BSc (Eng) (UWI)
  (Chemical Engineering)

2.4 Programs in Food Science & Technology

2.4.1 Philosophy and Goals

2.4.2 The useful application of knowledge to the developmental needs of the food industry in the Caribbean, to the real world of commerce and public need.

2.4.3 The fostering of scholastic achievement in academics and the conduct of research by both applied and theoretical methods, in order to produce individuals equipped for research and production in the food industry, government institutions, other universities and research institutions, development agencies, other teaching and technical establishments and in libraries and information centres.

2.4.4 General Information

2.4.5 The full-time academic staff of the Unit comprises three (3) members involved in different aspects of food technology: engineering, micro-biology, processing, packaging, food chemistry, quality assurance, sensory analysis and management.

2.4.6 The full-time academic staff is supplemented by visiting and special lecturers, full-time and part-time researchers and supported by three (3) technical staff.

2.4.7 The Unit is equipped with science laboratories which include a processing hall containing a range of small-scale equipment suitably instrumented for the systematic study of operations involved in the food industry; a food microbiology and quality control laboratory.

2.4.8 Areas of current research include food analysis, food preference and sensory studies, food fermentations, milk, meat, fish, fruit and vegetables microbiology and technology, root crop processing-dehydration, extrusion, food product development (food formulation from novel components).
2.4.9 The Unit maintains links with industry particularly in the area of food manufacture. Staff are also involved in scientific and technical societies, in particular, the Institute of Food Technologists (USA), the Canadian Institute of Food Science & Technology and the Institute of Food Science & Technology (UK). Staff members also have connections with overseas institutions which they visit and in which they participate. There are links with national and international development agencies.

2.4.10 Graduates of this programme have found employment in the food industry, mainly in research and development, quality control and production management. Some are pursuing research in government and industry-sponsored research organisations. Some are on the academic staff of universities. Other opportunities arise in the catering and pharmaceutical industries, in teaching, in libraries and information centres and with overseas institutions and development agencies.

2.5 **Food Science & Technology Unit**

2.5.1 **Programme Structure**

2.5.2 Candidates for registration in this programme must first hold a degree in any of the following subjects:

- Food Science & Technology;
- Chemistry or Applied Chemistry;
- Chemical, Biochemical or Agricultural Engineering;
- Agriculture;
- Nutrition;
- Home Economics with a major in Nutrition or Food Technology or other relevant qualifications acceptable to the Faculty of Engineering.

2.5.3 **Entry Requirements**

2.5.4 **MSc in Food Science & Technology**

2.5.5 The Regulations for the MSc in Food Science & Technology are the same as the General Regulations for the MSc (Eng) in the Faculty of Engineering, except that candidates applying for registration should normally have either:

a. A Bachelor’s Degree in Food Science & Technology, Natural Science or Nutrition (with Mathematics and/or Statistics and Chemistry at the Preliminary and Introductory Level) or Agriculture, or Chemical Engineering or Agricultural Engineering;

b. An equivalent academic or professional qualification acceptable to the Faculty of Engineering.

2.5.6 **MPhil in Food Science & Technology**

2.5.7 The Regulations for the MPhil in Food Science & Technology are the same as the General Regulations for the MPhil except that candidates applying for registration should normally have either:

a. A Bachelor’s Degree in Food Science & Technology,

b. A Master’s Degree in Food Science & Technology,

c. An equivalent academic or professional qualification acceptable to the Faculty of Engineering.

2.5.8 **PhD in Food Science & Technology**

2.5.9 The Regulations for the PhD in Food Science & Technology are the same as the University and Faculty of Engineering regulations for the degree of Doctor of Philosophy except that candidates applying for registration should normally have either:

a. A Master of Philosophy Degree in Food Science & Technology of The University of the West Indies,

b. An equivalent academic or professional qualification acceptable to the Faculty of Engineering.
2.5.10 MSc Programme - Course of Study

2.5.11 Following the pattern established by the Institute of Food Technologists in the United States and the Institute of Food Science & Technology in the United Kingdom, students will be required to pursue an appropriate course of study as determined by the Graduate School, UWI, St. Augustine and the Food Science & Technology Unit, Department of Chemical Engineering.

2.5.12 To earn the Master of Science degree, a minimum of 30 credits of successful graduate study coursework is required.

2.5.13 Candidates failing the examination in any course of the MSc Programme may be allowed a second attempt at the examination on the recommendations of the Examiners to the Board for Graduate Studies.

2.5.14 Candidates will not be normally permitted to repeat the examination in any one course on more than one (1) subsequent occasion.

2.5.15 Candidates must also conduct a six (6)-credit research paper project under the supervision of an academic member of the Food Science & Technology Unit.

2.5.16 Full-time students must normally submit their Project Reports nine (9) months after completion of the written examinations, while part-time students are required to do so within twelve (12) months. Candidates who fail to submit their Reports in good time shall be removed from the Register of Postgraduate students.

2.5.17 Students should demonstrate proficiency in Food Science & Technology by satisfactory completion of at least 30 credits of coursework, fifteen (15) of which must be the following core courses:

- Food Chemistry
- Food Microbiology
- Food Quality Assurance
- Fundamentals of Food Process Engineering

The remaining credits may be selected from the following options depending on the availability of teaching staff for that academic year:

- Beverage Processing
- Chemistry & Processing of Fats & Oils
- Chemistry of Food Colours
- Dairy Chemistry & Dairy Products Technology
- Food Analysis
- Food Packaging
- Food Processing Laboratories
- Industrial Management
- Literature Survey
- Preservation & Processing of Fruits and Vegetables
- Preservation & Processing of Meat & Poultry
- Preservation & Processing of Seafood
- Principles of Nutrition
- Sanitation in Food Processing
- Sensory Evaluation of Food
2.6 Syllabuses in Food Science & Technology

FOST 3000 (FS31A)
Principles of Food Science
The basic chemistry of carbohydrates, proteins, lipids, vitamins, salt, preservatives and antioxidants, enzymes, additives and water in relation to food preservation and processing.

FOST 6000 (FS60B)
Fundamentals of Food Process Engineering

FOST 6001 (FS60C)
Sanitation in Food Processing
Principles and practices of food plant sanitation. Cleaning and sanitising. Control and evaluation of microbial, insect and rodent contamination. Organisation of a sanitation control programme. Personal hygiene. Waste treatment and disposal. GMPs, SOPs, SSOPs and HACCP. Government and public health regulations.

FOST 6002 (FS60D)
Food Packaging

FOST 6003 (FS60E)
Food Chemistry
Chemistry and physics of the major food constituents. Composition and structure of foods. Chemical reactions involved in food processing, storage and handling.

FOST 6004 (FS60F)
Food Processing Laboratories
Laboratory exercises in the preservation and processing of meat, poultry, seafood, dairy products and fruits and vegetables. Processes will include thermal processing (canning), batch and HTST pasteurisation of milk, fruit juices and beverages. Dehydration of fruit purees. Production of soya products and comminuted meat products. Production of jams, jellies and marmalades. Spray-drying and extrusion procession. Meat curing and smoking. Production of fermented foods, e.g., yoghurt.

FOST 6005 (FS61A)
Food Microbiology

FOST 6006 (FS61B)
Food Quality Assurance

FOST 6007 (FS61C)
Preservation & Processing of Meat & Poultry
FOST 6008 (FS61D)  
**Preservation & Processing Fruits & Vegetables**

FOST 6009 (FS62A)  
**Food Analysis**
Principles and application of the chemical, physical and instrumental methods used to determine the constituents of foods. Separation techniques using GC and HPLC, and spectroscopic techniques including UV/Vis and IR methods. Special consideration applicable to the analysis of certain foods. Legal and governmental regulations.

FOST 6010 (FS62B)  
**Dairy Chemistry & Dairy Products Technology**

FOST 6011 (FS62C)  
**Beverage Processing**
Processing technology of the three major beverage groups - carbonated, non-alcoholic (soft drinks); carbonated mildly alcoholic (beer); non-alcoholic, non-carbonated, stimulating (coffee, tea). Raw material ingredients. Manufacturing processes. Standards of identity and standards for grades. Nutritive, public health and safety concerns.

FOST 6012 (FS62D)  
**Industrial Management**
Principles and models (qualitative and quantitative) that are critical to effective decision-making in Operations Management. Development and formulating operational strategies: capacity strategy, product strategy, process strategy and human resource strategy. Technical support activities: aggregate planning, quality assurance - quality management control, cost control and shop floor control.

FOST 6013 (FS63A)  
**Chemistry of Food Colours**
Occurrence, structure, physical and chemical properties of natural and synthetic food colours. The interaction between colour substances and other food components during processing and storage. Analytical aspects of food colours.

FOST 6014 (FS63B)  
**Chemistry & Processing of Fats and Oils**

FOST 6015 (FS63C)  
**Principles of Nutrition**
Nutrition value of foods and metabolism of essential nutrients. Basic and applied principles of nutrition to the formulation, fabrication, processing and marketing of food products. The application of principles of nutrition to the requirements of normal individuals throughout the life cycle.

FOST 6016 (FS63D)  
**Preservation & Processing of Seafood**
FOST 6017 (FS 63E)  
Sensory Evaluation of Foods  
The physiology, psychology and chemistry of flavour and flavour perception. Factual, visual and auditory components influencing the acceptability of foods. The principles and application of preference and discriminatory testing, and the interpretation of panel evaluation data.

FOST 6018 (FS 600)  
Literature Survey  
To undertake a literature survey of a particular topic in Food Science & Technology. Prepare a paper, and present findings at a seminar.

FOST 6019 (FS613)  
Food Science MSc Research Project

2.7 Programmes in Petroleum Engineering

2.7.1 General Information

2.7.2 The Subject  
Petroleum engineering involves the application of earth and physical sciences to the evaluation and exploitation of natural hydrocarbon resources. The dominant problems of the petroleum engineer are those of flow and equilibrium in porous media, in vertical and horizontal well bores, in surface pipelines and in primary process equipment. The complexity of the hydrocarbon fluids, and the geological strata involved in flow in reservoirs and production systems raises problems requiring sophisticated numerical techniques for their solution. In the practical field, drilling and production engineering continually pose new engineering problems requiring engineered solutions.

2.7.3 The Petroleum Engineering MSc Course

The Petroleum Engineering MSc Programme consists of eight (8) taught courses and an individual project. It is a conversion programme from other engineering and science-based degree foundations into the specialities of petroleum engineering. The content of the course is aimed at providing the necessary background for employment in the oil and gas industry, or springboard for a research degree, as well as serving as a refresher for those already working in industry.

2.7.4 Industrial Contact

We have strong links with both industry and government maintained by the growing awareness of the need for an interchange of advice and ideas. Industry also provides us with financial support for certain academic posts and scholarships. Visiting lecturers from the industry and government establishments make an important contribution to the more specialised teaching of the MSc programme.

Cooperation with Industry

• Many past students are now in responsible positions in industry.
• Lectures on some courses are given by personnel from industry.
• Regular seminars are given by engineers and managers from oil companies.
• Most companies regard the course as a good source of potential recruits.
• Industry support through scholarships and secondment.
• Majority of project topics are proposed and partly supervised by industry.
• Industry welcomes our students on visits.

2.7.5 Society of Petroleum Engineers (SPE)

Strong interaction with the Society of Petroleum Engineers, an international learned society looking after petroleum engineering. The aim of the SPE is to disseminate frontier knowledge from fundamental to field experience, including cost benefit. Over the years, the SPE has been most generous in its support to Petroleum Engineering at UWI, including scholarship support, running a student paper and welcoming students to their meetings and conferences.
2.7.6 **PVT Laboratory**
The Unit has a PVT facility which can be used for determining the properties of reservoir fluids to be used in reservoir evaluations for the oil and gas fields of Trinidad & Tobago.

2.7.7 **MSc in Petroleum Engineering**

2.7.8 **Programme of Study**

2.7.9 The Regulation for the MSc (Eng) in Petroleum Engineering, Petroleum Engineering & Management and Petroleum Management are the same as the General Regulations for the MSc (Eng) in the Faculty of Engineering, except that the candidates applying for registration should have at least:

   a. a Second Class Honours degree in Engineering/ Natural Sciences (Physics & Chemistry majors)/ Earth Sciences;
      or

   b. an equivalent qualification, in respect of either Engineering and/or Management.

2.7.10 A candidate applying for registration with a Pass degree may be considered for entry provided the candidate has acceptable industrial experience.

2.7.11 An MSc (Eng) candidate in Petroleum Engineering will be required to pursue a course of study approved by the Board of the Faculty of Engineering. Such a course of study will normally be made up of eight (8) of the following courses and a Project (1 course):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PENG 6000</td>
<td>Petroleum Geoscience (PE60D)</td>
</tr>
<tr>
<td>PENG 6001</td>
<td>Advanced Petroleum Geology &amp; Geophysics (PE60B)</td>
</tr>
<tr>
<td>PENG 6002</td>
<td>Drilling Engineering &amp; Completions (PE61D)</td>
</tr>
<tr>
<td>PENG 6003</td>
<td>Advanced Drilling Engineering &amp; Well Completions (PE61B)</td>
</tr>
<tr>
<td>PENG 6004</td>
<td>Advanced Production Engineering &amp; Technology (PE61C)</td>
</tr>
<tr>
<td>PENG 6005</td>
<td>Reservoir Evaluation (PE62D)</td>
</tr>
<tr>
<td>PENG 6006</td>
<td>Advanced Well Test Analysis (PE62B)</td>
</tr>
<tr>
<td>PENG 6007</td>
<td>Reservoir Engineering (PE63A)</td>
</tr>
</tbody>
</table>

Each candidate will also be required to submit a Project Report PENG 6019 (PE69A). Please note that not all courses will be offered in any given year.

2.7.12 **Credits for Diploma Courses towards the MSc Degree**

2.7.13 Holders of the Postgraduate Diploma in Petroleum Engineering, Petroleum Engineering and Management or Petroleum Management will be granted credit for courses completed in the programme if they are subsequently admitted to the MSc degree, provided that not more than five (5) years have elapsed since the date on which such courses were passed.

2.7.14 **Duration of Study**

2.7.15 As follows:

   a. The MSc is offered to full-time and part-time students.

   b. Full-time students will normally be required to complete the written examinations within one (1) year of registration and must normally complete the programme within three (3) years.

   c. Part-time students will normally be required to complete the written examinations within two (2) years of registration and must normally complete the programme within five (5) years.
2.7.16 Examination

2.7.17 As follows:

a. Evaluation in all courses will normally be by coursework and final examination. Candidates will be required to pass both the coursework and examination.

b. In PENG 6019 (PE69A) - MSc Petroleum Project - evaluation will be on the report. Candidates may also be orally examined.

Students will, in addition, be required to present a Paper at a seminar.

2.7.18 Short Courses and Seminars

2.7.19 The programme in Petroleum Engineering and Management also includes short courses and seminars on topics of interest to supervisors, engineers and managers in the petroleum industry. These are on subjects of topical interest and are organised frequently in response to the identified needs and problems. For further details on these short courses or general advice on the programme, you are invited to contact the Head, Department of Chemical Engineering.

2.8 Postgraduate Diploma in Petroleum Engineering

2.8.1 Candidates will be required to follow three of the following courses:

- PENG 6000 Petroleum Geoscience (PE60D)
- PENG 6001 Advanced Petroleum Geology & Geophysics (PE60B)
- PENG 6002 Drilling Engineering & Completions (PE61D)
- PENG 6003 Advanced Drilling Engineering & Well Completions (PE61B)
- PENG 6004 Advanced Production Engineering & Technology (PE61C)
- PENG 6005 Reservoir Evaluation (PE62D)
- PENG 6006 Advanced Well Test Analysis (PE62B)
- PENG 6007 Reservoir Engineering (PE63A)
- PENG 6008 Advanced Reservoir Engineering (PE63B)
- PENG 6010 Improved Oil Recovery (PE64E)
- PENG 6012 Natural Gas Engineering (PE65B)
- PENG 6015 Production Engineering (PE66A)
- PENG 6016 Petroleum Economics & Management (PE68B)
- PENG 6017 Selected Topics (PE67B)

Each candidate will also be required to submit a Project Report PENG 6019 (PE69A). Please note that not all courses will be offered in any given year.
2.9 Postgraduate Diploma in Petroleum Engineering & Management

2.9.1 Candidates will be required to follow three of the following courses:

- PENG 6002 Drilling Engineering & Completions (PE61D)
- PENG 6003 Advanced Drilling Engineering & Well Completions (PE61B)
- PENG 6006 Advanced Well Test Analysis (PE62B)
- PENG 6007 Reservoir Engineering (PE63A)
- PENG 6008 Advanced Reservoir Engineering (PE63B)
- PENG 6009 Strategic Petroleum Management & Organisations (PE64A)
- PENG 6010 Improved Oil Recovery (PE64E)
- PENG 6011 Petroleum Economics, Law & Contract Administration (PE65A)
- PENG 6012 Natural Gas Engineering (PE65B)
- PENG 6015 Financial Management & Accounting (PE66A)
- PENG 6020 Human Resource Management (PE67A)

Each candidate will also be required to submit a Project Report PENG6019 (PE69A).

2.11 Entry Requirements to the Diploma Programme

2.11.1 To be admitted to the prescribed course of study, candidates must be:

- in possession of at least a Second Class Honours degree from an approved university, in Engineering or Natural Sciences (Physics, Chemistry, or Mathematics majors) or Earth Sciences, and at least one (1) year of relevant industry experience. A candidate applying for registration with a Pass degree may be considered for entry provided the candidate has acceptable petroleum industry experience.

- in possession of an equivalent qualification which will include a combination of academic training and petroleum industry experience and which is acceptable to the Board for Graduate Studies.

2.11.2 A candidate for admission to the Postgraduate Diploma may be required to sit a qualifying examination. Candidates may be restricted by the Department to certain subject areas in the course of study.

2.11.3 Duration of Study

2.11.4 As follows:

a. The Postgraduate Diploma is offered to full-time and part-time students.

b. Full-time students will normally be required to complete the written examinations within one (1) year of registration and must normally complete the programme within three (3) years.

c. Part-time students will normally be required to complete the written examinations within two (2) years of registration and must normally complete the programme within four (4) years.

d. The project should be started at the commencement of the semester following the completion of the written examinations and completed within six (6) months for full-time or nine (9) months for part-time students.
2.11.5 Examination

2.11.6 As follows:

a. Evaluation in all courses will normally be by coursework and final examination. Candidates will be required to pass both the coursework and the examination.

2.12 MPhil in Petroleum Engineering
MPhil in Petroleum Geoscience
MPhil in Geoscience

2.12.1 The Regulations for the MPhil in Petroleum Engineering, Petroleum Geoscience or Geoscience are the same as the General Regulations for MPhil, except that candidates applying for registration should normally have either:

a. a Bachelor's degree in Petroleum Engineering or

b. an equivalent qualification or

c. a Diploma in Petroleum Engineering with a Pass with Credit (at least 60%) of The University of the West Indies

2.12.2 Graduates in the fields of geology/geophysics, natural sciences, and engineering (other than petroleum engineering) may be required to do qualifying examinations to become eligible for entry into the programme unless such a graduate possesses adequate and practical experience in industry, in which case only Departmental examinations will be required.

2.13 PhD in Petroleum Engineering
PhD in Petroleum Geoscience
PhD in Geoscience

2.13.1 The appropriate University and Faculty of Engineering Regulations for the degree of Doctor of Philosophy shall apply.

2.13.2 Candidates applying should normally have either:

a. a Master's degree in Petroleum Engineering of The University of the West Indies or an approved University or

b. an equivalent qualification

2.14 Syllabuses in Petroleum Engineering

PENG 6000 (PE60D)
Petroleum Geoscience

Introduction to Geology, Earth Structure, Plate Tectonics, Geological Time and History; Minerals and Rocks; Rock Forming Processes with Environments of Deposition; Sedimentary basins; Structural Geology and Hydrocarbon Traps; Origin, Migration and Accumulation of Petroleum; Composition of Hydrocarbons and Reservoir Characteristics. The petroleum reservoir; Geophysical exploration techniques. Mapping - Surface and Subsurface; Geological Laboratory. Field Trip. Petroleum Engineering vocabulary; Units. Pressures. Routine core analysis, laboratory procedures. Characteristics of reservoir rocks; pore space representation. Porosity; saturation; Volumetric representation of hydrocarbon in place. Permeability, Darcy and non-Darcy Flow; linear and radial flow; datum correction; Saturation effects; capillary pressure, relative permeability essentials.
PENG 6001 (PE60B)
Advanced Petroleum Geology & Geophysics
Interpretation of geological and geophysical data; Geological history of Trinidad & Tobago; Structural and stratigraphic setting of hydrocarbon occurrences; Hydrocarbon prospects; Evaluation of prospects; Seismic acquisition; Processing and interpretation of 2-D and 3-D data; Case studies.

PENG 6002 (PE61D)
Drilling Engineering & Completions
Rotary drilling rigs. Rig components, Drilling bits and bottom-hole assemblies; Coring. Drilling fluid systems. Mud engineering; Subsurface control and safety; Blowout prevention and wellhead equipment; Bore hold stability; Pressure losses; Rig hydraulics; Deviated drilling; Directional drilling; Horizontal well drilling; Hole problems and solutions; Fishing and stuck pipe; Drill string and casing string design; Solids removal; Pore pressure prediction and fracture hydraulics; completion techniques; Casing strings and setting depths. Subsea completions; Computer modelling: AFE; Offshore drilling and equipment. Drilling Safety. Drilling practice in Trinidad. Well completion design. Casing, Tubing & Wellhead Equipment; Packers; Downhole Tubulars; Subsurface control and safety; Cementing; Perforating; Completion/Workover fluids; Sand control; wireline operations; Coiled Tubing; Stimulation; Horizontal wells; Workover Programmes; Case studies.

PENG 6003 (PE61B)
Advanced Drilling Engineering & Well Completion
Drilling fluids; Surface chemistry; Non-Newtonian flow and pressure losses in the circulating system; Surge and swab pressures; Solids removal; Pore pressure prediction and fracture hydraulics; Blowout prevention and wellhead equipment; Bore hold stability; Deviated drilling; Hole problems and solutions; Drill string and casing string design; Offshore drilling and equipment; Cementing, completion techniques; Completion/ workover fluids; Subsea completions; Rig selection and evaluation; Bid evaluation; Sand control; Stimulation; Computer modelling; Case studies.

PENG 6004 (PE61C)
Advanced Production Engineering & Technology
Concept of nodes in the total production system; Inflow performance relationships; Single and multiphase flow; Nodal analysis; Natural and artificial lift methods and equipment; Production processes at surface; Control and instrumentation; Production logging; Pressure and rate measurement; Subsurface control and safety; Wellhead systems; Production economics.

PENG 6005 (PE62D)
Reservoir Evaluation
Well logging: Logging methods and interpretation techniques; Conditions around the wellbore, effects on measurements of mud filtrate invasion, formation contents etc. The terminology of well logging. Sw, Sxo, Rt, Rxo etc. Formation and fluid properties; The physical principles involved in geophysical well logging; electrical logs; sonic log; radioactivity logs; dipmeter log. The Archie Equations in clean formations. Discussion of the uncertainties involved. Estimation of porosity in different lithologies. Cross-plots for porosity and lithology, uncertainties. Estimation of water saturation. Gas effects. Differentiation between gas and oil hydrocarbon saturation. Effects of shaliness and modified equations. Shale estimation. Computed logs; Local field examples.

Well testing: Principles of Pressure Transient Test Analysis; the Diffusivity Equation; Analysis of Buildup and Drawdown Tests; Multi-rate testing; Type-curve Analysis; Determination of skin; wellbore storage, drainage radius and stabilisation time; Gas well-testing; Real gas potential application; Other well tests. Gas well-testing; computer logging packages. Local field examples.

PENG 6006 (PE62B)
Advanced Well Test Analysis
Diffusivity equation; Constant rate and constant pressure; Solutions; Effects of total skin and wellbore storage; Type-curve analysis; Varying wellbore storage; Determination of average pressure; Radius of drainage and stabilisation time; Multiphase flow; Real gas potential application; Multi-rate, interference, pulse and vertical permeability nesting; Layered systems; Fractured reservoirs; Faults; Channel sands; Use of pressure and its time derivative in type curve matching; Gas well-testing; MHF.
PENG 6007 (PE63A)  
Reservoir Engineering  
Hydrocarbon Composition; Properties of reservoir rocks and fluids; Phase behaviour; Vapour-liquid Equilibria; Oil and gas reservoirs; Drive mechanisms; Pore Volume Compressibility; Reservoir mechanics: PVT Analysis, General material balance; Natural water influx.

PENG 6008 (PE63B)  
Advanced Reservoir Engineering  
Dry gas, gas-condensate and oil reservoirs; Material balance and applications; Drive mechanisms; Tarner’s method; Natural water influx; Immiscible flooding; Reservoir simulation - single and multi-phase; Compositional simulators; Computer exercises.

PENG 6009 (PE64A)  
Strategic Petroleum Management & Organisations  
The nature and role of strategy in petroleum operations; Involvement of strategy in organisations; Structuring change; Leadership styles; Life cycles; Range of strategic planning and organisational behaviour; Learning and Development; Communicating strategy; Corporate cultures; Analysis of the corporate environment; Response to challenges.

PENG 6010 (PE64E)  
Improved Oil Recovery  
Water influx; Waterflooding; Problems of waterflooding. Models - Buckley Leverett, Stiles. Miscible and Immiscible Fluid Displacements; Carbon dioxide flooding; Ternary Diagrams; Minimum Miscible Pressure; Thermal methods of oil recovery; Heavy oil problems relevant to Trinidad. Well completion types for thermal processes; Other IOR processes. Screening Criteria; Reservoir simulation - single and multi-phase; Computer exercises.

PENG 6011 (PE65A)  
Petroleum Economics, Law & Contract Administration  
World energy supply/demand; Oil pricing; Petroleum leasing/contracts; Petroleum taxation; Comparison of petroleum natural gas; Managing petroleum resources; Petroleum act and regulations; Petroleum taxes act; Income tax in aid of industry act; Contractual arrangements; Drilling contracts; Natural gas contracts; Service (rental) contracts; Services contracts; Oil sales/purchase contracts.

PENG 6012 (PE65B)  
Natural Gas Engineering  
Properties of Natural Gas Systems; Gas Volumes; Reserve estimates; Pressure Transient Testing of Gas Wells; Deliverability Testing of Gas Wells; Gas Flow Measurement; Compression of Natural Gas; Gas Conditioning and Processing; Uses of natural gas; LNG; Field Development/Management; Gas Transmission/Pipeline Design Considerations; Offshore Operations; Gas Contracts.

PENG 6013 (PE66A)  
Financial Management & Accounting  
Basic principles of financial management; Financial reporting and the local regulatory framework; Financial ratio analysis; Corporate report analysis; International differences in petroleum finance; Budgeting and budgetary control; Short-term decision analysis; Long-term decision analysis; Introduction to strategic financial management; Balance sheets; Profit and loss accounts; Management of working capital; Preparation of management accounting statements; Investment appraisal techniques.

PENG 6014 (PE66C)  
Offshore Structures & Systems  
Oil and gas production facilities; Dynamics of floating structures; Floating production systems; Offshore loading; Offshore storage facilities; Articulated columns; Submerged production systems.
PENG 6015 (PE66E)
Production Engineering
Productivity Index (PI) and the Inflow Performance Relationships (IPR) for oil and gas wells. Single and multiphase flow; tubing sizing; Nodal analysis; Natural and artificial lift methods and equipment; Typical production profiles (plateau and exponential decline). Control and instrumentation; Pressure and rate measurement; Production logging; Surface operations; Wellhead systems; Surface facilities - onshore, offshore. Design and operation of crude oil separation, Emulsion breaking; liquid recovery. Gas production. Sand control; Wax and asphaltine problems. Hydrate prevention; Stimulation – acidisation and fracturing, HSE in production. Local field examples.

PENG 6016 (PE68B)
Petroleum Economics & Management
World energy supply/demand; Oil pricing; Petroleum taxation systems and comparisons; Cash flow, profit and profitability; Uncertainty and risk; Incremental investments; Contractual arrangements; Economic issues in natural gas; Managing petroleum resources.

PENG 6017 (PE67B)
Selected Topics
To include Petroleum Economics and Taxes, Management and Safety; Field Design Project. Coursework only.

PENG 6018 (PE67A)
Human Resource Management
Social environment of the petroleum industry; Managing change and creating effectiveness; Management structures; Diagnosis of change; Conflict management; Leadership; The strategy; Human resource planning; Organisations and culture; Communication; Labour markets; Trade unions and the collective bargaining process in petroleum industries; Work design and motivation; Management development; Evaluation and reward.

PENG 6019 (PE69A)
Project
Each candidate will also be required to submit a Project Report of an individual analysis of a problem.

PENG 6020 (PE65C)
Economic & Quantitative Aids to Decision-Making
Linear programming; Non-linear programming; Network planning techniques; Simulation in petroleum industry situations; Demand and supply of key commodities in the petroleum industry; Demand analysis; Energy market structures; Pricing practices; The role of the state in the market economy; Decision-making under uncertainty, time value of capital, correlation and regression analysis, analysis of time-series data, stochastic decision-making and Markov Analysis; Other decision-making models.

PENG 6021 (PE66B)
Petroleum Production Planning & Control
Decision theory; Forecasting techniques in petroleum production operations; Processing and capacity planning; Inventory management; Material requirement planning; Sequencing and line balancing; Scheduling operations; Resource allocation; Project management techniques.

PENG 6022 (PE69B)
Maintenance & Safety Management
Maintenance activities; Types of maintenance; Trouble-shooting; Production equipment; Drilling equipment and maintenance; Scheduling planning activities for maintenance; Repair and programming design and evaluation; Health safety and welfare; Provision and role of the management in safety and awareness; Management of health; Occupational safety; Accidents and their causes; Financial implications of accidents; Protective devices; Legislation for safety and environmental issues.
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Head of Department
Mr. Raymond F. Charles

Administrative Assistant
Mrs. Andrea Perreira

Secretary
Ms. Rohanna Rafeek

Telephone No: 662-2002; Ext: 2501

3.1 Research

3.1.1 Civil Engineering is intimately concerned with what is called the ‘Built Environment’. In this regard, it is directed at the provision of facilities that can be used beneficially by the community. Clearly, such facilities condition the process of social and economic development and to a large extent, mirror them. The civil engineering industry is therefore of strategic national and regional importance in the Caribbean. An important aspect of research in the Department is the role of the construction sector in the local national economies.

3.1.2 Because civil engineering works are essentially ‘resource hungry’, that is to say, they consume large quantities of materials in their creation, there is a considerable potential for cost savings in the use of materials for construction. One way of achieving this is through more imaginative use of traditional materials. Another is to develop entirely new materials from indigenous sources. Materials research is therefore an area accorded high priority by the Department.

3.1.3 Other areas of priority take account of the special conditions under which civil engineering works are carried out in the Caribbean. This is true of the organisation and management of labour, the techniques of construction, operation and maintenance of facilities, no less than of the design of systems and the specification of materials. Additional focus is also placed on Hazard Resistant Construction and Coastal Engineering.

3.1.4 The research interests of the Department are thus related directly to the critical needs and interests of the wider community. Towards this end, it seeks to cultivate links with organisations and interest groups outside the University. Research funded by the National Institute of Higher Education Research, Science and Technology (NIHERST), TANTEAK, IDRC and the EU are typical examples. Funds are also obtained from international sources such as the British Council. The facilities provided are good and constantly being improved. There are eight laboratories: Structures, Concrete, Fluid Mechanics, Environmental Engineering, Soil Mechanics, Highway Materials, Geology and Transportation, to which has recently been added a new computing facility.
3.1.5 The main areas of research can be listed as follows:

- Civil Engineering Economics
- Civil Engineering Project Management
- Computer-aided Engineering & Design
- Disaster Mitigation & Management
- Environmental Engineering
- Materials Engineering
- The Analysis & Design of Foundations
- The Analysis & Design of Hydraulic Systems
- The Analysis & Design of Structures
- Transport Engineering
- Other areas of research related to the Construction programme are indicated in Section 3.5.4.

The Department offers programmes of study by research leading to the MPhil and PhD degrees in Civil Engineering in all its areas of specialty.

3.2 **Staff in the Department**

The principal teaching and research interests of staff in the Department are as follows:

**PROFESSORS EMERITUS**

- **Ignatius D.C. Imbert,**
  ME (NU), PhD (Dub), EurIng, CEng, MIEI, MASCE, FAPETT
  (Construction Engineering & Management Concrete Technology)

- **Harry O. Phelps,**
  CMT, BSc (Wales), DIC (Lond), PhD (Manch), FICE, CEng, FAPETT
  (Fluid Mechanics, Hydrology & Environmental Engineering)

**PROFESSORS**

- **Anil K. Sharma,**
  BSc (BHU), ME (Roorkee) PhD (Raj), MICE, MSET, MISTE, MACI, MAPETT, MASCE, MIFS, CEng
  (Structural Analysis & Design)

- **Winston H.E. Suite,**
  BSc (SpPhys), BSc, MSc, PhD (UWI), FAPETT, MASCE
  Programme Leader, Materials & Concrete
  (Technology, Construction Engineering & Management, Building Contracts)

- **Chintanapalli Venkobachar,**
  BSc (Maths Major, Phys, Chem) (SVU, Tirupali), BTech (IIT, Madras), MTech, PhD (IIT, Kanpur)
  (Environmental Engineering)

- **Patrick Holmes,**
  BSc, PhD (Swansea), MICE, Hon MCGI
  (Visiting Professor, Imperial College, University of London)

**SENIOR LECTURERS**

- **Raymond F. Charles,**
  BSc (Eng), MPhil (UWI), MAPETT, FIAT, FICE, REng
  Head of Department
  (Highway/Road Materials Design),

- **Timothy M. Lewis,**
  MEng (L’pool), MSc (Stirling), PhD (UWI), MICE, CEng, MAPETT, FASCE
  (Construction and Project Engineering, Management & Economics, CAD)

- **Robin W.A. Osborne,**
  BSc, PhD (UWI)
  (Concrete Technology & Testing Construction Materials Building Maintenance & Repair)

- **Kangala N. Ramamurthy,**
  BE (Madras), MTech, PhD, IIT (Madras)
  (Construction Engineering & Management Building Technology)

- **Gyan S. Shrivastava,**
  BTech, MTech (IIT), MSc (Lond), PhD (UWI), CEng, MICE
  (Fluid Mechanics, Hydrology)

**LECTURERS**

- **Dilip Baidya,**
  BE (Eng) (Calcutta), MTech, PhD (IISC) (Bangalore)
  (Geotechnical Engineering)

- **Tariq Cheema,**
  BSc (Punjab), MSc (Leeds), PhD (South Dakota)
  (Engineering Geology, Hydrogeology & Environmental Geology)

- **Richard Clarke,**
  BSc, MPhil, PhD (UWI), MIFS, CQE, REng
  (Structural Analysis & Design)
The Faculty of Engineering

- **Vincent Cooper,**
  MEng (McGill), MASC (Nova Scotia), BSc (Eng), PhD
  (Water Resources)

- **Derek Gay,**
  BSc (UWI), DIC, MSc (Lond), PhD (Texas), MAPETT
  (Geotechnical Engineering, Coastal Zone Engineering)

- **Joanna Ibrahim,**
  BSc (Oceanography), MSc, PhD (Plymouth)
  (Coastal Zone Engineering & Management)

- **Ian Khan-Kernahan,**
  BSc, MSc (Maths) (Lond), BSc, PhD (UWI), MAPETT
  (Structural Analysis & Design, Information Technology)

- **Madaniyo Mutabazi,**
  BSc (Eng) (Dar Es Salaam), MSc (Wisconsin), PhD
  (Kansas)
  (Transportation Engineering)

- **Everson Peters,**
  BSc (UWI), MSc (Guelph), PhD (New Zealand)
  (Water Resources & Environmental Engineering)

- **Keith Sirju,**
  BSc (UWI), DIC, MSc (Lond), CEng, MAPETT, FASCE, MICE
  (Structural Analysis & Design)

**PART-TIME LECTURERS**

- **Kenrick Burgess,**
  BSc (Hons) (UWI), MBA (Brunel), Dip Con Eng & Man,
  Dip PA (UWI), Dip Man (UK), MA
  (Project Management)

- **Myron W. Chin,**
  BSc (Loughb), PhD (Manch), CEng, FICE, MASCE,
  FAPETT, FIStructE
  (Construction Engineering & Management,
  Natural Hazards)

- **Francis Ellis,**
  MSc (CE&M), DipUM (Wales)
  (Quantity Surveying)

- **Constantin Stere,**
  BSc, MSc, PhD (Romania)
  (Coastal Zone Engineering)

**HONORARY FELLOWS**

- **Dave Basco,**
  PhD, PE (USA)
  (Coastal Engineering)

- **Selwyn Lee Young,**
  BSc (Eng), PhD (Liverpool)
  (Professional Practice)

**RESEARCH ASSISTANTS**

- **Ravi Baboolal,**
  BSc (Eng) (UWI)
  (Water Resources)

- **Anameka Dharry,**
  BSc (Eng) (UWI)
  (Natural Hazards)

- **Candice Gray,**
  BSc (Eng) (UWI)
  (Beach Management)

- **Deborah Lamb,**
  BSc (Eng) (UWI)
  (Coastal Zone Engineering)

- **Christina Rodriguez-Stewart,**
  BSc (Human Ecology), MSc (UWI)
  (Civil Engineering)

- **Ian Samaroo,**
  BSc (Eng) (UWI)
  (Structural Engineering)

- **Kiola Swanston,**
  BSc (Earth Science) (UWI)
  (Coastal Zone Management)
3.3 Faculty of Engineering/Industry Advisory Committee

* Mr. Tony Gibbs  
Managing Director  
CEP Limited (Barbados)

* Mr. Errol Grimes  
Chief Executive Officer  
Water & Sewerage Authority (WASA)

* Mr. Dave MacIntosh  
Chief Executive Officer  
Environmental Management Authority (EMA)

* Mr. Ronald Nurse  
Chief Executive Officer  
Trintoplan Consultants Limited

* Mr. Winston Riley  
President  
Joint Consultative Council (JCC)

3.4 Programme in Construction Engineering & Management

3.4.1 The practice of civil engineering involves a series of decisions having to be made on choices from a diverse and complex set of alternatives. Such choices are often interrelated and are usually urgent.

3.4.2 Decisions have to be made throughout the life of a project from the basis of the initial conception through the design phase, and material and procedure selection to the construction and commissioning of the completed structure.

3.4.3 At any stage, the effectiveness of the whole process can be compromised by poor decision-making. As a result, a heavy demand is placed upon both the managerial and technical skills of the engineers involved.

3.4.4 The primary objective of the MSc/Diploma programme is to improve the decision-making capabilities of engineers and other construction professionals in the region, with a view to improving the efficiency and effectiveness of the whole construction process.

3.4.5 There has been a continuing tendency for civil engineering projects to become both increasingly large and increasingly complex. This has naturally resulted in the technical and managerial functions not only becoming more difficult but also becoming more important.

3.4.6 As a result, there is a continuing need to provide training programmes that upgrade the skills and capabilities of engineers and other construction professionals in modern engineering and managerial techniques. An important secondary objective of the MSc/Diploma programme is to provide this service.

3.4.7 In more general philosophic terms, the goals of this programme are to provide instruction in a range of engineering, economic and managerial subjects that should enable engineers and construction professionals to be better able to deal with the problems that can occur on a construction project.

3.4.8 By allowing a wider perspective of engineering technology and economy to be taken, it is anticipated that the quality of engineering management should thereby improve.

3.4.9 The programme should also equip engineers and construction professionals to apply modern knowledge effectively in the real, competitive world of industry, and hence to assist the nations of the regions in their bid for modernisation and development.

3.4.10 The programme is also directed towards fostering the advancement of knowledge through the promotion of research into the problems and opportunities that face the construction sector.

3.4.11 Emphasis is placed upon the publication and presentation of the results of this research to the widest possible national and international audience.

3.4.12 Clearly the spin-off benefits of this programme include enhancing the initiative, creativity and purposeful thinking that are generated in those who participate.
3.5 **Postgraduate Diploma in:**
- **Construction Management**
- **Construction Engineering**
- **Construction Engineering & Management**

3.5.1 Before registration as a student of the University proceeding to the Postgraduate Diploma in Construction Engineering, Construction Management or Construction Engineering & Management, a candidate must have the following:

i. A first degree or equivalent qualification in Civil, Structural, Construction, Building or Architectural Engineering;
   or

ii. A first degree or equivalent qualification in Architecture or Quantity Surveying;
   or

iii. An equivalent qualification acceptable to the Faculty of Engineering.

Any candidate for the Diploma may be required to sit an entrance examination and/or complete an introductory/qualifying course before being granted permission to read for the Diploma. In addition, candidates seeking admission under (ii) or (iii) may be restricted to certain subject areas in the Course of Study.

3.5.2 Candidates for the Diploma will be required to follow the prescribed Course of Study for not less than one (1) academic year (full-time) or two (2) academic years (part-time).

3.5.3 The courses offered are grouped into core subjects and optional subjects. The core subjects are:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COEM 6000</td>
<td>Structure &amp; Operation of the Construction Sector (CE60A)</td>
</tr>
<tr>
<td>COEM 6003</td>
<td>Organisation &amp; Management of Construction (CE61A)</td>
</tr>
<tr>
<td>COEM 6005</td>
<td>Construction Project Management (CE62A)</td>
</tr>
<tr>
<td>COEM 6007</td>
<td>Human Resource Management &amp; Industrial Relations in Construction (CE63A)</td>
</tr>
<tr>
<td>COEM 6009</td>
<td>Contracts Management &amp; Construction Law (CE64A)</td>
</tr>
<tr>
<td>COEM 6011</td>
<td>Construction Economics (CE65A)</td>
</tr>
</tbody>
</table>

The optional subjects are:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COEM 6001</td>
<td>Infrastructure Planning &amp; Construction (CE60B)</td>
</tr>
<tr>
<td>COEM 6005</td>
<td>Construction Equipment (CE61B)</td>
</tr>
<tr>
<td>COEM 6006</td>
<td>Construction Accounting &amp; Finance (CE62B)</td>
</tr>
<tr>
<td>COEM 6008</td>
<td>Strategic Land Use Planning &amp; Development (CE63B)</td>
</tr>
<tr>
<td>COEM 6010</td>
<td>Structural Design (CE64B)</td>
</tr>
<tr>
<td>COEM 6012</td>
<td>Geotechnics in Construction (CE65B)</td>
</tr>
<tr>
<td>COEM 6013</td>
<td>Materials Technology (CE66B)</td>
</tr>
<tr>
<td>COEM 6014</td>
<td>Construction Materials (CE67B)</td>
</tr>
<tr>
<td>COEM 6015</td>
<td>Maintenance &amp; Facilities Management (CE68B)</td>
</tr>
<tr>
<td>COEM 6016</td>
<td>Natural Hazards Management (CE69B)</td>
</tr>
<tr>
<td>COEM 6017</td>
<td>Construction in Hazard-Prone Areas (CE69C)</td>
</tr>
</tbody>
</table>

3.5.4 Candidates pursuing a Postgraduate Diploma will be required to follow and sit examinations in six (6) courses.

3.5.5 They will also be required to carry out coursework as prescribed and to complete and submit a project report.

3.5.6 The examination will be conducted by means of written papers, coursework and project report. Candidates may also be orally examined on any part of the examination.

3.5.7 Part-time students will be required to complete the written examinations and submit the project within two (2) academic years.
3.5.8 Successful completion of the examinations will lead to the award of a Diploma in Construction Engineering or Construction Management or Construction Engineering & Management. The designation will depend upon the course combinations.

3.6 **MSc (Eng) in Construction Engineering & Management**

3.6.1 The Regulations for the MSc (Eng) in Construction Engineering & Management are the same as the General Regulations for the MSc (Eng) in the Faculty of Engineering except that candidates applying for registration should normally have either:

i. A *Bachelor’s degree in Civil, Structural, Construction or Building Engineering*;
   or

ii. An *equivalent qualification*.

3.6.2 An MSc (Eng) candidate in Construction Engineering & Management will be required to pursue a programme of study approved by the Board of the Faculty of Engineering. Candidates will be required to follow and sit examinations in the six (6) core courses as well as:

- COEM 6010 Structural Design (CE64B)
- COEM 6012 Geotechnics in Construction (CE65B)
- COEM 6014 Construction Materials (CE67B)
- COEM 6016 Natural Hazards Management (CE69B)

and three (3) other courses from the list.

The student is also required to submit a research project. Part-time students will be required to complete within two (2) calendar years.

3.6.3 Full-time students will be required to take examinations in all the courses by the end of the first year.

3.6.4 Holders of the Diploma in Construction Engineering or the Diploma in Construction Management or the Diploma in Construction Engineering & Management who qualify for registration under Regulation 3.5.1 may be allowed to register for the MSc (Eng) in Construction Engineering & Management. Once accepted, such candidates will be registered as part-time students and will be required to take examinations in the remaining prescribed courses by the end of the academic year in which they are registered.

3.6.5 Candidates may proceed to the project only after successful completion of all the courses and may be registered to complete the project either as full-time or part-time students.

3.7 **MSc (Eng) in Construction Management**

3.7.1 Candidates applying for registration should normally have either:

i. A *Bachelor’s Degree in Civil, Structural, Construction, Building Engineering, Quantity Surveying, Land Surveying*, or

ii. An *equivalent qualification*.

3.7.2 An MSc candidate in Construction Management will be required to follow and sit examinations in the six (6) core courses as well as six (6) other courses selected from:

- COEM 6001 Infrastructure Planning & Construction (CE60B)
- COEM 6004 Construction Equipment (CE61B)
- COEM 6006 Construction Accounting & Finance (CE62B)
- COEM 6008 Strategic Land Use Planning & Development (CE63B)
- COEM 6013 Materials Technology (CE66B)
- COEM 6015 Maintenance & Facilities Management (CE68B)
3.7.3 The student is also required to submit a research project.

Part-time students will be required to complete within two (2) calendar years.

3.7.4 Short Courses and Seminars

3.7.5 The Programme in Construction Engineering & Management also includes Short Courses and Seminars on topics of interest to the sector. These are on subjects of topical interest and are organised at various times in response to identified needs and problems.

3.7.6 Details of Short Courses and Seminars are advertised widely and notified to appropriate individuals as and when details are finalised.

3.7.7 For further details of the courses and the programme syllabus, or general advice on the programme, please contact the Head, Department of Civil & Environmental Engineering.

3.8 Syllabuses

COEM 6000 (CE60A)
Structure & Operation of the Construction Sector

Structure of the local, regional and international construction sector, relationship to the other sectors in economic and social development; role of each of the principal actors and relationship between them; impact of government policy, legislation and national planning; development of needed materials and human resources; domestic and international funding; international contracting, tendering and dispute resolution; impact of climate, level of technological development and cultural/religious peculiarities, internal and external demand for construction.

COEM 6001 (CE60B)
Infrastructure Planning & Construction

Introduction: Infrastructure and economic development; Factors affecting size, site and route selection; System identification; Potable water, sewerage, drainage, road and rail network, bridges, airports, sea and river ports, dams, transmission systems (pipes and lines); Government policy and legislative policy; Ownership and funding; Vulnerability to natural disasters; Construction methods and techniques, equipment and technology; Coastal protection works and land reclamation.

COEM 6002 (CE60C)
The Project

The research project takes the form of an investigation into a topic of significance to the construction sector, and is intended to ensure the capacity of the student to apply skills acquired within the prescribed courses. It is executed under the direction of one or more supervisors approved by the Department, and is examined by the submission of a written report, which is required to conform to the general standards for MSc projects within the Faculty of Engineering. The project shall be formally assigned as soon as practicable after the results of the written examinations are available, and in any case not normally later than July 1 in any year. The project shall normally be completed within three (3) months of being assigned, i.e., by the end of September of the year in question. Any project not completed at the end of December of the year of assignment shall require formal approval of extension of time.
**COEM 6003 (CE61A)**
**Organisation & Management of Construction**
The functions of managers; planning, organising, controlling and leading. The role of managers; interpersonal, informational and decision-making. The evolution of management thought, from the Industrial Revolution to now. Professional ethics and the engineer/manager. Problem-solving and decision-making. Initiative and creativity. Information Technology (IT) and management information systems (MIS), and the role of computers in information management. The management of quality; TQM and ISO 9000.

**COEM 6004 (CE61B)**
**Construction Equipment**
Major types and items of equipment in use in construction; their operating features, capacities, maintenance requirements, service life, limitations, etc. Cranes, conveyors, earthmoving equipment, concrete mixers and transporters, concrete finishing equipment, paving equipment, vehicles, pumps, etc. Small equipment: vibrators, power tools, manual tools, personal protective equipment; Ergonomic and safety implications for users, their implications for productivity; Pilferage, theft, off-site usability, training requirements, etc. Fixed items: scaffolding, ladders, props, jacks, walking boards, hoardings, safety nets; formwork and falsework.

**COEM 6005 (CE62A)**
**Construction Project Management**
This course addresses the culture, principles and techniques of project and programme management. The following are covered: What is a project? What is project management? The project life cycles for different industries, project context: planning the project (project selection - tools and techniques), scope management defining the project. Project planning, work breakdown structures, Gantt Chart, PERT Chart, CPM, preparing the master plan, project budgeting, responsibility matrix, communication plan, project criterion for success, project control (project baseline, status reporting, control cycle, monitoring and control tools, resource grading, change control, resource levelling, variance reporting tools, project audit). Implementation, project finalisation and close-out. Project cost, risk and quality management. What is programme management, benefits of programme management, programme management organisation/programme planning, benefits management, stakeholder management, programme management processes, effective project and programme teams. The project support office, audit, applications of project management software, e-business programme management.

**COEM 6006 (CE62B)**
**Construction Accounting & Finance**
COEM 6007 (CE63A)
**Human Resource Management**
& Industrial Relations in Construction
Identification of skills required, manpower planning and development, education, training, recruitment, certification; Leadership in construction, motivation, teamwork, productivity calculus. Industrial climate, politics, trade unionism; Health and safety, labour legislation; Negotiations and dispute resolution.

COEM 6008 (CE63B)
**Strategic Land Use Planning & Development**
National Physical Development Plans; Town and Country Planning Act; Building Regulations, Site-Specific Plans; Renewal and Development of Urban Slums, Squatter Settlements, Rural Communities, Feasibility Studies and EIA’s; Vulnerability of Satellite Residential Communities and Industrial Disasters, Natural Disasters and Disaster Management Site-Specific Plans, Special problems with development of mega-projects.

COEM 6009 (CE64A)
**Contract Management & Construction Law**
An introduction to the different legal systems. The impact of law on the delivery of engineering goods and services; Law and the construction sector. The making of law and the courts; litigation. The elements of contract law and relation with the construction sector. Types of contracts; Different procurement systems; Standard form building contracts (specifications codes of practice; Standards, statutes and local government regulations); The elements of the Law of Tort, disputes and conflict resolution methods; Professional associations, codes of ethics, professional liability; Construction claims; Different forms of business organisations; Business law and the company act; Health and safety legislation; Environmental law; Introduction to intellectual property; Confidentiality of information; Warranties and indemnity. Introduction to international law.

COEM 6010 (CE64B)
**Structural Design**

COEM 6011 (CE65A)
**Construction Economics**

COEM 6012 (CE65B)
**Geotechnics in Construction**

COEM 6013 (CE66B)
**Materials Technology**
Factors affecting the choice and use of materials in construction. The general properties and behaviour of the major types of construction materials. Factors affecting the production of the construction materials in major use in the Caribbean. Specifications, standards and testing of materials. Methods of improving the properties and performance of materials. Major-project patterns in the Caribbean (e.g., marine projects) and the resultant demands for materials performance. Materials procurement, handling, storage, and extraction control.
COEM 6014 (CE67B)
Construction Materials
Concrete and concrete-making materials, including rock products. Timber and timber products. Pavement materials. Fill materials. Coating systems and adhesives in construction. Steel reinforcement, structural steel, corrugated sheeting, light alloy sections. Glass and glazing systems. Fired ceramics: blocks, bricks, tiles, etc. Plastics and polymers in construction. Cladding materials. Composites. Other construction-material topics which may be of importance from time to time. (All topics may not be taught each year).

COEM 6015 (CE68B)
Maintenance & Facilities Management

COEM 6016 (CE69B)
Natural Hazards Management
The course deals with the genesis and nature of natural hazards, their physical and theoretical basis as well as their operation and propagation. It deals with their economic and social impact; vulnerability of structures; policy and legislation; planning response; engineering and physical response; the development of site-specific disaster plans; international, regional and local response agencies; evacuation and evacuation drills and simulations; search and rescue; recovery, emergency relief shelter management and risk analysis.

COEM 6017 (CE70A)
Construction in Hazard-Prone Areas
This course will deal mainly with the planning, conceptual design and construction of structural systems to resist a range of natural hazards, tropical storms and hurricanes, earthquakes, landslides, flooding, coastal erosion and storm surges. Wind and earthquake design aspects will be introduced with special emphasis on housing; also to be emphasised would be earth-retaining and marine structures, drainage channels and bridge abutments.

3.9  MPhil, PhD in Construction Management
3.9.1 The Construction Engineering & Management Programme also offers programmes of study by research leading to the MPhil and PhD Degrees in Construction Engineering & Management, Construction Engineering and Construction Management.

3.9.2 The regulations for the MPhil in Construction Management would require:

a. A good honours degree (Upper Second Class) in one of the construction-related professions, e.g., Civil Engineering, Building Engineering, Architecture, Quantity Surveying, Planning, Land Surveying, etc.

b. At least one (1) year of relevant industrial experience.

3.9.3 MPhil, PhD in Construction Engineering & Management
3.9.4 For Construction Engineering & Management and Construction Engineering Programmes, the applicant must possess:

a. A first degree with Honours (Upper Second Class) in Civil or Structural Engineering, Construction, Building or Architectural
or

b. An equivalent acceptable qualification and

c. At least one (1) year of relevant industrial experience.

3.9.5 A candidate may be required to sit an entrance examination and/or complete introductory/qualifying courses before being allowed to read for the MPhil or PhD degree.
3.9.6 The Principal Areas of Research

3.9.7 The principal areas of research are as follows:

- Behaviour of Structural Elements/Systems under Loadings
- Building Aerodynamics
- Caribbean Construction Firms
- Construction Economics
- Construction Finance
- Construction Management & Administration
- Construction Materials
- Construction Public Policy
- Construction Technology
- Contract Procurement Systems
- Disaster Mitigation & Management
- Earthquake & Hurricane Resistance Design
- Energy Management and Thermal Comfort in Buildings
- Expert Systems
- Flood Management
- Infrastructure Planning
- Infrastructure Technology in Construction Management
- Macro & Micro Economic Issues in Construction
- Maintenance, Rehabilitation & Finance
- Management of Quality in Construction
- Productivity in Construction
- Resource Management
- Structural Design & Codes for Disaster Mitigation

3.10 Diploma in Construction Management by Distance Mode

3.10.1 The Construction Engineering & Management Programme offers a Postgraduate Diploma in Construction Management by Distance Mode, which commenced in the Academic year 1999-2000.

3.10.2 Students will be required to successfully complete four (4) compulsory core courses and two (2) optional courses.

3.10.3 The compulsory core courses are:

- COEM 6000 Structure & Operation of the Construction Sector (CE60A)
- COEM 6003 Organisation & Management of Construction (CE61A)
- COEM 6005 Construction Project Management (CE62A)
- COEM 6009 Construction Contracts & Law (CE64A)

At this point, only two (2) of the optional courses are being offered. It is hoped that in the near future, more subjects will be included in this category to permit the student some element of choice.

3.10.4 The courses being offered in the optional category are:

- COEM 6006 Construction Accounting & Finance (CE62B)
- COEM 6015 Maintenance & Facility Management (CE68B)

3.10.5 Students will be required to take two (2) courses per semester beginning with two (2) of the core subjects in the first semester, then the two (2) optional courses in the second semester and the remaining two (2) core courses in the third semester. The research project is to be carried out in the fourth semester.
3.11 Programme in Coastal Zone Engineering & Management

3.11.1 The coastal zone is a highly sensitive area and is seen as a transition zone between the land and sea, or a band of varying width along the shore. A number of ecosystems exist in a state of balance and the coast is not only affected by local conditions but also by events and conditions long distances away.

3.11.2 The tropical marine and coastal systems of the Caribbean Sea provide a major source of wealth that, directly or indirectly, supports the economies of the region and an estimated 40% of the population in the wider Caribbean that resides within two kilometers of the coast. Depletion of coastal and ocean resources through overfishing or exploitation of corals and sands for building material is a major impact and when considered together with an increase in pollution and the resulting endangerment to public health and water-based industries such as fishing and tourism, they present a tremendous challenge to the Caribbean region.

3.11.3 Generally, it is accepted that the coastal resources in the wider Caribbean are under increasing pressure from human activity, natural hazards such as hurricanes and lesser tropical storms and the threat of erosion and loss of coastal infrastructure and beaches due to sea level rise from global warming.

3.11.4 Integrated coastal zone management in the wider Caribbean is recognised as the approach for ensuring the survival and sustainable development of the coastal resources of the region. The Coastal Zone Manager needs to have a stream of knowledge and skills that would support reliable decision-making on the sustenance of coastal resources and infrastructure and systematic tropical coastal zone management initiative.

3.11.5 The Graduate Programme in Coastal Zone Engineering in the Department of Civil & Environmental Engineering has two (2) degree offerings:
(i) Postgraduate Diploma in Coastal Zone Processes, and
(ii) MSc in Coastal Zone Engineering

Both offerings are based on common core courses and engineering design elements through additional compulsory courses and electives are introduced to establish the strengthening of the subject area to MSc level of instruction.

3.12.1 Programme Objectives

- To provide advanced and specialised knowledge in the field of coastal zone engineering and management associated with the natural and man-made coastal zone infrastructure.
- To equip the graduate with the knowledge of coastal processes and techniques required for the assessment of coastal zone defense systems in anti-hazard design.
- To produce a graduate capable of developing coastal zone management systems.
- To produce a graduate capable of managing the implementation and monitoring of coastal zone plans and projects.

3.12.2 Admission Requirements

(i) A first degree from an approved University in the Natural Sciences, Planning, Civil Engineering, Environmental Engineering, Surveying, Land Information, or

(ii) An accredited BTech or HND/Associate Degree in Civil Engineering plus five (5) years related postgraduate experience.
3.13 Postgraduate Diploma in Coastal Zone Processes

3.13.1 Programme Content

3.13.2 Four of the five courses in the programme will be delivered on-line through Web CT media, according to the schedule given in the Programme Structure, and the remaining one will be done by intensive face-to-face delivery.

In Semester I, Coursework in Coastal Zone Metrics will be done on site within the last two weeks of the face-to-face sessions, immediately following the end of semester examinations. The designated Coursework and examinations site for this course will be in Trinidad and Tobago for the first cycle of delivery, and will vary from Island State to Island State over the following year 2003/2004 to 2007/2008, with non-campus territories receiving priority for selection. Students will be informed of the Coursework and examinations site at the application stage of the programme.

The course deliveries will be supported by expert online tutors.

The programme is made up of a core of courses and a project and will be done over a minimum of two (2) semesters or a maximum of six (6) semesters.

There are five (5) core courses, each carrying 4 credits to be done over the two semesters amounting to 20 credits. All candidates will also be required to complete a project worth 6 credits.

The total credits required to complete the programme are 26.

3.13.3 Programme Structure

<table>
<thead>
<tr>
<th>COURSES</th>
<th>Semester I</th>
<th>Semester II</th>
</tr>
</thead>
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<tr>
<td>CZEM 6100</td>
<td>Coastal Processes &amp; Hazards (CE80A)</td>
<td>CZEM 6104</td>
</tr>
<tr>
<td>CZEM 6101</td>
<td>Coastal Geomorphology (CE81A)</td>
<td>CZEM 6105</td>
</tr>
<tr>
<td>CZEM 6102</td>
<td>Coastal Zone Metrics (CE82A)</td>
<td>CZEM 6107</td>
</tr>
</tbody>
</table>
3.14 Syllabuses

CZEM 6100 (CE80A) Coastal Processes & Hazards
Tides; currents (Caribbean), storm surges; waves, uniform and random; design wave prediction/extreme value analysis; wave prediction from winds; waves in shallow water, models; wave set-down and set-up; wave-induced alongshore currents; sediment transport, unidirectional flow, coastal, alongshore and across-shore, sediment prediction models; cohesive sediments, sediment budgets on coastline, sources and sinks; pocket beaches; assessing site functionality and vulnerability to coastal disasters.

CZEM 6101 (CE81A) Coastal Geomorphology
Coastal classification and morphology, volcanic coasts, reefs, corals, estuaries and wetlands, continental shelf; coastal morphodynamics, coastal inlets, morphodynamics and shoreface processes; geotechnical investigations; slope and embankment stability; soil liquefaction, stabilisation, compaction, bearing capacity and settlement.

CZEM 6102 (CE82A) Coastal Zone Metrics
Descriptive statistics; nearshore and upland sampling, measurements and monitoring techniques for storms, beach profiling, tidal, wind and wave measurements, currents and sediments; aqueous sampling techniques; coastal resources, hazards, classification and configuration, coastal hazard vulnerability tools; database development; spatial techniques and web-based solutions.

CZEM 6103 Coastal Defense & Control Systems
The functional performance of coastal structures, groynes, artificial headlands, offshore breakwaters and beach nourishment; Prediction of sand trapping/beach level control; Sensitivity to directional wave climate; Relative importance of extreme events vs. “normal” wave climate.

CZEM 6104 (CE83B) Coastal Zone Management
Coastal zone resources, configuration and performance; development demand and assessment; coastal zone plan development, management scheme and structure; organisational and information networking; data, databases and sources; legislation and regulations, environment and enforcement; design options, evaluation of impacts, risk assessment and vulnerability; economic analysis; optimum design selection, performance monitoring, objectives and monitoring programme design, feedback.

CZEM 6105 (CE84B) Environmental Impact Assessment of Coastal Zones
Objectives of EIA, legal context; scope of impacts of coastal developments, visual, audible, smell, water quality, contaminants in water and on sediments, pollution ecology, quality standards; communities, resorts, reefs, corals, wetlands and estuaries; watershed impacts; mitigation and remedial measures, control measures, consequences of infringement, monitoring and management.

CZEM 6106 Design of Coastal Structures
The structural performance of coastal structures: Design considerations ñ wave loading; jetties, armoured breakwaters, sea walls, caisson walls, rock revetments; Critical design features, probability of failure, risk, economic analysis; Design for enhancement of capacity in response to climate change and sea level rise: Monitoring and maintenance.
CZEM 6107 (CE85B)
Coastal Zone Management Project
This project-based course carries six (6) credits, provides the candidate with the opportunity to integrate knowledge and skills learned throughout the programme. Conceptual work on the project may begin at the end of Semester I and the project must be completed and submitted within one (1) month of the end of Semester II examinations. In this course, candidates develop, design and present a project, plan and justify the project and work to satisfy performance, economic and social constraints. All project submissions will be orally presented one (1) month after the end of Semester II examinations at the Department of Civil & Environmental Engineering, UWI, St. Augustine Campus and a panel of Departmental examiners will mark the projects. As an alternative, the candidate may opt to pursue an internship project within the mainstream of their area of specialisation, that is approved by the UWI Academic Unit involved, and may involve the use of external resources through working visits to research organisations and Universities.

CZEM 6109
Dredging & Beach Engineering
Types of dredges, pumps, pipe systems; System performance analysis, production estimates; Tidal inlets, sand bypassing, shoaling mechanisms; maintenance dredging; Long-term management of dredged materials; Classification of beaches, sediment transport processes and budgets; Beach profile change models, beach nourishment, fill design and performance, end losses and design life, borrow site characteristics; Fill preservation structures, interaction of coastal defense structures and beaches.

CZEM 6110
Hurricane Engineering
Structure of winds, winds in coastal and marine areas, atmospheric boundary layer; Hurricane winds, forecasting and tracking systems, winds and wave prediction; Flooding, and flood management; Building response to hurricane winds; Retrofitting techniques for residential and congregational buildings, repair of coastal infrastructure; disaster preparedness and management.

CZEM 6111
Beach Resort Engineering
Development demands, social, economic and environmental objectives; Project planning, design considerations and criteria; Site planning, setback, visual amenity; route location for coastal roads and access infrastructure; Conceptual design of beach and uplands/shoreface infrastructure and facilities, configuration and layout; Beach management systems, control and maintenance of beach infrastructure and resources.

CZEM 6112
Coastal Zone Modelling
Deterministic hydrodynamic modelling, tidal models, estuaries, and coasts; scenario modelling; Dimensional analysis, coastal infrastructure model design, construction and testing.
3.15 Coursework

3.15.1 In Semester I, coursework in Coastal Zone Metrics will be done on site within the last two (2) weeks of the face-to-face sessions, immediately following the end of semester examinations.

3.15.2 The designated coursework and examinations site for this course will be in Trinidad & Tobago for the first cycle of delivery and will vary from Island State to Island State over the following years, with non-campus territories receiving priority for selection.

3.16 Assessment

3.16.1 Performance in core courses and new electives will be assessed by both written examinations and coursework. Candidates may also be orally examined on any part of the examinations. Candidates will not normally be given more than two attempts at a particular examination.

3.16.2 Progression from one semester to another will depend upon performance, with candidates expected to pass at least 50% of all exams for normal progression.

3.16.3 The Postgraduate Diploma will be awarded with Pass or Distinction following the normal University requirements for taught postgraduate diploma programmes.

3.16.4 The MSc Degree will be awarded with Pass or Distinction following the normal University requirements for taught Masters programme.

3.17 Programme in Civil & Environmental Engineering
(To begin in the 2005/2006 academic year).

There are two (2) Degrees offered in this programme:-

(i) MSc in Civil Engineering

(ii) MSc in Civil with Environmental Engineering

3.17.1 Programme Objectives

* To extend existing engineering and science knowledge beyond the level covered at the BSc Honours Degree level and to move to a professional, Masters output.

* To widen existing engineering and science knowledge and to include areas not covered in the BSc Honours Degree level.

* To develop the skills required for team-working (and, for CEng, leadership), social and business awareness, through further studies, such as law, finance, management, risk assessment and environmental issues.

* To gain experience of team-working, ideally with cross-disciplinary elements, integrating topics covered in the BSc level and centred on real professional and business issues.

3.17.2 Admission Requirements

There are two routes offered for admission to the programmes:

* Route 1 provides for 4 continuous years of study leading to the award of the BSc Honours and the MSc Degrees. Applicants must have successfully completed the 3-year BSc Honours Degree programme in three (3) years, attaining a minimum of 55 % weighted average across the three (3) years (GPA of 2.5).

* Route 2 provides for successful completion of the BSc Honours Degree and pursuit of the MSc Degree after two (2) years of Initial Professional Development in the workplace. This would give the student an opportunity to better understand the learning outcomes of BSc Honours Degree before proceeding to the MSc.

An MSc candidate in Civil Engineering must have a BSc Civil Engineering Honours Degree and those for the MSc Civil with Environmental Engineering Degree must have a BSc Civil with Environmental Engineering Honours Degree, or an equivalent qualification.
3.17.3 Programme Content

* The MSc programme is made up of core courses, electives and an integrated design project and will be done over a minimum of three (3) semesters or a maximum of six (6) semesters.

* A total of 40 or 41 credits are required to complete the programme, depending on the electives chosen. The semester I workload is 15 credits, semester II has 16 or 17 credits and semester III has 9 credits.

* The programme will be an evening programme with lectures and tutorials being delivered face-to-face between 4:00 pm and 8:00 pm on weekdays. One (1) course, Coastal Processes & Hazards, will be delivered on-line.

3.18 MSc in Civil Engineering

3.18.1 Programme Structure

The courses offered are grouped into core subjects and optional subjects. The core subjects are:

**Semester 1**
- CIEN 6000 Advanced Environmental Engineering Systems Design (CE90A)
- COEM 6009 Contract Management & Construction Law (CE64A)
- COEM 6012 Geotechnics in Construction (CE65B)
- PRMG 6001 Project Leadership & Organisational Behaviour (PR60A)
- PRMG 6003 Project & Programme Management (PR62A)

**Semester 2**
- CIEN 6001 Advanced Structural Engineering (CE91B)
- CIEN 6002 Road Network Conservation (CE92B)
- CZEM 6100 Coastal Processes & Hazards (CE80A)

The optional subjects are:

- CZEM 6104 Design of Coastal Structures (CE83B)
- CZEM 6105 Environmental Impact Assessment of Coastal Zones (CE84B)
- ECNG 6613 Database Systems Principles & Design (EE66W)
- ENGR 6016 Entrepreneurship & Innovation (FE 68B)
- GINF 6003 GIS Applications Development (GI64B)
- PRMG 6012 Value Engineering & Management (PR68B)
- PRMG 6013 International Project Management (PR69B)

**Semester 3**
- (CE400) Project: Civil Engineering Design C9
3.19 MSc in Civil with Environmental Engineering

3.19.1 Programme Structure

The courses offered are grouped into core subjects and optional subjects. The core subjects are:

**Semester 1**
- CIEN 6000 Advanced Environmental Engineering Systems Design (CE90A)
- COEM 6009 Contract Management & Construction Law (CE64A)
- COEM 6012 Geotechnics in Construction (CE65B)
- PRMG 6001 Project Leadership & Organisational Behaviour (PR60A)
- PRMG 6003 Project & Programme Management (PR62A)

**Semester 2**
- CIEN 6003 Advanced Water & Wastewater Systems (CE93B)
- CIEN 6004 Industrial Pollution Prevention & Control (CE94B)
- CZEM 6100 Coastal Processes & Hazards (CE80A)

**The optional subjects are:**

- CIEN 6005 Design of Coastal Structures (CE95B)
- CZEM 6105 Environmental Impact Assessment of Coastal Zones (CE84B)
- ECNG 6613 Database Systems Principles &Design (EE66W)
- ENGR 6010 Economics for Environmental Engineering (FE65A)
- ENGR 6011 GIS, Land Use & Resource Management in Environmental Engineering (FE65B)
- ENGR 6016 Entrepreneurship & Innovation (FE68B)
- MENG 6402 Human Resource Management (ME64K)
- PRMG 6012 International Project Management (PR69B)

**Semester 3**
- (CE401) Project: Civil & Environmental Engineering Design (C9)
3.20 **Syllabuses**  
(To be read in conjunction with syllabuses from other Departments and programmes where applicable.)

**CIEN 6000 (CE90A)**  
Advanced Environmental Engineering Systems Design  
Design of surface and ground water treatment systems. Design of water treatment plant and domestic wastewater treatment plants. Various design alternatives. Design of primary, and secondary. Solid waste handling systems: landfill siting and design, design of compost plant, and vermicululture plant. Design of air pollution control equipments or particulate capture and gaseous pollutants.

**CIEN 6001 (CE91B)**  
Advanced Structural Engineering  
Flexibility and stiffness methods; numerical methods in Structural Engineering, non-linear analysis; computer aided analysis and design.

**CIEN 6002 (CE92B)**  
Road Network Conservation  
Road networks, classes, function and configuration; Pavement Maintenance Management Systems; Roadway characteristics, vehicle fleet costs and performance; Maintenance and rehabilitation strategies and policies; Maintenance and performance prediction models; Pavement design and performance prediction models; Pavement design and performance maintenance budgeting and financing, optimisation and programme development.

**CIEN 6004 (CE94B)**  
Industrial Pollution Prevention & Control  

**CIEN 6005 (CE402)**  
Project (Design IV)  
This course is a capstone project designed to generate a learning atmosphere that is close as possible to the experience of working on the design of a real engineering project. The project work is carried out yearlong, engenders a sense of leadership in the student, and draws on the first three years of learning in the programme. The emphasis is on self-learning, creativity, design, understanding, project team-working and communication skills, as well as engineering judgement and problem solving. The projects are interdisciplinary, with the involvement of students from other departments, experienced practicing professional engineers in addition to the UWI supervisors and tutors, as well as other Engineering Departments in the Faculty. Students may also pursue internship/industry projects that are approved by the Department. This course applies to both Civil Engineering and Civil with Environmental Engineering programmes.

**CIEN 6003 (CE93B)**  
Advanced Water & Wastewater Treatment Systems  
Advanced water and wastewater treatment systems like chemical precipitation, aeration adsorption, ion exchange, membrane processes and their functional design. Importance of nutrients and their removal from wastewater. Biological nitrification and denitrification, and treatment systems. Uptake of phosphorus by biological systems, disposal of treated effluents.
4.1 Research

A. GENERAL ACTIVITIES

4.1.1 The Department offers programmes of study by research leading to the MPhil and PhD degrees in Electrical & Computer Engineering. Research includes activities in its major subject groups - Communication Systems, Computer Systems, Control Systems, Electronic Systems and Energy Systems. The Department is also at the forefront of research in the technology of the steel pan. Some of the more specific activities are provided below.

B. COMMUNICATIONS

4.1.2 Research in the Communication Systems group includes performance of multiservice networks, non-linear autoregressive process modelling; and telecommunications regulation and policy.

4.1.3 Research in new and emerging communications technologies focuses heavily on the Performance Analysis of wired and wireless high-speed, multiservice networks. The group is actively engaged in, for example, the evaluation of ATM networks in wired and wireless environments, Mobility Management for wireless ATM networks, Mobile IP and the Performance of TCP in wireless as well as mobile environments. This work is conducted both on simulated platforms as well as on a multiservice carrier-grade hardware platform hosted in the Nortel Networks Communications Laboratory in the department.

4.1.4 Another exciting area of research in the Communication Systems Group is that of non-linear process modelling using neuro-fuzzy techniques. These techniques may be usefully applied to traffic engineering as well as in compression algorithms. For example, autoregressive process modelling of Long Range Dependent (LRD) Multimedia traffic is particularly important in the modelling of modern communications network traffic which displays non-linear characteristics. Also, long term predictive coding techniques, and the associated neuro-fuzzy/non-linear models, have the potential to achieve the tremendous compression ratios required of modern communications network applications and services.
The Communication Systems group is building its strength in technical areas relating to telecommunications regulation and policy. These include: spectrum management, network interconnection and network modelling and simulation.

The Communication Systems group has enjoyed the gracious support of industry for a number of years. Support has been forthcoming in a variety of ways from TTNIC, Nortel Networks, Lucent Wireless Networks Group, Digidata, TSTT, The Ministry of Energy and Energy Industries, Microsoft Caribbean, NGC, OAS, ICL, IBM and TTARS.

C. ENERGY SYSTEMS

Research in Power Systems is related to real operating and planning problems encountered in the industry. Emphasis is placed on special problems related to peculiarities of small, isolated systems as obtains in all the Caribbean countries.

Current research activities include consideration of the effects of large loads, such as are furnaces, on the system operation and the life span of equipment; simulation of various electromechanical and electromagnetic transient phenomena; introduction of wind energy systems to a grid; linear and non-linear optimisation problems as applied to power systems and design and simulation of power electronic drives.

Research is also being conducted in the electronic control of machines and drives where induction motors are being controlled using rotor field-oriented control and digital signal processing methods. Electromagnetic interference and radio frequency interference problems are being studied as well as power factor correction in the presence of harmonics.

D. ELECTRONIC SYSTEMS

Research in this area involves the design and testing of new analogue circuit configurations using operational amplifiers and linear integrated circuits. New methods, such as the Driving Point Impedance technique, are being explored and traditional approaches are being re-examined as new devices become available. Other areas under investigation include the design and application of a new form of transconductance amplifier, the use of current feedback techniques in small and large signal design and the evaluation of current conveyors and their comparison with operational amplifiers in the design of voltage amplifiers, filters, multiphase oscillators and gyrators.

The Electronics group is actively involved in the design of digital logic systems using the current technologies. In this regard, the Department boasts of state-of-the-art FPGA and CPLD technologies for rapid prototyping of logic solutions.

E. THE REAL TIME SYSTEMS GROUP DEVELOPMENT AND RESEARCH PROJECT

The Real Time Systems Group operates a Development and Research programme in support of regional industry. The Group is itself an experiment on the process of technological innovation in the Caribbean region. Some of its development projects include:

i. Development of SCADA and DCS systems for control applications.

ii. The CMAP and SIMS project.

iii. Real time multiplayer gaming for content-based Internet applications.

iv. Electronic course management systems.

v. Spectrum management.

4.2 Staff in the Department

The principal teaching and research interests of staff in the Department are as follows:

PROFESSOR EMERITUS
- **Kenneth S. Julien,** CMT, BSc (Nott), PhD (UBC), FIEEE, FIEE
  (Energy Systems)

SENIOR LECTURERS
- **Brian R. Copeland,** BSc (Eng)(UWI), MSc (Toronto), PhD (USC)
  Head of Department
  Leader, Control Systems Group
  (Control Systems, Digital Electronics, Microprocessors)

- **Stephan J.G. Gift,** BSc (Eng), PhD (UWI), MAPETT, FAPETT, SMIEEE, MCAS
  Leader, Electronic Systems Group
  (Electronics & Control Systems)

- **Kim I. Mallalieu,** BSEE (MIT), MSc (Rochester), PhD (Lond), MSPIE, MAPETT
  Leader, Communications Systems Group
  (Digital Communications)

- **Chandrabhan Sharma,** BSc, MSc, PhD (Eng) (UWI), SMIEEE, MAPETT, SenMemISA, MAWEA, REng
  Leader, Energy Systems Group
  (Industrial & Commercial Power Systems, Energy Systems)

- **Jagat N. Tripathi,** BSc (Agra), BE, ME (IISc)(Bangalore), PhD(Aston), CEng, MIEEE, FIETE(India)
  (Telecommunications, Electronics)

SENIOR LECTURER (TEMPORARY)
- **St. Clair A. King,** BSc, MSc (MIT)(Eng), PhD (Glas)
  (Electrical Circuits & Control Systems)

LECTURERS
- **Fernando Castellanos,** BSc, MASc (Colombia), PhD (British Colombia)
  (Energy Systems Simulation)

- **Ronald De Four,** BSc, MPhil (Eng)(UWI), MIEEE
  (Power Electronics, Energy Systems)

- **Albert Kong,** BSc, MPhil, PhD (Eng)(UWI)
  (Artificial Intelligence Systems, Computers & Controls)

- **Alvin Lutchman,** BSc (Eng)(UWI), MSc (Eng)(Aston), Dip. Mgt. Studies (UWI), FAPETT
  (Electrical Machines, Power Systems)

- **Feisal Mohammed,** BSc, PhD (Eng)(UWI), MAPETT, MIEEE
  Leader, Computer Group
  (Microprocessors & Software Engineering)

- **Fasil Muddeen,** BSc, MSc (Eng) (UWI)
  (Signal Processing, Digital Systems)

- **Lucien Ngalamou,** BSc, MSc, PhD (France)
  (Computer Systems, Digital Systems)

- **Cathy-Ann Radix,** BSc (Eng)(UWI), PhD (Plymouth), IEEE
  (Robotics, Embedded Systems)

- **Sastry Subrahmanga,** BTech, MTech, PhD (REC/Warangal)
  (Computer, Energy Systems)

ASSISTANT LECTURER
- **Richelle Adams,** BSc, MSc (Eng)(UWI/Lucent)
  (Data Communication Systems)

- **Varun Chogah,** BSc, MSc (Eng) (UWI)
  (Communication Systems)

- **Tarun Pinto-Pereira,** BSc (Eng) (UWI), MSc (UMIST)
  (Communication Systems)

HONORARY CONSULTANTS
- **Frances Correia,** BSc (Comp Eng Sys) (Florida), BSc (Bus Mgmt) (Florida)
  (Computer Systems)

- **Winston Lakshman,** BSc (UWI), MSc (Florida)
  (Control Systems)

* On leave
The Faculty of Engineering

- **Bernard Mitchell,**  
  BSc, MSc (Eng) (UWI), MSc (Bus Adm.) (Scotland)  
  (Communication Systems)

- **Linus Rogers,**  
  BSc (Eng), MSc (USA)  
  (Electronic Systems)

- **Indarjit Singh,**  
  BASc, MEng (Toronto)  
  (Energy Systems)

**ASSISTANT DEVELOPMENT ENGINEER**
- **Kirk Lashley,**  
  BSc (Eng) (UWI)

**RESEARCH SUPERINTENDENT**
- **Byron Marcel,**  
  BSc (Eng) (UWI)

**TEACHING ASSISTANTS**
- **Patrick Browne,**  
  BSc (Eng) (UWI)

* **Benoit Heumez,**  
  BEng (France), BSc, MPhil (UK)

* **Emily Ramoutar,**  
  BSc (Eng) (UWI)

4.3 **Faculty of Engineering/Industry Advisory Committee**

* **Ms. Francis Correia,**  
  Woodbrook

* **Mr. Winston Lakshman,**  
  Point Lisas

* **Mr. Bernard Mitchell,**  
  General Manager  
  Telecommunications Services of Trinidad & Tobago (TSTT)

* **Mr. Linus Rogers,**  
  Chairman  
  Airport Authority of Trinidad & Tobago

* **Mr. Indarjit Singh,**  
  Assistant General Manager (Engineering)  
  Trinidad & Tobago Electricity Commission (T&TEC)

4.4 **MSc (Eng) Programmes - Regulations**

4.4.1 The general regulations for MSc (Engineering) in various specialist fields offered by the Department are the same as the general regulations for MSc (Engineering) in the Faculty of Engineering except the following:

i. **Title of Degree**  
   Three programmes will be offered at this time:

   MSc (Eng) - Communication Systems
   MSc (Eng) - Digital Systems
   MSc (Eng) - Energy Systems

ii. **Entry Requirements**  
   Within the overall Faculty Regulations, the specific minimum requirements for the programmes will be:

   a. BSc (Hons) in Electrical and/or Computer Engineering.
   b. BSc (Hons) in Mechanical Engineering.
   c. BSc (Hons) in Applied Physics majoring in Electronics.
   d. Such other qualifications deemed equivalent to any of the above (a,b,c) by the Faculty.

   However, for entry into MSc (Eng) Electrical Energy Systems programme, only candidates with qualifications under categories (a) or (b) or equivalent, are eligible.

   Candidates with a BSc Third Class (Hons) Degree in Electrical Engineering may be considered eligible for entry, subject to an evaluation of the BSc degree and relevant post-degree industrial experience.

   All students who seek entry under categories (ii) b, (ii) c and (ii) d as indicated above, may be required to pursue additional pre-requisite coursework and undertake examinations in these courses. The additional coursework requirements will be determined by the Head of the Department and will normally not exceed twelve (12) credits.
iii. **Credit Requirements**
Successful completion of the Programme will require:

- 24 credits of coursework through examinations PLUS
- Completion of project assigned twelve (12) credits

iv. **Structure of the Programme**

(a) Each MSc programme will consist of CORE, RESTRICTED ELECTIVE and UNRESTRICTED ELECTIVE Courses.

(b) All courses chosen by each student have to be approved by the Head of the Department.

(c) The Project (12 credits) must be associated with the specialised field identified with the degree programme.

v. **Inclusion of Final Year BSc Courses**
Final year BSc (Eng) courses can be included in the MSc programmes, in accordance with Faculty Regulations with the following additional proviso:

“No courses previously taken at the Undergraduate level can be credited towards the MSc programme.”

vi. **Duration of Programmes**
Full-time and part-time students are normally expected to fulfil the degree requirements in three (3) semesters and six (6) semesters respectively.

4.4.2 **Prerequisite Courses**
Courses relevant to the specialty offered under BSc (Electrical & Computer Engineering) programme. These will be determined by the Head of the Department.

4.4.3 **Schedule of Courses**

- **Energy Systems**

**CORE COURSES**

1. ECNG 6500 Computer-aided Power System Analysis (EE65A) E3
2. ECNG 6501 Power System Dynamics (EE65B) E3
3. ECNG 6503 Advanced Power System Protection (EE65D) E3
4. ECNG 6505 Surge Phenomena & Insulation Co-ordination (EE65F) E3

**RESTRICTED ELECTIVE COURSES**

1. ECNG 6502 Power System Operations & Planning (EE65C) E3
2. ECNG 6504 Electrical Drives & Industrial Power Systems (EE65E) E3
3. ECNG 6508 Switchgear & Transformer Technology (EE65J) E3

**UNRESTRICTED ELECTIVE COURSES**

1. ECNG 6506 Optimisation Techniques (EE65G) E3
2. ECNG 6507 Energy Economics & Planning (EE65H) E3
3. ECNG 6508 Power Systems Instrumentation (EE65I) E3
4. ECNG 6510 Power Systems Monitoring & Control (EE65K) E3
5. All other postgraduate courses offered by the Faculty of Engineering.
6. A maximum of six (6) credits selected and approved by the Head of the Department from the Undergraduate courses listed at the end of schedule.
• Digital Systems

CORE COURSES
1. ECNG 6600 Real Time Systems E3 (EE66C)
2. ECNG 6602 Digital Electronic Design E3 (EE66E)
3. ECNG 6603 Modern Control Strategies E3 (EE66F)
4. ECNG 6604 Linear Control Systems E3 (EE66K)
5. ECNG 6605 Distributed Computer Control (EE66L)
6. ECNG 6609 Analogue Electronic Systems (EE66S)
7. ECNG 6612 Operating Systems E3 (EE66V)
8. ECNG 6613 Database Systems Principles & Design (EE66W)
9. ECNG 6700 Stochastic Processes E3 (EE67A)
10. ECNG 6701 Data Communication Networks (EE67B)

RESTRICTED ELECTIVE COURSES
1. ECNG 6601 Digital Electronic Systems (EE66D)
2. ECNG 6606 Optical Components (EE66N)
3. ECNG 6607 Optical Applications (EE66P)
4. ECNG 6608 Digital Integrated Circuits (EE66Q)
5. ECNG 6610 Digital Systems Hardware Organisation & Design (EE66T)
6. ECNG 6611 Software Engineering II (EE66U)
7. ECNG 6614 Multiprocessor Systems (EE66X)
8. ECNG 6615 Advanced Computer Methods (EE66Y)
9. ECNG 6616 Computer Graphics (EE66Z)
10. All other MSc courses, offered by the Department of Electrical & Computer Engineering, for which credit will not be received in the core category.

UNRESTRICTED ELECTIVE COURSES
1. All other Postgraduate courses offered by the Faculty of Engineering.
2. Any course, for which credit has not yet been received at the undergraduate level, selected and approved by the Head of Department from the Undergraduate courses listed at the end of this schedule.

• Communication Systems

CORE COURSES
1. ECNG 6700 Stochastic Process E3 (EE67A)
2. ECNG 6701 Data Communication Network (EE67B)
3. ECNG 6703 Principles of Communication (EE67D)
4. ECNG 6708 Transmission Systems (EE67K)

RESTRICTED ELECTIVE COURSES
1. ECNG 6702 Principles of Switching (EE67C)
3. ECNG 6706 Antennas & Radiation (EE67H)
4. ECNG 6707 Multimedia Communication Systems (EE67I)
UNRESTRICTED ELECTIVE COURSES
1. COMP 6150 Distributed Computing E3 (CS61B)
2. COMP 6700 Cryptography & Computer Security (CS62B)
3. ECNG 6506 Optimisation Techniques E3 (EE65G)
4. All other postgraduate courses offered by the Faculty of Engineering.
5. A maximum of six (6) credits selected and approved by the Head of the Department from the Undergraduate Courses listed below.

UNDERGRADUATE COURSES
1. COMP 3750 Numerical Computing I E4 (CS37C)
2. ECNG 3001 Communication Systems II E3 (EE31B)
3. ECNG 3002 Data Communication Systems (EE31D)
4. ECNG 3003 Telecommunication Networks (EE31T)
5. ECNG 3005 Modern Control Systems (EE32D)
6. ECNG 3006 Microprocessor Systems, Design & Applications (EE33A)
7. ECNG 3009 Instrumentation Systems (EE35E)
8. ECNG 3011 Power Systems Protection (EE35C)
9. ECNG 3014 Discrete Signal Processing (EE36A)
10. ECNG 3017 Computer Applications C3 (EE38B)
11. ECNG 6700 Mathematics III (M37A) E3
12. MENG 3000 Engineering Management I C3 (ME30A)
13. MENG 3006 Production Management E2 (ME31A)

4.5 Syllabuses

* MSc - Energy Systems

ECNG 6500 (EE65A)
Computer-aided Power System Analysis
Review of power system components and their representation; Network equations and solutions; Load-flow and solution techniques; Power flow controls; Fault studies; Solution of large networks; Application of diakoptics.

ECNG 6501 (EE65B)
Power System Dynamics
Generalised machine theory - Synchronous machine: parameters, steady state and transient state models - steady state; Dynamic and transient stability of Power Systems - large induction motor loads; Effects on system dynamics - Multi-machine Systems - stabilisation of power systems.

ECNG 6502 (EE65C)
Power System Operation & Planning
Economic and Security methods in Power Systems - Control of interconnected systems - Reliability analysis of Power Systems - System Planning and Expansion.

ECNG 6503 (EE65D)
Advanced Power System Protection
Relay elements; Principles; Relay response; Voltage and Current transducers; Microprocessor-based relays; Comparator characteristics; Over-current protection; Fault protection with centralised digital computer; Real-time fault-impedance calculations; Sampling techniques; Co-ordination of protective systems; Assessment and cost of protection.

ECNG 6504 (EE65E)
Electrical Drives & Industrial Power Systems
ECNG 6505 (EE65F)
Surge Phenomena & Insulation Coordination
Classification and origins of surges; Lightning and switching transients; Sustained transients; Ferro-resonance phenomena; Digital computer simulation techniques; Protection against over-voltages; Insulation Coordination.

ECNG 6506 (EE65G)
Optimisation Techniques
Linear Programming: Simplex and revised Simplex methods, Duality, Sensitivity analysis - Dynamic Programming and Integer Programming methods - Network Planning techniques; PERT/CPM; Dynamic Optimisation methods - Applications to Engineering Systems.

ECNG 6507 (EE65H)
Energy Economics & Planning
The Energy System - Technical, Economic and Planning Issues; Power System Economics; Cost of Service Tariff structure; System Expansion Studies.

ECNG 6508 (EE65I)
Power System Instrumentation
Signal processing and conditioning; Transducers; Metering technology (volts, amperes, watts, vars, frequency, etc.); Application of P techniques in instrumentation; Thermal measurements (flow pressure, temperature, etc.); Techniques, networking of instruments; Application of computers to measurement and display; Transient data recorders; Maintenance of power system instruments.

ECNG 6508 (EE65J)
Switchgear & Transformer Technology
Physics of high pressure arcs; Circuit interruption techniques; Air circuit breakers; Oil circuit breakers; SF6 circuit breakers; Vacuum circuit breakers; Specification/standards applied to circuit breakers; Modern trends in circuit breaking; Maintenance and testing of circuit breakers; Transformer core and winding arrangements; Transient behaviours of transformers; Onload tap changing gear; Load cycles and transformer ratings.

ECNG 6510 (EE65K)
Power Systems Monitoring & Control
SCADA systems, networking applied to power systems; On-line load flow and security analysis; State estimation techniques; Automatic load frequency control; Modern trends in power system monitoring and control.

*MSc - (Digital Systems)*

ECNG 6600 (EE66C)
Real Time Systems
Software and system concepts, real-time definitions; events (asynchronous, synchronous), determinism, time-loading, address modes, memories and input-outputs. Required attributes in a real-time programming language information hiding and its use in designing reliable, understandable and maintainable real-time systems. Elements of the software life cycle, specification and design techniques. Real-time kernels. Inter-task communication and synchronisation. Memory management, system performance analysis and optimisation. An overview of real-time database systems. An introduction to the design of distributed real-time systems. Multiprocessor systems.

ECNG 6601 (EE66D)
Digital Electronic Systems
ECNG 6602 (EE66E)
Digital Electronic Design
Digital electronic design using regionally accessible technology: Field Programmable Gate Arrays and Programmable Array Logic devices. Logic design tools. Design considerations for hybrid microprocessor/digital logic systems. Practical aspects of logic implementation. Students will develop the target skills and capabilities through a mix of the following activities: supervised lab sessions, classroom discussions, audio-visual presentations, unsupervised lab activities, research, project reports and presentations. Evaluation of EE66E is 100% by coursework.

ECNG 6603 (EE66F)
Modern Control Strategies
State Space methods; state feedback, Optimal Control, Linear Quadratic Regulation (LQR) and Linear Quadratic Gaussian (LQG) methods, State Estimation, Optimal State Estimators and Kalman filters, Stochastic Control, Model Reference Adaptive Control (MRAC), Self Tuning Regulators, Intelligent Control Systems, Neuro-Fuzzy Control.

ECNG 6604 (EE66K)
Linear Control Systems

ECNG 6605 (EE66L)
Distributed Computer Control
Overview and Goals of a Distributed System: historical development, promises of distributed systems, extensibility, ease of maintenance, ease of programming. What can be distributed? Performance requirements (specification). Hardware Design Issues: dedicated function, traffic sharing, dynamic and hybrid architecture. Software Design Issues: task allocation, client server approach, distributed operating systems, distributed database systems, hardware and software fault tolerance, comparison of different structures. Software reliability concepts, designing for maintainability. Real time specification, issues, state and event issues. Industrial Networking: MAP/TOP Standardisation, Field Bus, Trends in DCCS. Examples of commercially available DCCS.

ECNG 6606 (EE66N)
Optical Components
This course identifies key components used in optical systems: fiber, sources, detectors, amplifiers, modulators, etc. It presents the theoretical foundation for the physical phenomena utilised in the operation of the optical devices and then investigates the performance limitations imposed by these physical processes. Ideal and real characteristics of the optical devices are related to performance specifications represented in commercial data sheets. Case studies treat cost analysis for system design.

ECNG 6607 (EE66P)
Optical Applications
This course treats the design and performance analysis of systems derived from a range of optical applications. Optical applications are drawn from Communications and Instrumentation. After this course, the student will have an appreciation for the description of light in terms of its degrees of freedom (amplitude, phase, frequency, polarisation and propagation direction) and the physical processes used to manipulate these parameters for communications, sensing and beam-positioning. The student should be able to evaluate the performance of a range of systems and offer reasonable component selection criteria for the design of such systems. Cost analysis is treated.
ECNG 6608 (EE66Q)  
**Digital Integrated Circuits**
Introduction to IC fabrication techniques; Comparative study of logic families; Structure of memory elements; Design of VLSI design using stick diagram techniques; MOS, VLSI design.

ECNG 6609 (EE66S)  
**Analogue Electronic Systems**
Analysis and design of discrete building blocks - current sources, voltage sources/references; Amplifier characteristics and implementations including the Differential amplifier and with analysis of op-amp circuits; Special function circuits - integrated and discrete; High power audio amplifier techniques; Switch mode power supply design; High frequency amplifier design.

ECNG 6610 (EE66T)  
**Digital System Hardware Organisation & Design**
Architecture of representative processors; Hardware programming language; Machine organisation; Hardware realisation; Micro-programming; Intersystem communication; Interrupt and memory mapped I/O; Communication and error control; Large memory systems; High-speed computer arithmetic realisations.

ECNG 6611 (EE66U)  
**Software Engineering II**
Review of design methodologies; Modularity and decomposition; Parallel programming; Programme design; Design quality; Programme implementation and testing; System testing; Performance testing and documentation; Maintenance; Phased development; Changing schedule and requirements; Productivity; Updating documentation.

ECNG 6612 (EE66V)  
**Operating Systems**
Communicating Sequential Process (CSP): Symbolic description of processors, traces, communication channels, pipes, etc. with analysis of properties such as synchronisation, parallelism, deadlock and livelock, data flow, etc. Centralised vs. Distributed Systems: comparisons of the behaviour of centralised operating systems vs. distributed operating system. Synchronisation, Deadlock and livelock Analysis using CS. Layered Protocol and Client Server Model: ISO OSI model, layers, interfaces and protocols. Remote Procedure calls and Distributed File Systems: message transport over network, RPC GEN tools. ‘C’ Programming for operating system development. UNIX as an industrialised standard platform.

ECNG 6613 (EE66W)  
**Database Systems Principles & Design**
Database fundamentals; Relational techniques; Data representation; Packing and protection; Access security protection; Selection in a database; DBMS techniques and database architectures; Real time databases; File structures; Optimised access and linking structures; Functional interference; Product overview.

ECNG 6614 (EE66X)  
**Multiprocessor Systems**
Introduction to parallel processing techniques; Parallel processing languages and algorithms; Introduction to synchronous multiplexing.

ECNG 6615 (EE66L)  
**Distributed Computer Control**
Overview and Goals of a Distributed System: historical development, promises of distributed systems, extensibility, ease of maintenance, ease of programming. What can be distributed? Performance requirements (specification). Hardware Design Issues: dedicated function, traffic sharing, dynamic and hybrid architecture. Software Design Issues: task allocation, client server approach, distributed operating systems, distributed database systems, hardware and software fault tolerance, comparison of different structures. Software reliability concepts, designing for maintainability. Real time specification, issues, staste and event issues. Industrial Networking: MAP/TOP Standardisation, Field Bus, Trends in DCCS. Examples of commercially available DCCS.
ECNG 6616 (EE66Z)
**Computer Graphics**

ECNG 6617 (EE66M)
**Artificial Intelligence Systems**
Fuzzy computing; basic definitions and terminology, fuzzy set operations, membership functions, fuzzy relations, fuzzy if-then-else rules, fuzzy reasoning; adaptive networks; architecture, back propagation learning methods, associative memory learning methods, supervised and unsupervised learning neural networks, neuro-fuzzy modelling, system identification; least squares methods; derivative-based and derivative free optimisation methods, genetic algorithms; neuro-fuzzy computing applications.

ECNG 6619 (EE66S)
**Analogue Electronic Systems**
Analysis and design of discrete building blocks - current sources, voltage sources/references; Amplifier characteristics and implementations including the Differential amplifier and with analysis of op-amp circuits; Special function circuits - integrated and discrete; High power audio amplifier techniques; Switch mode power supply design; High frequency amplifier design.

ECNG 6701 (EE67B)
**Data Communication Networks**
Modelling of the control processes in computer and data communication networks; Line and network protocols; Distributed Algorithms; Dynamic routing; Congestion control; Local Area Networks; Radio and Satellite multi-access schemes.

ECNG 6702 (EE67C)
**Principles of Switching**
Switched networks for telephony; Teletraffic analysis; Digital circuit switching; Integrated digital networks; Packet switching; Signalling and control in digital telephone networks; New developments in digital telephone networks.

ECNG 6703 (EE67D)
**Principles of Communication**
Fundamental principles underlying the transmission of digital data over noisy channels; Digital modulation and signal design; Decision regions and optimum receivers; Inter-symbol interface and adaptive equalisation; Convolution codes; Fading and multipath channels.

ECNG 6704 (EE67F)
**Performance Engineering of Computer Communication Systems**
Markov models; Modelling reliability; Queuing theory; Networks of queues; Simulation; Computer performance evaluation; System reliability.

* MSc (Communication Systems) *

ECNG 6700 (EE67A)
**Stochastic Processes**
Fundamentals of detection; Estimation and stochastic processes of importance in communication; Review of probability and introduction of vector notation for sets of random variables; Principles of hypothesis testing and parameter estimation; Introduction to stochastic processes in continuous and discrete time; Correlation functions; Power spectra and linear systems with stochastic inputs.
ECNG 6706 (EE67H)
Antennas & Radiation
General theory of radiation and its application to the analysis of representative types of antennas; Design of antenna arrays, microwave reflectors and lenses.

ECNG 6707 (EE67I)
Multimedia Communication Systems
Image processing: Filtering, sampling and compression of images (JPEG); High definition video (MPEG and HDTV); Speech processing; Speech and hearing; Coding for telephony; Speech synthesis, Speech over networks; Integrated Services Digital Networks: Narrowband and broadband ISDN, ATM; Frame relay and SMDS; Multimedia transmission over networks: TCP/IP, MPEG transport stream.

ECNG 6708 (EE67K)
Transmission Systems

4.6 MRP Programme – Regulations

4.6.1 The general regulations for MRP offered by the Department are the same as the general regulations for MRP in the Faculty of Engineering except the following:

4.6.2 Title of Degree
One programme will be offered at this time:

• MRP (Telecommunications)

4.6.3 Entry Requirements

(1) (a) An Honours degree in Law, Economics, Policy, Engineering, Finance, Planning, Communications, Business or any other relevant field or
(b) Suitable experience and/or qualifications deemed equivalent to the above, on the basis of special approval and

(2) A minimum of two (2) years relevant professional work experience.

4.6.4 Credit Requirements
Successful completion of the programme will require:

• 27 credits of coursework PLUS
• Completion of project assigned 9 credits

4.6.5 Structure of the Programme
The MRP (Telecommunications) programme consists of eight (8) required courses and three (3) required seminars. The courses carry a weighting of three (3) credits each and are delivered over the Internet. The seminars carry a weighting of one (1) credit each and are delivered face-to-face.

The project (9 credits) is normally executed in three (3) months following the completion of the final semester assessment exercises.

4.6.6 Duration of Programme
The MRP (Telecommunications) programme is offered on a part-time basis only. Students are normally expected to fulfill the degree requirements in two (2) calendar years.
4.7 **Schedule of Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPTL 6800</td>
<td>Public Policy Frameworks (RP68A)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6801</td>
<td>Contemporary Telecommunications Networks &amp; Technologies (RP68B)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6802</td>
<td>Legal and Regulatory Frameworks (RP68C)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6803</td>
<td>Economics &amp; Pricing in Telecommunications Networks (RP68D)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6804</td>
<td>Licensing of Telecommunications Services (RP68E)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6805</td>
<td>Interconnection in Telecommunications Networks (RP68F)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6806</td>
<td>Telecommunications Sector Planning (RP68G)*</td>
<td>3</td>
</tr>
<tr>
<td>RPTL 6807</td>
<td>The Regulatory State in Comparative Perspective (RP68H)*</td>
<td>3</td>
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<tr>
<td>RPTL 6808</td>
<td>Seminar 1 (RP68I)</td>
<td>1</td>
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<tr>
<td>RPTL 6809</td>
<td>Seminar 2 (RP68J)</td>
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<td>RPTL 6810</td>
<td>Seminar 3 (RP68K)</td>
<td>1</td>
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<tr>
<td>RPTL 6811</td>
<td>MRP Project (RP68L)</td>
<td>9</td>
</tr>
</tbody>
</table>

*These courses are delivered over the Internet.

4.8 **MRP (Telecommunications)**

**RPTL 6800 (RP68A) Public Policy Frameworks**

This course seeks to provide participants with an advanced working exposure to both the theoretical and practical implications of telecommunications policy-making. Presented in a global context, the course content places emphasis on the strategic issues, the emerging trends and the social implications of telecommunications policies in the first decade of this 21st century. Participants will critically examine the combination of decisions, non-decisions, technologies and practices that together constitute the substance of telecoms policy-making anywhere in the world. It examines these developments particularly from the vantage point of the Global South, with Caribbean case studies forming the centre-piece of the analytical frame of reference. Among the key specific issues covered are: the nature of policy, the concept of technology, the emergence of telecommunications, the Internet and its policy implications, their relationships to context and culture, multiple stakeholder interests, monopoly and competition, the roles of government, service providers, policy-making institutions, universal service/access provisions, international trade regimes and intellectual property rights issues, among others. At the end of the course, each participant would be able not only to articulate more informed perspectives on the key global policy issues, but would also be enabled to manage the local policy process within countries and institutions, including preparing policy issue documents and consultants briefs as part of his/her professional capabilities.
RPTL 6801 (RP68B)
Contemporary Telecommunication Networks & Technologies

This course tracks the technical aspects of telecommunications networks which impact on traditional and contemporary regulation and policy. In order to establish the technical basis for traditional telecommunications regulation and policy, it dismantles traditional voice networks, traditional (IP) data networks and wireless networks. In each case, it draws reference to issues relating to implementation, interconnection, performance and the use of public resources. Particular topics include analogue and digital signal representation; traffic characteristics of voice, video and data; network types by service, topology, technology and ownership; measures of information; transmission; circuit and packet switching; routing; access; signalling; numbering, network architecture; protocol stacks. Summaries are given on key features relating to popular protocols. The foundational treatment leads into a treatment of network convergence, Next Generation Networks and the technical issues that underpin contemporary and emerging Telecommunications regulation and policy. Case studies include Transitional Scenarios towards Next Generation Networks, Top Level Domain Administration, Number Portability and Network Security. Students use simulation and Internet-based utilities to explore some basic concepts introduced in the course.

RPTL 6802 (RP68C)
Legal & Regulatory Frameworks

This course brings together the range of disciplines necessary to execute telecommunications policy. The fundamental tenets of regulatory theory are presented and the rationale for contemporary regulation explored. The evolving role of regulation in a diverse networked industry is mapped. International initiatives and commitments are reviewed. Regulatory functions are summarised and comparative arguments advanced regarding sector-specific, multi-sector and international regulation as well as disbanding regulation altogether. From a more pragmatic perspective, the role of law in regulatory regimes is identified and the legal framework for regulation presented. The gamut of relevant legal issues and areas are situated in the telecommunications sector. Sector specific legal issues are categorised by contracting parties: operators, users and the regulator. The principles of economic regulation are reviewed and their impact on national economic development explored. Cultural factors and logistical issues are used to enrich theoretical arguments, in order to ground studentsí explorations in their national context. Explorations are made into regulatory remedies which suit different economic and market environments and provocative questions posed. Students are required to design, present and defend proposals in a simulated real life context.

RPTL 6803 (RP68D)
Economics & Pricing in Telecommunication Networks

This course establishes the foundation for the economic and market context in which telecommunications is currently situated. It presents a discourse on market structures in general and analyses traditional telecommunications markets (long distance, local and international) as well as contemporary and emerging markets (mobile voice and data, Internet-based and converged). It also develops the fundamental economic principles, concepts and models which underpin service costing, service pricing and network interconnection. It analyses the economics of contemporary telecommunications services, in the context of related network industries. It examines regulatory and policy issues from an economic perspective.
RPTL 6804 (RP68E)
Licensing of Telecommunications Services
This course establishes the rationale for licensing and differentiates between telecommunications technologies, applications and services in this context. It identifies the various elements which are subject to licensing. RP68E discusses the related roles and activities of the ITU and the corresponding roles of national regulatory bodies. As background for wireless licensing, the course presents the basics of the electromagnetic spectrum, wireless transmission, bandwidth, capacity and wireless applications. The various generations of cellular technologies are demystified. The technical principles and practice of spectrum management are treated. The economic principles and practice of spectrum management, including associated pricing models are discussed. Benchmarks and best practice are reviewed. RP68E also discusses licensing issues relating to wired services including the Internet, cable TV and NGNs (Next Generation Networks). The course explores the manner in which licensing and spectrum management strategies impact on developmental objectives. RP68E makes rich use of case studies.

RPTL 6805 (RP68F)
Interconnection in Telecommunication Networks
This course charts the evolving dimensions (general, technical, economic and legal) of interconnection policy and practice. The role of interconnection in realising regulatory objectives is examined. The multilateral framework for interconnection under the WTO is described and parallels are drawn with interconnection policy prescribed under national law. The technical background for public network interconnection (basic definitions; unbundling; services; facilities; interconnection points and core standards) along with various cost models, forms the basis for comparative modelling of interconnection costs. The structure of interconnection charges are analysed. The objectives, principles and methodologies for setting originating and terminating price schedules are established. Basic legal and regulatory frameworks, within which interconnection negotiations are situated are reviewed. Economic and legal arguments are presented from the perspectives of the incumbent/dominant firm, new entrant and regulator. Students analyse the various commercial and social objectives which underpin interconnection negotiations. They also critique existing interconnection regimes and negotiation strategies. International case studies and benchmarks are incorporated extensively into the course.

RPTL 6806 (RP68G)
Telecommunications Sector Planning
This course examines the practical and institutional issues relating to telecommunications policy implementation. It recognises the centrality of contemporary telecommunications policy-planning to the developmental objectives of nations and recognises the policies of other key sectors (science, technology, media, etc.) which collaboratively constitute an integrated national ICT policy. It explores organisational models for telecommunications Ministries and regulatory bodies as well as models for communication between these entities and their counterpart institutions. The course places great emphasis on the logistical issues relating to sector planning and development. In particular, it explores methodologies for institutional design and related issues including planning frameworks, institutional powers, organisational structure, staffing, human resource development, resourcing, decision-making, public management, needs assessment, transparency, financing, accountability, performance metrics and performance evaluation. It places institutional issues into the context of telecommunications policy frameworks. The course provides students with an academic space, complemented by international experience, in which to explore the full gamut of sector development from needs assessment through planning to implementation and evaluation.

RPTL 6807 (RP68H)
The Regulatory State in Comparative Perspective
This course seeks to combine conceptual and comparative approaches to the study of network regulation in order to place telecommunications regulation into its wider context: nationally and internationally. It introduces students to contested accounts of regulatory developments and contested issues in the regulation of network industries. The course considers explanations for the rise of the regulatory state and regulatory change, discusses telecommunications in cross-national and cross-sectoral perspective by drawing on examples from the Caribbean, Northern America and the European Union and introduces students to debates on contested issues in regulatory design, such as accountability, transparency and universal services.
RPTL 6808 (RP68I)
Seminar 1

RPTL 6809 (RP68J)
Seminar 2

RPTL 6810 (RP68K)
Seminar 3

RPTL 6811 (RP68L)
MRP Project

* Prerequisites are given in brackets. These prerequisites may also be satisfied by successfully completing appropriate short courses conducted by the Department.
DEPARTMENT OF MECHANICAL & MANUFACTURING ENGINEERING

Head of Department
Dr. Winston G. Lewis

Secretary
Mrs. Angela Oudit

Telephone No: 662-2002; Ext: 2067

5.1 Research

5.1.1 The Department offers the facilities to carry out research leading to the MPhil and PhD Degrees in a wide range of important areas: Mechanical, Industrial and Agricultural Engineering (Biosystems), Production Engineering & Management.

5.1.2 Research students register for the MPhil degree in the first instance and then, subject to the Faculty and University’s Regulations, may upgrade to the PhD degree. Students who already have a Master’s degree obtained through a substantial research project, may register directly for the PhD. A research student works in his chosen field of research under the guidance of a supervisor who has substantial expertise and experience in the field.

5.1.3 Persons interested in pursuing research leading to the MPhil or PhD degrees in Agricultural, Industrial, Mechanical or Production Engineering & Management are invited to contact the Head of Department to discuss their research interests and for further information on research opportunities within the Department. The Department may be able to provide some financial support for specific research projects.

5.1.4 Academic staff within the Department are active in several areas of research as indicated below:
Agricultural Engineering, Agricultural Mechanisation, Crop Processing & Post-harvest Technology, Soil & Water Engineering

Dr. E. Ekwue
Professor C.V. Narayan
Professor C.K. Sankat

Industrial Engineering & Engineering Management

Mr. N.S. Arumugadasan
Dr. B.V. Choudary
Mr. R. Ellis
Mr. S.M.J. Lau
Dr. W.G. Lewis
Dr. Kit-Fai Pun
Professor U.R.K. Rao

Industrial Automation & AI Applications

Dr. J. Bridge
Dr. B.V. Choudary
Dr. P. Persad
Professor U.R.K. Rao

Materials & Manufacturing (Technology & Systems)

Dr. B.V. Choudary
Dr. C.A.C. Imbert
Mr. S.M.J. Lau
Dr. W.G. Lewis
Professor U.R.K. Rao

Theoretical & Applied Mechanics

Dr. S.Y. Keshavan
Dr. J. Bridge

Thermodynamics, Heat Transfer & Renewable Energy Resources

Professor G.S. Kochhar
Dr. K. Manohar
Dr. P. Persad

5.1.5 A sample of recent Research Theses and Projects are listed as follows:

i. Neural Network Model for a Cement Kiln.

ii. An Exergy Analysis of a Hydrocarbon Processing Unit.


vi. Deep Drawing with a Novel Technique for Blank Holding.


viii. Post-harvest Handling and Processing Systems for Peanuts, Nutmegs, etc.

ix. Refrigerated and Controlled Atmosphere Storage for Breadfruit, Mangoes, Carambola, etc.

x. Osmotic and Air-drying Behaviour of Fruit and Fish.

xi. A Reliability-centred Maintenance Programme.

xii. Induction Melting of Iron Carbide.

xiii. Strategic Remodelling of the Quality Systems of the Laboratories at the Caribbean Epidemiology Centre (CEC).
5.2 Staff in the Department

The principal teaching and research interests of staff in the Department are as follows:

PROFESSORS
• Gurmohan S. Kochhar,  
  BE (Baroda), MS (Wisconsin), PhD (UWI), MASME, MASHRAE, FAPETT  
  (Applied Thermodynamics, Energy)

• Chris V. Narayan,  
  BSc, MSc (Guelph), PhD (Mich State), MAPETT  
  (Engineering Design, Agricultural Mechanisation)

• Upamaka R.K. Rao,  
  BTech (Hons), MTech (IIT), DIC, MSc, PhD (Lond)  
  (Machine Tools, Metal-cutting, CAD/CAM, Production Systems)

• Clement K. Sankat,  
  BSc (Eng), MSc (UWI), PhD (Guelph), FI AgrE, CEng, MASAE, MAPETT  
  (Dean of Faculty)  
  (Post-harvest & Food Process Engineering, Engineering Graphics & Design)

SENIOR LECTURERS
• Edwin I. Ekwue,  
  BEng (Nigeria), MSc, PhD (Cranfield), MASAE, MNSAE  
  (Soil & Water Engineering, Farm Structures & Environment)

• Clément A.C. Imbert,  
  BSc (Eng) (UWI), MScTech (Brunel), PhD (UWI) FAPETT, MASME  
  (Materials Technology & Manufacturing Processes)

• Srirangapattanam Y. Keshavan,  
  BE (Bangalore), ME, PhD (IIS)  
  (Stress Analysis, Applied Mechanics)

• Stanley M.J. Lau,  
  BSc (Eng) (UWI), MEng (Cornell), MSc (Accounting) (UWI)  
  (Industrial Management, Engineering Economics & Finance)

• Winston G. Lewis,  
  BSc (Eng), MPhil (UWI), PhD (Tuns), MAPETT, MISS, MTSISS, REng  
  Head of Department  
  (Manufacturing Technology, Plant Layout & Ergonomics)

• Prakash Persad,  
  BSc (Eng), PhD (UWI), AMASME, MAPETT  
  (Control Systems, Robotics, Energy)

• Kit Fai Pun,  
  MSc (Stirling), MEd (Manchester), MSc (Middlesex), MPhil (City Univ, Hong Kong), PhD (Newport), PhD (Middlesex), CEng, EurIng, CPEng  
  (Industrial Engineering & Management)

LECTURERS
• Nagamuttu S. Arumugadasan,  
  BSc (Eng)(Ceylon), MSc (Sussex), MPhil (UWI), CEng, FIMechE, FIE (Sri Lanka), CQE, MORS, MASQ  
  (Systems Modelling & Optimisation)

• Jacqueline Bridge,  
  BSc (Eng)(UWI), PhD (Cornell), Dip.Ed. (Utech), MASME  
  (Applied Mechanics, Vibrations)

• Boppana V. Chowdary,  
  BTech (Nagarjuna), MTech, PhD (IIT Delhi)  
  (Production Technology, CAD/CAM, Manufacturing Systems)

• Ruel Ellis,  
  BSc (Eng)(UWI), MSc (Brunel)  
  (Industrial Engineering)

• Krishpersad Manohar,  
  BSc (Eng), PhD (UWI), MASME, AMASHRAE  
  (Applied Thermodynamics)
PART-TIME LECTURERS

• Benedict Chatoor,
  BSc (UWI), PG Dip (Aston)
  (Materials Technology)

• Arnim Drakes,
  BSc (Eng) (UWI), MSc (Bir)
  (Maintenance & Safety)

• Kishore Jhagroo,
  BSc, MSc (Eng) (UWI)
  (Maintenance Engineering & Management)

• Karene Ramkissoon,
  BA (Psychology) (New York)
  Marketing

• Pallant Ramsundar,
  BSc (Mech Eng) (UWI), MSc (Prod Eng & Mgt) (UWI),
  Dip (Mgt Stud) (UWI),
  Adv PG Dip (Tool Design) (India)
  (Production Design & Development)

• Lennox Sealy,
  BSc (Agric), Dip (Techl(UWI), Dip (French Lang & Civ),
  MS (France), PhD (Biochem & Physiology) (France)
  Dip Mang Stud (UWI), EMBA (UWI)
  (Human Resource Management)

• Selwyn Tom Pack,
  BSc, MSc (Eng) (UWI)
  (Engineering Graphics & Design)

HONORARY LECTURER

• Sennen Matabadal,
  BSc, MSc (UWI)
  (Power Plant Engineering)

GRADUATE/RESEARCH ASSISTANT

• Aaron Ameerali,
  BSc (Eng) (UWI), MAPETT
  (Manufacturing)

• Miguel Jagessar,
  BSc (Eng) (UWI)
  (Engineering Design)

• Ravesh Lalla,
  BSc (Eng) (UWI)
  (Engineering Design)

• Terrence Lalla,
  BSc (Eng), MSc (Prod Eng & Mgt)
  (Manufacturing)

• Nadine Sangster,
  BSc (Eng) (UWI)
  (Controls)

5.3 Faculty of Engineering/Industry Advisory Committee

• Mr. Linford Carabon
  Industrial Gases Limited

• Mr. Michael Ng Chow
  Tracmac

• Mr. Hayden Brown
  PCS Nitrogen Trinidad Limited

• Mr. Eugene Tiah
  President
  Phoenix Park Gas Processors Limited

• Mr. Sennen Matabadal
  Powergen
5.4 Masters and Doctoral Programmes in Agricultural Engineering (Biosystems Engineering)

5.4.1 Objectives
The main objective of these programmes is to offer sound, attractive Graduate degrees through both teaching and research in the three main areas of Agricultural Engineering viz:

i. Engineering Design

ii. Crop Processing, Food Engineering & Post-harvest Technology

iii. Soil & Water Engineering

5.4.2 These guidelines apply to Masters and Doctoral Degree candidates and the number and nature of courses taken will be determined by both the background of the candidate and the Degree of interest.

5.4.3 All of the current rules, regulations and examination requirements for Postgraduate Degrees by Research in the University will apply, i.e., regulations for the MPhil and the PhD degrees.

5.4.4 The Degree in Engineering Design
The Research Degree in Engineering Design is aimed at training students to carry out research and development in the area of Tool and Equipment Design for agriculture and related industry. This will cover field equipment from hand tools and special accessories for local crops and products, to handling and pre-processing equipment for the food industry. Farm machinery design and development for small farm usage and for tropical crops will be encouraged.

5.4.5 The Degree in Crop Processing & Post-harvest Technology
The Research Degree in Crop Processing & Post-harvest Technology is aimed at the training of graduate students in post-harvest technology, crop processing and agribusiness development. The emphasis will be on primary crop processing and post-harvest technology of perishables (high moisture content, biological products, e.g., cereal grains, vegetables, fish and meat) and durable (lower moisture content, e.g., cereal grains, oilseeds). Product and process development will be encouraged all within a framework of agribusiness development for the Caribbean. Developing improved systems to process and store tropical crops/foods and by-products can lead to increased agribusiness activities in the Caribbean. These include packing-houses for fruits, vegetables, root crops and cut flowers both for domestic and export markets and food processing industries which utilise tropical fruits, vegetables, fish meat, etc.

5.4.6 The Degree in Soil & Water Engineering
The Research Degree in Soil & Water Engineering is aimed at the training of graduate students in Irrigation and Drainage Engineering, Soil Erosion and Conservation Engineering, Theory and Practices of Soil Cultivation and General Water Resources Planning and Development related to agriculture. Emphasis will be placed on modern methods of irrigation design and planning as well as on techniques of modifying the soil mechanical properties in order to improve soil workability by farm machinery and to minimise soil erosion. The research work in Soil & Water Engineering will also assess the effectiveness of new and existing techniques to reduce the related problems of soil erosion and degradation, poor drainage status and soil compaction under the impact of mechanical forces.

5.4.7 Degree Structure for MPhil and PhD
These being Research Degrees, students will be expected to produce a satisfactory Thesis (MPhil or PhD) as stipulated in the University’s regulations.
5.4.8 Additionally, students depending upon their academic background, will be required to take three (MPhil) or four (PhD) Departmental courses. These courses will be used to direct the student’s approach towards the research topic in particular, strengthening their knowledge base in their area of interest and to research methodology in general.

5.4.9 Finally, the student will be asked to give a mandatory research Seminar within three (MPhil) or four (PhD) Semesters of first registration.

5.4.10 The Degree structure therefore comprises of the following: -

\[ \begin{align*}
&\text{i. An MPhil or PhD Thesis} \\
&\text{ii. Departmental Courses (three for MPhil, four for PhD)} \\
&\text{iii. A Research Seminar}
\end{align*} \]

5.4.11 For all three Degrees, both at the MPhil and PhD levels, the structure is therefore as follows: -

**COMPULSORY COURSE**
AM63A Research Methodology

**ELECTIVE COURSES**
AENG 6001 Processing & Storage of Perishable Crops (AE60A)
AENG 6002 Processing & Storage of Durable Crops (AE61A)
AENG 6003 Physical Properties of Agricultural Products (AE62A)
AENG 6004 Special Topics in Design (AE62B)
AENG 6005 Reading Course in Agricultural Engineering (AE63A)
AENG 6006 Hydrology & Water Resources (AE64A)
AENG 6007 Irrigation & Drainage Engineering (AE64B)
AENG 6008 Soil Mechanics & Cultivation (AE65A)
AENG 6009 Soil & Water Conservation Engineering (AE65B)
AGBU 3000 Farm Business Management in Agriculture (AM30C)
AGBU 3006 Agricultural Project Appraisal & Implementation (AM36A)
MENG 64.. Statistical Methods in Engineering (ME64A)

Other suitable courses from the Faculties of Engineering and Science & Agriculture may also be taken, subject to Departmental approval.

**RESEARCH SEMINAR**
AENG 6010 Research Seminar (AE600)

**RESEARCH THESIS**
AENG 7000 MPhil Thesis (AE610)
AENG 8000 PhD Thesis (AE620)

5.4.12 **Duration of Study**
It is envisaged that a Master's programme of research and study can be completed by full-time postgraduate students in two to three (2-3) calendar years. This will be encouraged. The time limits for completion of postgraduate degrees (MPhil and PhD) however, are those as normally specified by the University.

5.4.13 **Entry Requirements**
The normal University Regulations will apply for entry into the MPhil programme specifically an Honours Degree in any of the following disciplines viz.:

- Engineering
- Natural Sciences
- Earth Sciences
- Food Science
- Agriculture
- Agricultural Economics

as well as any other suitable degree. The suitability of the applicant’s undergraduate training as generally specified above will be matched to the specific degree of interest. Students with Pass Degrees will be accepted only under special circumstances principally related to postgraduate experience.
5.5 Syllabuses

AENG 6000 (AE653)
Research Methodology
Critical discussion of the application of scientific methodology to research in agricultural economics. The role of inductive and deductive logic in scientific research in the Caribbean.

AENG 6001 (AE60A)
Processing & Storage of Perishable Crops
Harvesting and handling of perishable crops; Post-harvest physiology; Crop pre-treatment for storage and processing; Water activity; Intermediate moisture foods; Principles of refrigeration and application to chilling and freezing; Thermal properties; Packing-house requirements; Packaging; Perishable process/Preservation principles.

AENG 6002 (AE61A)
Processing & Storage of Durable Crops
Crop physical properties and characteristics; Harvest methods; Transient heat and mass transfer; Psychrometrics; Handling; Cleaning; Drying and storage systems; Dehydration; Pest control; Primary processing operations; Milling; Separation and Extraction; Processing of selected tropical crops.

AENG 6003 (AE62A)
Physical Properties of Agricultural Products
Geometry and shape factors. Some flotation and aerodynamic properties. Elastic and viscoelastic behaviour including variation with moisture and temperature. Measurement of toughness, friction, impact strength, and other properties that may be used as quality indicators.

AENG 6004 (AE62B)
Special Topics in Design
This is a project course graded by coursework only. Students will be required to analyse problems and existing equipment and to carry out design or modification work.

AENG 6006 (AE64A)
Hydrology & Water Resources
Surface water hydrology and movement; Meteorology, Runoff measurement; Hydrograph analysis; Water balance studies; Groundwater resources; Pumping test; Bore hole design; Computer applications.
5.6 Masters and Doctoral Programmes in Mechanical, Manufacturing & Industrial Engineering

5.6.1 Background
A research degree programme that leads to the award of a Master of Philosophy (MPhil) or a Doctor of Philosophy (PhD) in Mechanical Engineering, Manufacturing Engineering or Industrial Engineering is being offered by the Department.

At the undergraduate level in Mechanical & Manufacturing Engineering, students are founded on the areas of Engineering Mechanics and Design, Thermal Engineering and Energy Systems, and Manufacturing Design, Processes and Systems. Students acquire the ability to deal with interrelated activities and operations involving product design, materials selection, production planning, quality assurance and management, and development of methods for integrating facilities and systems by which products may be manufactured economically.

At the undergraduate level in Industrial Engineering, students are grounded in Information Systems and Technology, Manufacturing Systems and Technology, Human Factors Engineering, and Management Science Operations Research. The current emphasis of IE is on the design, improvement and installation of integrated systems of people, material, equipment, information and energy. Graduates are employed in the service and manufacturing industries to harness and manage resources for sustainable development in the Caribbean region.

The objectives of the MPhil/PhD programmes in Mechanical/Manufacturing/Industrial Engineering by research are:

a. To provide training at the postgraduate level in specialised Mechanical / Manufacturing/Industrial Engineering subject areas through teaching and to solve engineering problems through research.

b. To assist in the transfer of new, emerging and advanced technologies to the businesses of the Region through the mechanism of research projects.

c. To develop and augment the region’s pool of expertise in Mechanical/Manufacturing/Industrial Engineering.

d. To assist in the development of the Region through an outreach programme.

5.6.2 Degree Structure for MPhil and PhD
The Degree structure comprises the following:

i. An MPhil or PhD Thesis

ii. Departmental Courses (three for MPhil, four for PhD)

iii. A Research Seminar

5.6.3 Research Thesis
These being Research Degrees, students will be expected to produce a satisfactory Thesis (MPhil or PhD) as stipulated in the University’s regulations.

5.6.4 Departmental Courses
Depending upon their academic background, students will be required to take three (MPhil) or four (PhD) Departmental courses. These courses will be used to direct the students’ approach towards the research topic in particular, strengthening their knowledge base in their area of interest and to research methodology in general.
a. **Compulsory Course**

MENG 6508 Research Methods (IE/ME 68H)

b. **Elective Courses**

i. **Industrial Engineering Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>IENG 6000</td>
<td>Total Quality Management (IE64N)</td>
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<tr>
<td>IENG 6001</td>
<td>Expert Systems (CS22B)* (IE66G)</td>
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<tr>
<td>IENG 6002</td>
<td>Distributed Information Systems &amp; Databases (IE34A)* (IE66H)</td>
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<tr>
<td>IENG 6003</td>
<td>Computer Integrated Manufacturing Systems (IE66K)</td>
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<td>IENG 6004</td>
<td>Occupational Biomechanics (IE67G)</td>
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<td>IENG 6005</td>
<td>Industrial Ergonomics (IE67H)</td>
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<td>IENG 6006</td>
<td>Occupational Safety &amp; Health (IE67K)</td>
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<td>IENG 6007</td>
<td>Industrial Automation (IE68G)</td>
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<td>IENG 6009</td>
<td>Robotic Technology &amp; Applications (IE68K)</td>
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<tr>
<td>IENG 6010</td>
<td>Operations Research in Manufacturing I (IE33A)* (IE69G)</td>
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<td>IENG 6011</td>
<td>Operations Research in Manufacturing II (IE33A)* (IE69H)</td>
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<td>IENG 6012</td>
<td>Operations Research in Services (IE33A)* (IE69K)</td>
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<tr>
<td>IENG 6013</td>
<td>Directed Readings (IE670)</td>
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<tr>
<td>MATH 3530</td>
<td>Mathematics III (M37A) (M26A)*</td>
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<tr>
<td>MENG 6506</td>
<td>Project Management (ME65Q)</td>
<td>ME64G</td>
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ii. **Mechanical/Manufacturing Engineering Courses:**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>MENG 6200</td>
<td>Production Technology (ME25B)* (ME62G)</td>
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<tr>
<td>MENG 6201</td>
<td>Machine Tool Technology (ME62H)</td>
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<tr>
<td>MENG 6202</td>
<td>Applied Materials Technology (ME 62K)</td>
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<tr>
<td>MENG 6203</td>
<td>Robotic Technology &amp; Applications (ME62L)</td>
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<tr>
<td>MENG 6300</td>
<td>Applied Ergonomics (ME63G)</td>
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<tr>
<td>MENG 6301</td>
<td>Computer Applications in Manufacturing (ME63H)</td>
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<tr>
<td>MENG 6302</td>
<td>Design of Plant &amp; Services (ME63K)</td>
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<tr>
<td>MENG 6303</td>
<td>Computer Control Systems (ME63L)</td>
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<tr>
<td>MENG 6400</td>
<td>Production Planning &amp; Control (ME64G)</td>
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<tr>
<td>MENG 6401</td>
<td>Advanced Production Management (ME64H)</td>
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<td>MENG 6402</td>
<td>Human Resource Management I (ME64K)</td>
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<td>MENG 6403</td>
<td>Human Management II (ME64L)</td>
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<tr>
<td>MENG 6404</td>
<td>Maintenance Engineering &amp; Management (ME64M)</td>
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<tr>
<td>MENG 6405</td>
<td>Total Quality Management (ME64N)</td>
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<tr>
<td>MENG 6500</td>
<td>Industrial Marketing (ME65G)</td>
<td></td>
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<tr>
<td>MENG 6501</td>
<td>Statistical Methods in Engineering (ME65H)</td>
<td></td>
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<tr>
<td>MENG 6502</td>
<td>Financial Management (ME65K)</td>
<td></td>
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<tr>
<td>MENG 6503</td>
<td>Applied Operations Research (ME65L)</td>
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<tr>
<td>MENG 6504</td>
<td>Technology &amp; Product Development (ME65M)</td>
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<tr>
<td>MENG 6505</td>
<td>Health, Safety &amp; The Environment (ME65N)</td>
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<tr>
<td>MENG 6506</td>
<td>Project Management for Mechanical Engineers (ME65Q)</td>
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</tbody>
</table>

* Prerequisites are given in brackets. These prerequisites may also be satisfied by successfully completing appropriate short courses conducted by the Department.
The above courses build upon the foundations laid at the undergraduate level and are thus vertically integrated with the undergraduate programme.

d. Research Seminar - IE/ME600
This is compulsory and must be completed within three (3) (MPhil) or four (4) (PhD) Semesters of first registration.

5.6.5 Duration of Study

a. Full-time students will normally be expected to complete the course examination requirements within two (2) semesters for MPhil and three (3) semesters for PhD, and complete the programme in accordance with the relevant University Regulations.

b. Part-time students will normally be expected to complete the examination requirements within four (4) semesters for MPhil and six (6) semesters for PhD, and complete the MPhil programme in accordance with the relevant University Regulations.

5.6.6 Entry Requirements

a. BSc Honours Degree in Industrial, Mechanical, Manufacturing or Electrical Engineering or equivalent. Only in exceptional circumstances will candidates with pass degrees be considered.

b. Normally, at least one (1) year of industrial experience is desirable.

5.7 Syllabuses

IENG 6000 (IE64N)
Total Quality Management

IENG 6001 (IE66G)
Expert Systems

IENG 6002 (IE66H)
Distributed Information Systems & Databases
Information systems in business/industry. Systems planning, requirements analysis. Systems analysis and design methods including structured methodologies. Data communications and distributed processing. Distributed database system, Management support systems.

IENG 6003 (IE66K)
Computer Integrated Manufacturing System

IENG 6004 (IE67G)
Occupational Biomechanics
IENG 6005 (IE67H)
Industrial Ergonomics
Introduction to the attributes of the human as a functioning system. The human sensory processes as human information input channels. Anthropometry and physical workspace and arrangement. Displays, controls and workplace design. Material material handling and human strength. The working environment - atmospheric conditions; light, color, illumination; noise and vibration. Circadian rhythms, chronobiology and shift work in the workplace. Human-computer interaction.

IENG 6006 (IE67K)
Occupational Safety & Health

IENG 6007 (IE68G)
Industrial Automation

IENG 6009 (IE68K)
Robotic Technology & Applications

IENG 6010 (IE69G)
Operations Research in Manufacturing I

IENG 6011 (IE69H)
Operations Research in Manufacturing II
Application of operations research methodology to distribution, Independent inventory, layout and handling, and Maintenance decisions in manufacturing organisations.

IENG 6012 (IE69K)
Operations Research in Services
Application of operations research methodology to strategy, facilities, logistics, and scheduling decisions in service organisations.

IENG 6013 (IE670)
Directed Readings
A critical review of the current literature in a special topic of importance to Industrial Engineering.

MATH 3530 (M37A)
Mathematics III

MENG 6200 (ME62G)
Production Technology
This course follows on from the fundamental principles of the manufacturing process and design in the undergraduate programme and emphasises the broader aspects of the production systems as opposed to the processes themselves. Topics will include welding design considerations and specifications, foundry systems, metal-forming equipment, polymer technology, machining system, automation and Computer Integrated Manufacturing.

MENG 6201 (ME62H)
Machine Tool Technology
Functional study of different types of machine tool elements such as spindles drives, bedways, bearings, tool holders, and work holding devices; effect of vibrations and methods of controlling vibrations; lubrication and cooling; acceptance test for machine tools; machine tools for newer machining techniques; large machine tool systems, numerical control of machine tools.
MENG 6202 (ME62K)
Applied Materials Technology
This course follows on from the fundamental principles in the undergraduate programme and goes further into the more applied aspects of materials performance. The emphasis would be on preventive and investigative methods and would include such topics as inspection techniques, failure mechanisms and analysis.

MENG 6203 (ME62L)
Robotic Technology & Applications
Basic structure of robots; Classification and structure of robotic systems; Drives and control systems; Co-ordinate transformation and kinematic analysis; Trajectory planning and control; Programming; Intelligent robotic systems; Robotic applications and installation.

MENG 6300 (ME63G)
Applied Ergonomics
Effect of heat on workers, acclimatisation; noise in industry, hearing loss, noise control; Colours in working environments; Light sources, illumination standards, brightness and contrast, visual fatigue; Levers, dials and controls; Human vibration control; Man-machine systems; Work design, hand-tool design, work-station design; Wider application of ergonomics.

MENG 6301 (ME63H)
Computer Applications in Manufacturing
Introduction to artificial intelligence, artificial neural networks, expert systems, fuzzy and neuro-fuzzy systems and their applications in the manufacturing and process industries.*

MENG 6302 (ME63K)
Design of Plant & Services
Product, process and schedule design, line balancing; Activity relationships and space requirements; Personnel requirements; Material handling including robotic and automatic-guided vehicles; Plant layout; Computer-aided plant layout; Receiving and shipping; Storage and warehousing; Office planning; Facility services - electricity, water, air-conditioning communications.

MENG 6303 (ME63L)
Computer Control Systems
Concepts of computer control; Process modelling, solution of difference equations; Stability analysis; System inputs and generating functions; System response; Discrete controller design, stability and realisability; sample period selection, feed forward control and cascade control; control computers; computer interfacing and sensors for computer control.

MENG 6400 (ME64G)
Production Planning & Control
Computer-controlled production and inventory systems; Computer-aided process planning techniques; Database configuration and techniques for forecasting and implementation of aggregate plans; Groups Technology for planning and control; Manufacturing Automation Protocol at the Shop Floor; Computer-controlled scheduling and sequencing techniques; Computerised costing systems.

MENG 6401 (ME64H)
Advanced Production Management
Designing, managing and improving operations in competitive environments; Supply chain management/logistics in operations; Management of the global business/operations environment; Managing technology and innovation for competitive advantage.

MENG 6402 (ME64K)
Human Resource Management I
Formal and informal organisation; The bureaucratic model; The organisational environment; Modern organisation theory; The individual in the organisation; SKAO; Theories of motivation and leadership industrial relations; IRA, RSBA; Communication in organisations; Performance appraisal systems.

MENG 6403 (ME64L)
Human Resource Management II
External staffing; Internal staffing; Base wage and salary systems; Training and development; Job evaluation systems; HRM planning; OD and change; Occupational health and safety; Future issues.
MENG 6404 (ME64M)
Maintenance Engineering & Management
Objectives and policies of maintenance; Reliability, availability, and maintainability; Failure statistics and analysis. Terotechnology and life cycle costing; Preventive maintenance: Condition-based and scheduled maintenance; Corrective maintenance and overhauls; Plant turnarounds; Work-planning and control; Performance and productivity analysis; Quantitative technique; Computer in maintenance.

MENG 6405 (ME64N)
Total Quality Management
Philosophy and principles of total quality management; Customer satisfaction; Quality systems; Quality tools; Continuous improvement; Employee involvement and empowerment; Supplier partnerships; Benchmarking; Quality function deployment; Statistical process control; Taguchi’s quality engineering; Experimental design.

MENG 6500 (ME65G)
Industrial Marketing
Nature and scope of marketing; Characteristics of industrial marketing; Organisational buyer behaviour; Industrial marketing research; Industrial marketing planning; Product planning, industrial innovation and new product strategies; Choice of channels and physical distribution; Price determination; Industrial advertising and sales promotion; Personal selling; Marketing audit, cost analysis and controls.

MENG 6501 (ME65H)
Statistical Methods in Engineering
Probability distributions; Estimation and hypothesis testing; Correlation and regression analysis of variance; Experimental design; Multivariate statistics.

MENG 6502 (ME65K)
Financial Management
Analysis of financial statements; Financial forecasting and planning; Risk, return and valuation; Capital budgeting; Financial structure and leverage; Cost of capital; Financing mix decisions; Current asset management: Cash, marketable securities, accounts receivables, inventory and short-term financing; Long-term financing; Common stock, debt, preferred stock, term loans, and leasing; Dividend policy.

MENG 6503 (ME65L)
Applied Operations Research
Modelling and optimisation of large scale systems; Linear and non-linear models, stochastic models, multi-criteria models; Use of computer software packages; Decision support systems.

MENG 6504 (ME65M)
Technology & Product Development
Relationship between technology transfers, technological change and economic development. Technology diffusion and innovation industry; Technology selection and capacity planning; Design axioms and corollaries; Features in design and manufacturing; Management of product development; Strategic approval; Integration of expert systems; Databases and CAD; Neural networks in design of products.

MENG 6505 (ME65N)
Health, Safety & The Environment
Hazards associated with manual work, machinery, mechanical systems, construction and other common industrial scenarios; Safety technology and engineering controls; Electricity and fire; Principles of industrial hygiene; Occupational health hazards; Personal Protective Equipment; Ergonomics; Welfare issues - the working environment; Risk assessment and hazard analysis; Job safety analysis; Safe systems of work, including permit to work systems; Inspection techniques; Accidents: causation, investigation, reporting and costs; Communication; Motivation and training; Psychological factors in safe behaviour; Safety and health legislation (in Trinidad and Tobago, and key legislation in the UK and USA).

MENG 6506 (ME65Q)
Project Management
Project identification in context of investment programme at national and sectorial level; Pre-investment studies; Detailed project preparation, development and evaluational project organisation; Project analysis and evaluation (technical, economics, financial, social and environmental). Project implementation (procurement/contracts programming and control); ex-post evaluation.
MENG 6508 (IE/ ME68H)
Research Methods

5.8 MSc Programmes in Production Engineering & Management, Production Management, & Engineering Management

5.8.1 Programme Objectives

5.8.2 The overall objective of the programme is to provide advanced education and training for graduates in Engineering, Science and related areas to meet current and future needs of manufacturing and allied industries.

5.8.3 Three areas of specialisation are identified to enable students to pursue a course of study closely related to the needs of their organisations and their personal career advancement:

i. MSc in Production Engineering & Management
The purpose of this course of study is to provide graduates in Mechanical and Industrial Engineering with an in-depth understanding of the technical, economic and managerial factors and their integration in the specification, design and operation of manufacturing systems.

Output: A competent Production Engineer capable of combining technical and managerial functions.

ii. MSc in Production Management
The purpose of this course of study is to provide graduates in Engineering and Science with a thorough understanding of the analysis, planning and control of production systems.

Output: A competent Production Manager capable of profitable operations of manufacturing enterprises.
iii. MSc in Engineering Management
The purpose of this course of study is to enable graduates in Engineering and Science to strengthen and enhance their managerial capabilities.

Output: A competent Engineering Manager capable of effective management of engineering functions and services.

5.8.4 Programme Content

5.8.5 The Programme consists of a set of courses grouped under four (4) major Subject Groups and a Final Project. Each course is taught over one (1) semester and carries three (3) credits and the Final Project carries twelve (12) credits.

A. Production Technology and Materials
MENG 6200 Production Technology (ME62G) (MENG 2008) (ME25B)*
MENG 6201 Machine Tool Technology (ME62H)
MENG 6202 Applied Materials Technology (ME62K) (MENG 3015)(ME35A)
MENG 6203 Robotic Technology & Applications (ME62L)

B. Production Systems Design
MENG 6300 Applied Ergonomics (ME63G)
MENG 6301 Computer Applications in Manufacturing (ME 63H)
MENG 6302 Design of Plant & Services (ME63K)
MENG 6303 Computer Control Systems (ME63L)

C. Production Management & Control
MENG 6400 Production Planning & Control (ME64G)
MENG 6401 Advanced Production Management (ME64H) (MENG 3006) (ME31C)
MENG 6402 Human Resource Management I (ME64K)
MENG 6403 Human Resource Management II (ME64L)
MENG 6404 Maintenance Engineering & Management (ME64M)
MENG 6405 Total Quality Management (ME64N)

D. Engineering Management & Optimisation
MENG 6500 Industrial Marketing (ME65G)
MENG 6501 Statistical Methods in Engineering (ME65H)
MENG 6502 Financial Management (ME65K)
MENG 6503 Applied Operations Research (ME65L)
MENG 6504 Technology & Product Development (ME65M) (ME34A)
MENG 6505 Industrial Health & Safety (ME65N)
MENG 6506 Project Management (ME65Q)

E. MENG 6600 Final Project (ME660)

5.8.6 In addition, undergraduate options, not more than the equivalent of nine (9) credits, may be taken from the following list in each of the subject groups:-

<table>
<thead>
<tr>
<th>Subject Group</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>A MENG 2008</td>
<td>Manufacturing Technology (ME25B)</td>
</tr>
<tr>
<td>MENG 3014</td>
<td>Computer-aided Design &amp; Manufacture (ME34B)</td>
</tr>
<tr>
<td>MENG 3015</td>
<td>Materials Technology (ME35A)</td>
</tr>
</tbody>
</table>
Subject Group | Course Title |
---|---|
B | IENG 2000 Work Study & Ergonomics (IE20A) |
| IENG 3004 Control Systems Technology (IE32A) |
| IENG 3006 Automation (IE32C) |
C | ME31C Production Management |
D | IENG 2002 Operations Research I (IE23A) |
| IENG 3007 Operations Research II (IE33A) |
| IENG 3008 Simulation (IE33B) |

5.8.7 Requirements for Award of MSc

5.8.8 Candidates are required to obtain a total of 36 credits, as given below, in coursework and complete an industry-oriented project, ME660, equivalent to twelve (12) credits.

i. **MSc in Production Engineering & Management:**
   18 credits from Subject Groups A and B and 18 credits from Subject Groups C and D.

ii. **MSc in Production Management:**
   24 credits from Subject Groups B and C and 12 credits from Subject Group D.

iii. **MSc in Engineering Management:**
   12 credits from Subject Groups A and B, and 24 credits from Subject Groups C and D.

Selection of courses is subject to the approval of the Department.

5.8.9 Entry Requirements

5.8.10 The requirements for admission to the Programme are as follows:

i. **MSc in Production Engineering & Management:**
   A BSc Degree in Mechanical, Industrial or Production Engineering or an equivalent.

ii. **MSc in Production Management:**
   A BSc Degree in Engineering or Science or an equivalent. Candidates with other qualifications will be considered if they have at least ten (10) years industrial experience in the area of Production Management. Qualifying examinations may also be prescribed for such candidates.

iii. **MSc in Engineering Management:**
   A BSc in Engineering or Science or an equivalent. Candidates with other qualifications will be considered if they have at least ten (10) years industrial experience in the area of Engineering Management. Qualifying examinations may also be prescribed for such candidates.

ii. Normally, at least one (1) year of industrial experience is desirable.

5.8.11 Who Should Enrol

5.8.12 The Programmes would be most useful to Engineers and Managers holding responsibilities for Planning, Design and Development, Production/Operations, Plant Maintenance, and Projects in Manufacturing and Service Industries.

5.8.13 Graduates in Engineering or Science wishing to pursue careers in Production/Operations Management may also apply.

5.8.14 Duration of Study

5.8.15 Full-time students will normally be expected to complete the examination requirements within two (2) semesters and complete the Project in accordance with the relevant University Regulations.

5.8.16 Part-time students will normally be expected to complete the examination requirements within four (4) semesters and complete the Project in accordance with the relevant University Regulations.
5.8.17 Regulations

5.8.18 The General Regulations of the University and Faculty of Engineering Regulations for MSc Degrees shall apply.

5.8.19 Candidates are required to pass both coursework and written examinations in each course offered.

5.8.20 In respect of each candidate who fails the examination in any course, the Examiners shall recommend to the Board for Graduate Studies whether a second attempt at the examination should be permitted.

5.8.21 A full-time candidate who fails not more than two (2) courses in a semester may be allowed a second attempt at the examinations in those courses.

5.8.22 A part-time candidate who fails not more than one (1) course in a semester may be allowed a second attempt at the examination in that course.

5.8.23 Candidates will not normally be permitted to repeat the examination of any one (1) course on more than one subsequent occasion.

5.9 Masters Degree Programme in Manufacturing Engineering (MME)

5.9.1 Programme Objectives

5.9.2 The objectives of this professional, postgraduate programme are:

i) To provide students with greater depth of technical knowledge in manufacturing and greater breadth and options in related areas;

ii) To develop an understanding of manufacturing systems, modelling and simulation.

iii) To provide a deeper understanding of the knowledge required for designing products, tools and manufacturing systems in a concurrent engineering perspective;

iv) To synthesise and apply the knowledge and techniques in the taught courses in project work; and

v) To develop an understanding of the multi-disciplinary nature of manufacturing through group design projects that provide experience in team-based business and design projects.

5.9.3 Programme Content

5.9.4 The programme consists of a set of courses grouped in three semesters (i.e., two normal semesters plus one summer semester). The core components include the two parts of the Investigative Project, the seminar series, five (5) compulsory courses and twelve (12) optional courses. All courses are of three (3) credits unless otherwise specified.

5.9.5 The programme stresses university-industry linkages. Student projects will normally be provided and sponsored by companies in which a joint advisory committee of Faculty members and corporate personnel will provide guidance.

Semester 1

Compulsory Courses

MENG 6207 Computer integrated Manufacturing (ME62Q)
MENG 6208 Product, Tool & Manufacturing Analysis (ME62T)
MENG 6505 Health, Safety & The Environment (ME65N)
MENG 6508 Research Methods (ME/IE68H)

Optional Courses

One (1) course to be chosen from the following:

MENG 6402 Human Resource Management I (ME64K)
MENG 6506 Project Management (ME65Q)

Two (2) courses to be chosen from the following:

MENG 6204 Advanced Machining Methods & Analysis (ME62M)
MENG 6205  Advanced Forming Methods & Analysis (ME62N)
MENG 6206  Plastics Processing (ME62P)
MENG 6504  Technology & Product Development (ME65M)

Semester 2

Project Work
MENG 6601  Investigative Project Part I (ME66A)

Compulsory Courses
MENG 6304  Advanced Manufacturing Systems (ME63M)
MENG 6507  Entrepreneurship & Innovation (ME67G)

Optional Courses
One (1) course to be chosen from the following:

MENG 6200  Production Technology (ME62G)
MENG 6202  Applied Materials Technology (ME62K)
MENG 6203  Robotic Technology & Applications (ME62L)
MENG 6401  Advanced Production Management (ME64H)
MENG 6405  Total Quality Management (ME64N)

Semester 3

Project Work
MENG 6602  Investigative Project Part II (ME66B) (9 Credits)

Seminar Series
ENGR 6700  Management & Leadership Seminars (FE67G) (2 Credits)

5.9.6 Requirements for Award

5.9.7 Students need to complete five (5) Compulsory Courses (15 credits) and four (4) Optional Courses (12 credits), attend a series of Management and Leadership Seminars (2 credits) and conduct an Investigative Project (Parts I and II - 12 credits). The project must be completed by the end of August. In total, forty-one (41) credits will be required for the programme.

5.9.8 Duration of Study

5.9.9 This is a one-year (3-semester), full-time programme building upon the foundation of the three (3) BSc (Hons) Degree programmes presently offered in the Department which are accredited by IMechE (UK) on the route to Chartered Engineer status.

5.9.10 Entry Requirements

5.9.11 The requirements for admission to the programme are as follows:

1) UWI graduates with:
   i) BSc (Eng) in Mechanical Engineering
   ii) BSc (Eng) in Industrial Engineering, and
   iii) BSc (Eng) Mechanical Engineering with Minor in Biosystems Engineering

2) Graduates with a BSc Degree in Mechanical, Industrial, Manufacturing or Production Engineering or equivalent from recognised universities or institutes of higher education.

3) Only in exceptional circumstances will candidates with Pass Degrees be considered.

5.9.12 Regulations

5.9.13 The General Regulations of the University, the Faculty of Engineering and the Department of Mechanical and Manufacturing Engineering for MSc Degrees shall apply.
5.9.14 Syllabuses

ENGR 6700 (FE67G)
Management & Leadership Seminars
Active participation in Seminars and discussions on topics including: Project Management; Case Studies in Human Resource Management; Business Processes; New Venture Development; Supply Chain Management and other related areas.

MENG 6200 (ME62G)
Production Technology
This course follows on from the fundamental principles of the manufacturing process and design in the undergraduate programme and will emphasize the broader aspects of the production systems as opposed to the processes themselves; Topics will include developments in Metal Casting, Welding, Forming, Machining and Plastics processing technology and systems.

MENG 6202 (ME62K)
Applied Materials Technology
This course follows from the fundamental principles of materials technology and goes further into the more applied aspects of materials performance. The emphasis would be on preventive and investigative methods and would include such topics as inspection and analytical techniques, failure mechanisms and analysis.

MENG 6203 (ME62L)
Robotic Technology & Applications
Basic structure of robots; Classification and structure of robotic systems; Drives and control systems; Co-ordinate transformation and kinematics analysis; Trajectory planning and control; Programming; Intelligent robotic systems; Robotic applications and installation; Programmable Logic Controls.

MENG 6204 (ME62M)
Advanced Machining Methods & Analysis
Overview of methods and systems for material removal; Machining methods employing tools of defined geometry; Mechanics of orthogonal and oblique cutting; Nature of contact between chip and tool; Thermal aspects; Tool wear and Tool life; Machinability; Cutting fluids; Analysis of turning, drilling and milling processes; Abrasive machining processes; Developments in non-traditional machining methods; Economics of machining.

MENG 6205 (ME62N)
Advanced Forming Methods & Analysis
Stress and strain analysis; Yield conditions; Stress-strain relations in elastic and plastic deformations; Workhardening; Formulation of elastic and plastic problems; Methods of solution: Slab method; Slip-line fields and extremum principles; Applications of theory of plasticity to metal-working operations viz: wire drawing, extrusion, rolling, forging, deep drawing, spinning, etc; Friction in metal-forming; Recent developments in technology and theory of metal-forming.

MENG 6206 (ME62P)
Plastics Processing
Properties and applications of common and engineering plastics; Manufacturing methods for products of thermosetting and thermoplastic polymers; Design for production and development of tooling for Extrusion, Injection moulding; Thermoforming; Calendering; Rotational moulding; Compression moulding; Transfer moulding; Blow moulding; Film blowing; Analysis of polymer melt-flow; Processing of reinforced plastics.

MENG 6207 (ME62Q)
Computer Integrated Manufacturing
Introduction to CIM; Role of the computer in manufacturing; Hardward and software components of computer automation; Advanced computer architectures used in manufacturing; Computer Aided Design (CAD); Computer Aided Manufacturing (CAM); Linking CAD with CAM; Control of manufacturing equipment; Computer controlled parts handling and assembly; Simulation of manufacturing processes; Quality in CIM perspective; Programmable factory.

MENG 6208 (ME62T)
Product, Tool & Manufacturing Engineering
Product domain/process domain; Product design/product quality; Process flow chart; Sheet metal forming design considerations; Metal cast parts design; Plastic component design; Wood products design; Design for assembly; Finishes; Detailed tool, dye and mould design; Equipment selection; Manufacturing support systems.
MENG 6304 (ME63M)
Advanced Manufacturing Systems
Flexible manufacturing concepts: Planning and Control of FMS; Cellular manufacturing; Case studies in flexible manufacturing; Global strategy issues: Structuring international capacity; strategic management of advanced integrated manufacturing technologies; Methods and tools for agile manufacturing; Manufacturing strategy for globally competitive market evaluation, selection and adoption of AMS: Decision support system for evaluating and selecting projects incorporating strategic business objectives; Planning and justification of advanced manufacturing technologies; Implementation issues; Practices for implementing concurrent engineering; Simulation for cellular layouts; Internet for manufacturing managers and researchers.

MENG 6401 (ME64H)
Advanced Production Management
Designing, managing and improving operations in competitive environments by focusing on key elements: Quality, productivity and technology; Supply chain management/logistics in operations; Management of the global business/operations environment; Integrated flow of funds, data and materials; Industrial ecology process and product audits, EIA and ISO 14000; Management and the legal environment.

MENG 6402 (ME64K)
Human Resource Management I
Formal and informal organisations; The bureaucratic model; The organisational environment; Modern organisation theory; The individual in the organisation; SKAO; Theories of motivation and leadership; Industrial relations; IRA, RSBA; Communication in organisations; Performance appraisal systems.

MENG 6405 (ME64N)
Total Quality Management
Philosophies and principles of total quality management; Customer satisfaction; Quality systems; Quality tools; Continuous improvement; Employee involvement and empowerment; Supplier partnerships; Benchmarking; Quality function deployment; Statistical process control; Taguchi’s quality engineering; Experimental design.

MENG 6504 (ME65M)
Technology & Product Development
Technology transfers, technological change and economic development; Technology diffusion and innovation industry; Technology selection and capacity planning; Design axioms and corollaries; Features in design and manufacturing; Management of product development; Strategic appraisal; Databases in CAD; A1 in design of products.

MENG 6505 (ME65N)
Health Safety & Environment
Hazards associated with manual work, machinery, mechanical systems, construction and other common industrial scenarios; Safety technology and engineering controls; Electricity and fire; Principles of industrial hygiene; Occupational health hazards; Personal Protective Equipment; Ergonomics; Welfare issues - the working environment; Risk assessment and hazard analysis; Job safety analysis; Safe systems of work, including permit to work systems; Inspection techniques; Accidents: causation, investigation, reporting and costs; Communication; Motivation and training; Psychological factors in safe behaviour; Safety and health legislation (in Trinidad and Tobago, and key legislation in the UK and USA).

MENG 6506 (ME65Q)
Project Management
Project identification in the context of investment programmes at national and sectoral levels; Pre-investment studies; Project management, development and evaluation; Project organisation; Project analysis and evaluation (market, technical, economic, financial, social and environmental); Project implementation (procurement/contracts programming and control); Export evaluation.

MENG 6507 (ME67G)
Entrepreneurship & Innovation
Entrepreneurship (Theory and Practice); Entrepreneurship in small businesses; Entrepreneurial ventures; Creative design and innovation; Patterns of creativity and innovation (Ideas to Product to Market); Design, marketing and the consumers; Diffusion and transfer of technology and innovation; Strategic planning (Business Planning and New Ventures).
MENG 6508 (ME/IE68H)
Research Methods
Introduction to research; Writing research proposals, Structuring literature review; Design and planning of empirical research; Collection and presentation of data; Communication of research findings; Protecting and exploiting research; Research group seminars.

MENG 6601 (ME66A)
Investigative Project Part I
In the second semester, the student is required to submit a brief report (and make a presentation) which should comprise problem identification, objectives, scope, methodology and literature review for an industry relevant project requiring one or more of the following components: Product design and development; Process design and improvement; Tool and manufacturing engineering; System Design/Review for Productivity and Quality improvement and others.
6.1 Research

6.1.1 The Department has nine academic staff members involved with three taught postgraduate programmes in addition to MPhil and PhD research degrees. The taught programmes are MSc Geoinformatics, MSc Planning and Development and Graduate Diploma in Land Administration.

6.1.2 The Department’s research expertise is established in the ability to understand, capture and visualise the spatio-temporal phenomena and processes to provide reliable management options for decision-makers to achieve sustainable development.

6.1.3 These objectives are achieved by using surveying, mapping, monitoring, modelling and spatial analysis tools and techniques. Cutting edge technology is being utilised in the research such as global positioning systems, satellite remote sensing and GIS. The other side of the approach is the field of physical planning and development associated with policy planning, strategic and development planning, coastal zone planning and development control.

6.1.4 Priority areas and new themes of research have been identified and are being pursued. The research focus extends to areas covering geomatics, geodesy, land administration, spatial analysis, geoinformatics, spatial and settlements planning, the environment and ecosystems. The following are some topics of immediate concern:

- Application of CIT in urban planning and management.
- Biodiversity mapping and analysis, forest cover assessment, land use and land cover mapping and monitoring.
- Coastal zone management, developing plans for coastal zones, coastal erosion, modelling coastal changes for sustainable development.
- Comparative analysis of planning statutes and administrative structures in the Caribbean.
6.1.5 Resources for research include automated field and GPS data recording and computation systems, photogrammetric and satellite images processing and analysis tools, GIS and mapping hardware and software, in addition to state-of-the-art computing and digital services facilities.

6.2 **Staff in the Department**

The principal teaching and research interest of academic members of staff in the Department are as follows:

**PROFESSORS**

- **Serwan M.J. Baban,**
  BSc, MSc (Baghdad), PhD (East Anglia), PGCertTL (Coventry), FRGS, FGS, FRSPSoc
  Coordinator, MSc Geoinformatics
  (Geosciences, Environmental Remote Sensing & Geographic Information Systems)

- **Milica Bajić Brković,**
  Dipl Eng Arch (Belgrade), MCRP (Berkeley), PhD (Belgrade), IsoCaRP, IFRHS, UUS, TTSP
  BPTT Chair in Planning & Development;
  Coordinator, MSc Planning & Development
  (Design for Development, Human Settlements Planning, Coastal Zone Development & Planning)

**SENIOR LECTURER**

- **Jacob A. Opadeyi,**
  BSc, MSc (Lagos), MEng, PhD (New Brunswick), ANIS (Nigeria), MBA (UWI), ACSM (USA), MRICS
  (Engineering Surveying, Land/Geographic Information Systems, Land Administration)

**LECTURERS**

- **Raid Al-Tahir,**
  BSc (Baghdad), MSc, PhD (Ohio), MASPRS, MISST
  (Photogrammetry, Spatial Analysis, Remote Sensing)

- **Charisse Griffith-Charles,**
  BSc, MPhil (UWI), MISST
  (Cadastral Studies, Surveying, Land Administration)

- **Keith Miller,**
  BSc, PhD (CNAA)
  Head of Department
  (Geodesy, Hydrography, Adjustment)

- **Asad Mohammed,**
  BSc (Hons) (Waterloo), MRP, PhD (Cornell), MTTSP
  (Planning & Development, Human Settlements, Land Administration)

- **Michelle Mycoo,**
  BA (Hons) (UWI), MSc (Hong Kong), PhD (McGill), MTTSP
  (Land Use & Natural Resources Management, Institutional Environment, Planning Analysis)
6.3 Faculty of Engineering/Industry Advisory Committee

- Ms. Angela Cropper,
  President
  The Cropper Foundation

- Mr. Kameel Khan
  Managing Director
  Kameel Khan Property Services

- Ms. Deborah Thomas
  President
  Trinidad & Tobago Society of Planners (TTSP)

- Mr. Paul Williams
  Williams, Bartholomew & Associates

6.4 MPhil/PhD Degrees in Surveying & Land Information

It is possible to read for the MPhil and PhD in Surveying & Land Information in one of the surveying specialisations, Planning & Development and Geoinformatics.

6.4.1 MPhil in Surveying & Land Information

The Regulations for the MPhil in Surveying & Land Information are the same as the General Regulations for the MPhil, except that candidates applying for registration should normally have either:

a. A Bachelor's degree with Second Class Honours in Land Surveying;
   or

b. An equivalent qualification suited to the fields of Planning & Development or Geoinformatics.
6.4.2 PhD in Surveying
The Regulations for the PhD in Surveying are the same as the University and Faculty of Engineering regulations for the Degree of Doctor of Philosophy except that candidates applying should normally have either:

a. An MPhil Degree in Surveying and Land Information of The University of the West Indies or

b. A Master’s Degree by Research in Surveying and Land Information Planning or Geoinformatics of an approved University.

6.5 MSc in Planning & Development

6.5.1 Introduction
The MSc Programme in Planning & Development focuses on physical planning and development, with respect to theory, methodology, analysis and applications. Its aims are to equip the graduate with the knowledge associated with policy planning, strategic and development planning, physical planning and design, as well as development control in areas of development relevant for the Caribbean region.

6.5.2 Aims

a. To provide general and specialised knowledge in the field of Spatial and Human Settlements Planning and Development, with respect to theory, methodology, analysis and applications.

b. To equip the graduate with the knowledge for a profession in the field of physical planning and development, associated with policy planning, strategic and development planning, physical planning and urban design, coastal zone planning, environmental planning, as well as development control.

c. To produce a graduate capable of developing appropriate plans for communities and settlements, open areas, coastal zones, protected areas, areas exposed to natural and man-made hazards, and other areas where development occurs, or areas which are subjected to protection, conservation, or any other special treatment.

d. To produce a graduate capable of managing the implementation and monitoring of policies and plans.

6.5.3 Objectives

i) The core courses are intended to fulfil the following objectives:

- To provide students with full understanding of planning as a discipline, the philosophical basis of planning, and the major theoretical and analytic developments in the field.

- To cover the methods and procedures for making plans for physical development, be it for the public or private sector, at the national, regional, local or site level.

- To equip students with a reflective and insightful understanding of the social and environmental conditions of human settlements and spatial development and change.

- To equip students with understanding and knowledge of implementing policies, strategic and development plans, physical and urban design plans, as well as development control measures.

- To understand and evaluate the impact of development.
ii) The areas of concentration provide the basis for students to acquire a measure of specialisation, as well as background for further work, research and development.

The programme offers a wide range of courses that allows the student to pursue individual specialisations, progress to employment within the field and to embark on advanced study within planning, including MPhil/PhD research.

6.5.4 Entry Requirements
Applicants for the MSc in Planning & Development should have (1) at least a Second Class Bachelor’s Degree in a related area from a recognised institution, or (2) a combination of maturity, training and professional experience acceptable to the Faculty. A typical applicant would have a previous degree gained in Urban and/or Regional Planning, Surveying, Natural Sciences, Engineering, Geography, Architecture, Sociology, Economics, Political Science and Management.

6.5.5 Qualifying Student
An applicant not considered suitable for direct admission may be admitted as a qualifying student, up to one year. The structure of study will be designed to suit the needs of the individual student.

6.5.6 Transfer of Credits
Up to six (6) credit hours of coursework taken prior to enrolment in the Master’s programme, whether at this university or another, may be counted towards the Master’s degree, if the Head of Department formally approves acceptance of these courses. Former to the approval, the advice from the Programme Coordinator should be sought.

6.6 Programme Structure

6.6.1 Areas of Concentration
The MSc in Planning and Development is designed with the flexibility to allow some degree of specialisation in particular subject areas. This is achieved through the choice of Area of Concentration. The areas of concentration to be offered in 2004 - 2005 are:

- Human Settlements
- Coastal Planning & Development

6.6.2 Duration of Study
1. The MSc is offered to full-time and part-time students.

2. Full-time students will normally be expected to complete the coursework and written examinations within three (3) semesters of registration and must normally complete the programme within eight (8) semesters.

3. Part-time students will normally be expected to complete the coursework and written examinations within six (6) semesters of registration and must normally complete the programme within ten (10) semesters.

4. The final project should be started at the commencement of the semester following the completion of the written examination and completed within six (6) months for full-time and nine (9) months for part-time students.

5. The normal load for a part-time student is half that of a full-time student.

6. Students are required to take 16 credits of core courses, 12 credits of compulsory courses, then options exist:

   (i) Professional report (6 credits) with three (3) electives from a concentration (9 credits).

   (ii) Research Project (12 credits) with one (1) elective.
6.6.3 Examination

(a) Evaluation may take one of the following modes: (1) coursework only, normally applied for studio work, (2) combination of coursework and final examination, and (3) final examination. In case of combination, candidates will be required to pass both the coursework and examination.

(b) In MSc Research Project and MSc Professional Report, evaluation will be on the report. Candidates may also be orally examined. They will in addition be required to present at least one acceptable seminar.

(c) A full-time candidate who fails not more than two courses, or a part-time candidate who fails not more than one course in a semester may be allowed to repeat such courses if the Board of Higher Degrees so decides.

(d) A full-time candidate who fails more than two courses, or a part-time candidate who fails more than one course in a semester, will normally be required to withdraw from the programme.

6.6.4 Award of Degree

1. The MSc in Planning and Development will be awarded on successful completion of all courses and the Project.

2. The MSc may be awarded with distinction if the candidate attains an overall mark of “A” grade and a similar mark in the project.

6.7 Course of Study

6.7.1 Core Graduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLDE 6000</td>
<td>History &amp; Philosophy of Planning</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6001</td>
<td>Principles of Planning</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6002</td>
<td>Institutional Environment</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6003</td>
<td>Planning Studio</td>
<td>4</td>
</tr>
<tr>
<td>PLDE 6004</td>
<td>Design for Development Studio 1</td>
<td>3</td>
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</table>

6.7.2 Concentration on Human Settlements

Compulsory Courses:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>GINF 5002</td>
<td>Elements of GIS</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6005</td>
<td>Design for Development Studio 2</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6006</td>
<td>Human Settlements Planning</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6007</td>
<td>Community &amp; Participatory Planning</td>
<td>3</td>
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</table>
**Elective Courses:**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COEM 6001</td>
<td>Infrastructure Planning &amp; Construction (CE60B)</td>
<td>3</td>
</tr>
<tr>
<td>COEM 6008</td>
<td>Strategic Land Use Planning &amp; Development (CE63B)</td>
<td>3</td>
</tr>
<tr>
<td>COMP 6100</td>
<td>Computer Communication Network (CS61A)</td>
<td>3</td>
</tr>
<tr>
<td>GINF 6000</td>
<td>Spatial Database Management Systems (GI61A)</td>
<td>3</td>
</tr>
<tr>
<td>GINF 6010</td>
<td>Application of GIS in Urban Development (GI67B)</td>
<td>3</td>
</tr>
<tr>
<td>GINF 6011</td>
<td>Land Administration (SV63B) (GI67C)</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6008</td>
<td>Tourism Planning (PD62C) (inactive)</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6009</td>
<td>Transportation Planning (inactive)</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6010</td>
<td>Application of CIT in Urban Planning &amp; Management (PD63C)</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6012</td>
<td>Professional Planning Internship (PD69C)</td>
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<tr>
<td>PLDE 6014</td>
<td>Land Use &amp; Natural Resource Management (PD67B)</td>
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<tr>
<td>PLDE 6016</td>
<td>Reading Course (PD69D)</td>
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<td>SOCI 2007</td>
<td>Survey Design &amp; Analysis (SY22E)</td>
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<tr>
<td>SOCI 6001</td>
<td>Social Policy Analysis &amp; Evaluation (SY60B)</td>
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<tr>
<td>SOCI 6003</td>
<td>Advanced Research Design &amp; Analysis in Sociology (SY61A)</td>
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**Compulsory Courses:**

<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>GINF 5002</td>
<td>Elements of GIS (GI51A)</td>
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<tr>
<td>PLDE 6011</td>
<td>Planning in the Coastal Zone (PD65A)</td>
</tr>
<tr>
<td>PLDE 6013</td>
<td>Coastal Zone Planning Studio (PD66A)</td>
</tr>
<tr>
<td>PLDE 6014</td>
<td>Land Use &amp; Natural Resource Management (PD67B)</td>
</tr>
</tbody>
</table>

**Elective Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COEM 6001</td>
<td>Infrastructure Planning &amp; Construction (CE60B)</td>
</tr>
<tr>
<td>ENGR 6008</td>
<td>Environmental Impact Assessment in Environmental Engineering (FE64B)</td>
</tr>
<tr>
<td>ENGR 6010</td>
<td>Economics for Environmental Engineering (FE65A)</td>
</tr>
<tr>
<td>GINF 6009</td>
<td>Application of GIS in Natural Resource Management (GI67A) (upon instructor's approval)</td>
</tr>
<tr>
<td>AGBU 3003</td>
<td>Eco-tourism (AM33D)</td>
</tr>
<tr>
<td>PLDE 6005</td>
<td>Design for Development Studio 2 (PD63A)</td>
</tr>
<tr>
<td>PLDE 6006</td>
<td>Human Settlements Planning (PD64A)</td>
</tr>
<tr>
<td>PLDE 6007</td>
<td>Community &amp; Participatory Planning (PD64B)</td>
</tr>
<tr>
<td>PLDE 6008</td>
<td>Tourism Planning (PD62C)</td>
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<tr>
<td>PLDE 6009</td>
<td>Transportation Planning (PD62D)</td>
</tr>
<tr>
<td>PLDE 6012</td>
<td>Professional Planning Internship (PD69C)</td>
</tr>
<tr>
<td>PLDE 6015</td>
<td>Natural Disasters Mitigation &amp; Development Planning (PD66B) (inactive)</td>
</tr>
<tr>
<td>PLDE 6016</td>
<td>Reading Course (PD69D)</td>
</tr>
</tbody>
</table>
6.8 Syllabuses

PLDE 6000 (PD60A)  
**History & Philosophy of Planning**

Historical development of planning as a discipline and major theoretical and analytic developments in the field. What is planning and why planning? Evolution of planning. Anglo-American and European tradition. Third World urbanisation and planning. Planning in the Caribbean. Planning for small island developing states. Sustainable development and sustainable planning. Development vs. Environment – a false dilemma? Globalisation and impacts on planning. Impacts of CIT. The material covered in the course is related to the context and environment of the Caribbean and illustrated by case material from the region and other similar societies as far as available.

PLDE 6001 (SV60B)  
**Principles of Planning**

Regional survey, analysis and synthesis; Garden cities; Neighbourhood unit; Growth centres and secondary cities; National urban strategies; Self-help; Containment of urban regions, linear cities; Architecture of the poor and sustainable development; Urban process and planning interventions. Case studies.

PLDE 6002 (PD61A)  
**Institutional Environment**

The evolution of Caribbean legislation; Public and private property rights and policy instruments; Constitutional powers and responsibility of the government for the provision of land and environmental resources, utilities, transport, social services and public health; Planning-related legislation such as the Public Health Ordinance, Municipal Corporations Act, the Housing Act, Slum Clearance and Housing Act and the Public decision-making in Caribbean – the roles of government, political parties, interest groups; entrepreneurs and individuals; decision-making and the judicial review of public decision and appellate tribunals.

PLDE 6003 (PD66A)  
**Planning Studio**

This course offers a practical, problem-solving approach that involves students in varied planning projects. Projects expose students to data gathering, measurement, scaling, survey sampling and construction, observational and other unobtrusive methods, data analysis and presentation, regulation, report writing and presenting, and public speaking.

PLDE 6004 (PD63B)  
**Design for Development Studio 1**

Physical aspects of urban development and its relation to the economic, social and environmental features of human settlements development. Existing urban centres and towns. Redevelopment and renewal. Development of coherent communities into the real neighbourhoods and diverse districts. Public spaces. Conservation of natural environments and the preservation of the built legacy. Urban places framed by architecture and landscape design rooted in local history, climate, ecology and building practice. Infrastructure and amenity design and standards, including local traffic distribution, transportation and related land-use controls. Re-establishment of the relationship between the art of building and the making of community, through citizen-based participatory planning and design. The course is designed around a studio project.

PLDE 6005 (PD63A)  
**Design for Development Studio 2**

Urban and site design as an essential resource for planners, developers, activists, community leaders in promoting sustainable and more ecologically sound development. Cultural bias for design. New approaches: smart cities, sustainable cities, new urbanism. Competing goals and objectives in urban design. Users vs. providers of the built environment. Urban tissue. Public space. Safety and security in urban design. Elements and components: neighbourhood, block, street, individual building. Guidelines and standards. Method of delivery is a studio work combining lectures, practical field work, interactive group work and presentations. There will be individual assignments and group design projects (prerequisite PD63B).

PLDE 6006 (PD64A)  
**Human Settlements Planning**

The objective of this course is to demonstrate the ways in which human settlements planning is undertaken, whether this is for small towns, villages, neighbourhoods of extensive urban areas, regularisation and retrofitting informal settlements or greenfield sites contiguous with existing urbanisation. The focus is on the residential environment and community development, with the associated issues of fostering employment opportunities, responding to social and educational needs, commercial and recreational facilities demand, transportation, infrastructure and environmental concerns.
PLDE 6007 (PD64B)
Community & Participatory Planning
History, role and functions of both community and participatory planning. Growing role of public and stakeholders participation in the planning process. The evolution of planning in the Anglo-American and international experience. The specific process and tools of public consultation and participation in the development of plans and regulatory functions. The process and problems of community planning and participation in the planning process is achieved by fieldwork exercises with real communities, addressing tools and techniques, such as community mapping, needs assessment, visioning, strategic planning and lobbying. Noteworthy international experiences such as PRA and Assets Management are also reviewed.

PLDE 6008 (PD62C)
Tourism Planning
The course is intended to introduce physical planners to the land-use, infrastructure, coastal and environmental impacts and needs of this industry. This will be done at the macro, national and regional planning levels as well as the more detailed project, site and community levels.

PLDE 6009 (PD62D)
Transportation Planning (inactive)
An introduction to urban transportation planning and its relationship to land-use planning, including procedures for traffic impact analyses of urban development sites, analysis framework for long-range planning, data collection procedures, basic demand forecasting, assessment of alternative transport plans and impacts on the environment and land development at the regional scale.

PLDE 6010 (PD63C)
Application of CIT in Urban Planning & Management

PLDE 6011 (PD65A)
Planning in the Coastal Zone

PLDE 6012 (PD69C)
Professional Planning Internship
To expose students to professional practice by a 2-3 month placement in a public or private agency or firm (including NGOs/CBOs) that carries out planning related functions. Students are to work under the supervision and guidance of a professional planner and require skills in a range of professional practice activities from research and field data collection, analysis, development of planned designs, solutions, community advocacy, planning presentations including, oral, written and graphic skills. Students are expected to keep a log and prepare a report on the internship. The professional supervisor is also to present a satisfactory report on the intern.

PLDE 6013 (PD66A)
Coastal Zone Planning Studio
Studio work will be conducted using field examples to develop the student’s competency in identifying developmental issues in the coastal zone, development of policies and plans that reconcile competing and conflicting land uses in the coastal zone and understanding the institutional environment within which decisions must be made. This will involve skills development in field data collection, analysis, development of plans and design solutions, stakeholder participation and presentation skills using verbal, written and graphic skills.

PLDE 6014 (PD67B)
Land Use & Natural Resource Management
Relationships between people, technology and the environment. Environmental analysis for site-planning and coastal environment and the evaluation of the effects of development projects and policies on the environment with particular reference to the Caribbean context. Overview of environmental legislation in the Caribbean. Effectiveness of environmental management.
PLDE 6015 (PD66B)
Natural Disasters Mitigation & Development Planning (inactive)

The objective of this course is to train land use planners to prepare land use plans that address disaster prevention and mitigation, formulate physical standards and develop policies to enforce standards and building codes, identify projects for the retrofitting of vulnerable buildings and lifeline facilities, develop skills in hazard assessment, vulnerability assessment and hazard mapping. A case study approach and fieldwork exercises will be undertaken to expose students to the principles and process of natural hazard mitigation and development planning. Lessons learned and best practices drawn from international, regional and local case studies will be reviewed.

PLDE 6017 (PD690)
MSc Research Project

The research project is expected to be the result of a comprehensive investigation and independent analysis of a topic that is germane to the concentration that is being pursued by the student. The goal of the research should be to study a specific area or phenomenon and to provide a contribution of new knowledge to the field of study or produce a new interpretation of existing information.

PLDE 6018 (PD680)
MSc Professional Report

Professional Report addresses a current planning issue in the student area of concentration and should be designed to deepen the student’s understanding of the material learned in the taught courses and to develop skills in applying them to a given industrial (in this case planning) situation.

6.9 Postgraduate Diploma in Land Administration

This programme is being developed to address the reform of the policies, procedures, statutes and institutions involved in Land Administration and Management throughout the Caribbean. This programme is a response to the need to maintain and strengthen the human resources employed in land administration and land management in key institutions of the state, and private quasi-state sectors.

6.9.1 Objectives

a. Provide specialised training in Land Administration Management to key public, quasi-state and private sector professionals.

b. To enhance the existing process of reform in Land Administration in the public sector.

c. To enhance the Department’s capability in offering training in the broader area of Land Studies and Land Management in keeping with the Department’s strategic plan.

6.9.2 Entry Requirements

The main condition for entry would be a relevant first degree and relevant industrial experience or maturity and professional experience acceptable to the Faculty. Present entry requirements for either MSc Planning and Development or MSc Geoinformatics would also be acceptable. The target groups are:

(a) Public officials nominated by sponsoring institution.

(b) Professionals: Surveyors, engineers, planners, geographers, agriculturalists, natural and social scientists interested in the area of Land Administration and Management.

(c) Individuals interested in upgrading their skills on a course-by-course basis.
6.9.3 Course of Study
The programme will be delivered in six (6) short intensive instructional periods each approximately one week of whole day lectures, tutorial demonstrations and lab/field exercises. There will be a full-time, three-week period when students will work on their special projects towards the end of the cycle. The delivery of the programme is expected to be completed within twelve (12) months.

6.9.4 Students are required to complete the following courses:

LAND 5000 Introduction to Land Administration (SV50A)
LAND 5001 Introduction to Land Use & Natural Resource Management (SV50B)
LAND 5002 Valuation & Land Economy (SV51A)
LAND 5003 Land Law (SV51B)
LAND 5004 Land Information Management (SV52A)
LAND 5005 Property Management (SV52B)
LAND 5006 Special Project (SV50D)

6.9.5 Assessment and Award of Diploma
Within the exception of SV50D Special Project which shall be assessed as a 100% coursework, all other courses shall be assessed as follows: Final examination: 60% and assessed assignments: 40%. Diplomas shall be awarded upon completion of all courses and the final project.

LAND 5001 (SV50B)
Land Use & Natural Resource Management
Relationships between people, technology and the environment. Environmental analysis for site planning and coastal environment and the evaluation of the effects of development projects and policies on the environment with particular reference to the Caribbean context. Overview of environmental legislation in the Caribbean. Effectiveness of environmental management.

LAND 5002 (SV51A)
Valuation & Land Economy
An overview of the land economy of Trinidad & Tobago and the wider Caribbean. The nature of real property; land rent theory; locational theory; the role of the State in the land economy; land and property taxation; the real estate industry and the finance sector; land and property speculation; relationship between formal and informal land economy. Introduction to valuation and valuation methodology. Market analysis; concept of values. Macro and micro factors which influence values. Statutory valuation. Land Acquisition Act 1994 - Compensation and other provisions. Impact of Town and Country Planning on land use and values. Concept of Severance and Injurious Affection; supply and demand analysis. Introduction to economic rent.

LAND 5003 (SV51B)
Land Law

LAND 5004 (SV52A)
Land Information Management
Concepts of systems, information systems; geographic and land information systems. Data in LIS, their acquisition, input, pre-processing, verification, structures, management, manipulation, analysis, output and quality. Hardware and software consideration; project specific and national systems, their design and development.
LAND 5005 (SV52B)

Property Management

Property and real estate management, project and programme financing and management. Project cycle, management formulation and appraisal, project evaluation, public good vs economic good, time value of money, internal rate of return, net present value, discounting and shadow pricing, development and revitalisation strategies in the public sector, public/private sector partnerships.

LAND 5006 (SV50D)

Special Project

Students will be expected to do a Special Project of approximately 10,000 - 15,000 words. The topic will be chosen in collaboration with the agencies sending students to make it relevant to their work situation.

6.11 MSc in Geoinformatics

6.11.1 Introduction

The goal of the MSc in Geoinformatics programme is to provide high-quality professional graduate instructions in Geoinformatics that lead to productive careers and life long learning. Geoinformatics is a nascent multidisciplinary field in which graduates must be prepared to apply knowledge in new contexts, work cooperatively and communicate effectively. To meet these challenges, the programme objectives are to provide:

i. Further specialised education and training in the theory and application of geographic information science, building and management information infrastructure, and integrated technologies (photogrammetry, remote sensing and GPS).

ii. Opportunities for creative thinking in multidisciplinary areas including solving spatial information problems and advanced applications.

iii. Provide the regions with experts in Geoinformatics; and

iv. To facilitate further research and development in Geoinformatics.

6.11.3 Entry Requirements

Applicants for the Master of Science in Geoinformatics programme should have:

(a) A Second Class Honours BSc degree in Surveying & Land Information or a degree in a related area from a recognised institution.

(b) A Second Class BSc degree in Engineering, Natural Science, Agriculture or Geography, which includes Mathematics and Computer Science at levels equivalent to the respective courses in (a).

(c) An equivalent qualification acceptable to the Faculty of Engineering.

6.11.4 Prerequisite Knowledge and Capacity

The breadth requirement subjects for the degree are:

(i) survey measurements and adjustments;

(ii) photogrammetry and remote sensing; and,

(iii) legal aspects of surveying/land information systems.

Applicants without a background in these subject areas will be required to successfully complete Elements of GIS (GI51A) and at least one course from each of two from the three breadth requirement areas identified below. Students will be allowed to take these
foundation courses in parallel (as co-requisite) with the necessary core and elective courses. However, they will not count towards the credit requirements of the programme.

1. **Survey measurement and adjustment**
   **Credits**
   - SURV 2007 Adjustment Computations 3 (SV26A)
   - SURV 3002 Surveying with Satellites 3 (SV32A)

2. **Photogrammetry and Remote Sensing**
   **Credits**
   - SURV 2003 Digital Mapping (SV21B) 3
   - SURV 2013 Remote Sensing (SV26C) 3

3. **Land Administration and Legal Aspects of Surveying**
   **Credits**
   - SURV 2004 Cadastral Studies (SV25A) 3 (SV33A)
   - SURV 2006 Land Law (SV25A) 3
   - SURV 3016 Valuation & Land Economy 3 (SV22A) (SV32C)

6.11.6 **Programme Options**
The Geoinformatics programme will be offered with two alternatives: a Research option or a Professional option. Candidates for both options of the MSc in Geoinformatics degree are required to take a minimum of 28 credit hours of course work of which at least 16 credit hours must be taken in the Department. Candidates for the Research option are required to take an additional 12 Research credit hours for a total of 40 credits. Candidates for the Professional option are required to take an additional 6 course credit hours and a technical report for 6 credits for a total of 40 credits. Students may switch from one option to the other only with the approval of the Head of Department.

6.11.7 **Concentrations on Subject Areas**
The MSc in Geoinformatics programme is designed with the flexibility to allow some degree of concentration in particular subject areas. This is achieved through the choice of three electives and the Research Project for the MSc in Geoinformatics (Research), or up to five electives and the technical paper for the MSc in Geoinformatics (Professional). The reading courses in the different subject areas may also be utilised to achieve this objective.

6.11.8 **Duration of Study**
The programme is geared towards full-time study. It is expected that full-time students will complete the MSc Programme in 18 months. Part-time is expected to take two and a half years.

6.11.9 **Award of Degree**
Upon completion of all course and project/report requirements, a candidate will be awarded a Master’s degree. The name of degree awarded will depend on the option pursued. If the Research option is chosen, then the degree will be named MSc in Geoinformatics (Research). If the Professional option is pursued, then the degree awarded will be MSc in Geoinformatics (Professional).
## 6.12 Course of Study

### 6.12.1 Core Graduate Courses

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>GINF 6000</td>
<td>Spatial Database Management Systems (GI61A)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6001</td>
<td>Spatial Information Law &amp; Policy (GI62A)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6002</td>
<td>Spatial Analysis Techniques (GI63B)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6003</td>
<td>GIS Applications Development (GI64B)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6004</td>
<td>Research Seminar (SV65B) (GI65B)</td>
<td>3</td>
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</tbody>
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In addition to either

<table>
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<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>GINF 6005</td>
<td>Geoinformatics Technical Report (GI680)</td>
<td>6</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GINF 6006</td>
<td>MSc Geoinformatics Research Project (GI690)</td>
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### 6.12.2 Elective Courses

<table>
<thead>
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<th>Course Code</th>
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<th>Credits</th>
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<tr>
<td>COEM 6016</td>
<td>Natural Hazards Management (CE69B)</td>
<td>3</td>
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<tr>
<td>COMP 6100</td>
<td>Computer Communications Network (CS61A)</td>
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<tr>
<td>COMP 6150</td>
<td>Distributed Computing (CS61B)</td>
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</tr>
<tr>
<td>ECNG 6612</td>
<td>Operating Systems (EE66V)</td>
<td>3</td>
</tr>
<tr>
<td>ECNG 6613</td>
<td>Database Systems, Principles &amp; Design (EE66W)</td>
<td>3</td>
</tr>
<tr>
<td>GINF 6007</td>
<td>Issues &amp; Applications in Remote Sensing (GI66A)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6008</td>
<td>Measuring the Coastal Environment (GI66B)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6009</td>
<td>Applications of Geoinformatics in Natural Resource Management (GI67A)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6010</td>
<td>Applications of Geoinformatics in Urban Development (GI67B)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6011</td>
<td>Land Administration (SV63B) (GI67C)</td>
<td>4</td>
</tr>
<tr>
<td>GINF 6012</td>
<td>Reading Course in Geoinformatics (GI68A)</td>
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</tr>
<tr>
<td>MENG 6010</td>
<td>Human Resource Management I (ME64K)</td>
<td>3</td>
</tr>
<tr>
<td>NREM 6020</td>
<td>Identification of Environmental Problems &amp; Issues (NS60C)</td>
<td>3</td>
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<tr>
<td>NREM 6021</td>
<td>Introduction to Environmental Management (NS60D)</td>
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<tr>
<td>NREM 6031</td>
<td>Managing Environmental Data (NS60F)</td>
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<tr>
<td>PENG 6000</td>
<td>Petroleum Geology &amp; Geophysics (PE60A)</td>
<td>3</td>
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<tr>
<td>PLDE 6002</td>
<td>Institutional Environment (PD61A)</td>
<td>3</td>
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<tr>
<td>PLDE 6011</td>
<td>Planning in the Coastal Zone (PD65A)</td>
<td>3</td>
</tr>
<tr>
<td>PLDE 6014</td>
<td>Land Use &amp; Natural Resource Management (PD67B)</td>
<td>3</td>
</tr>
</tbody>
</table>
6.13 Syllabuses

GINF 5002 (GI51A)
Elements of GIS
Concepts of systems, information systems and geographic information systems, hardware and software systems, spatial data issues - acquisition and input, data structures, data management, data processing, data manipulation, data analysis, spatial data quality, designing and implementing GIS: data requirement, technical requirement, institutional requirement.

GINF 6000 (GI61A)
Spatial Database Management Systems
The course designed to provide knowledge and expertise in the design and development of spatial databases. A review of basic concepts of databases; spatial database design; the extended entity-relationship model; object-oriented database for GIS; Distributed and networked spatial databases; web-based GIS database design and management.

GINF 6001 (GI62A)
Spatial Information Law & Policy
The course provides an understanding of the legal and policy issues that relate to spatial data. Current and emerging issues of law in electronic environments, privacy rights and confidentiality, freedom of information, copyright and other product protection laws, legal liability, impact of law on the use of databases and spatial databases; legal options for dealing with conflicts, data sharing policies.

GINF 6002 (GI63B)
Spatial Analysis Technique
In-depth understanding of the concepts and techniques of spatial analysis, spatial interpolation and spatial data analysis. Spatial data analysis: spatial phenomena and relationships; spatial interpolation; spatial statistical concepts; analysis of specific patterns (point, line, area). Cluster analysis, spatial aggregation. Spatial analysis: location/ allocation analysis; address matching; network analysis; 3D analysis. This course will be complemented with a series of laboratory exercises to support the theoretical component of the course.

GINF 6003 (GI64B)
GIS Applications Development
The course is designed to provide an understanding of GIS application development issues and to develop competency in formulating strategies for solving spatial analytical problems. GIS applications development concepts and issues; requirements analysis; conceptual and logical design; pilot studies, benchmarking, data collection and automation; GIS system integration, application development including GUI development for specific areas of application.

GINF 6004 (GI65B)
Research Seminar
This course provides postgraduate students with elementary research knowledge and skills and training for the preparation and presentation of theses and technical papers. Additionally, the course facilitates the exchange of ideas between students, staff and invited guests.

GINF 6005 (GI680)
Geoinformatics Technical Project
The MSc Geoinformatics (Professional) requires the completion of a technical paper that deals with any aspect of Geoinformatics based on the University guidelines for projects. It shall be a supervised individual work that demonstrates the student understanding of the science, functions and use of Geoinformatics in an application and/or problem environment.

GINF 6006 (GI690)
MSc Geoinformatics Research Project
A Research Project is required to be completed for the MSc Geoinformatics (Research). The research project report is expected to be the result of a comprehensive investigation and independent analysis of a topic that is germane to the concentration that is being pursued by the student. The goal of the research should be to study a specific area or phenomenon and to provide significant incremental contribution of new knowledge to the field of study or produce a new interpretation of existing information.
GINF 6007 (GI66A)
Issues & Applications in Remote Sensing
The course is intended to familiarise students with the range of management and scientific problems that may be addressed with remote sensing. Scale issues in remote sensing, Multi-spectral image processing methods, image interpretation, analysing spatial patterns, issues in data integration, accuracy assessment, remote sensing and GIS. Remote sensing and change detection, remote sensing in the Caribbean. Remote sensing and hazard assessment and mitigation, remote sensing and biodiversity, remote sensing and coastal zone management, global remote sensing. New directions in remote sensing.

GINF 6008 (GI66B)
Measuring the Coastal Environment
The course provides the capability for those involved in any marine coastal issues to be able to understand, undertake and supervise simple measurements in the coastal environment. It will also provide the technical background required to manage larger programmes and communicate with contractors involved in measurement aspects of coastal projects. Environmental oceanography, positioning, underwater acoustic systems and information management.

GINF 6009 (GI67A)
Applications of GIS in Resource Management
The nature of spatial data, spatial analysis using GIS, GIS and modelling, environmental modelling in GIS, suitability studies, GIS and environmental impact assessment, GIS applications in water resource management, geo-hazards, biodiversity, global climate change as well as locating landfill and wind farm sites.

GINF 6011 (GI67C)
Land Administration
Concepts; legislative provisions and records relating to land, their transfer and control; land settlement in the Caribbean including family land, squatting, post indenture settlements, reservations; State lands and their management; land policy formulation, information needs, land administration and management.
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MSC IN ENVIRONMENTAL ENGINEERING

7.1 Introduction

Since the beginning of the modern environmental movement in the 1960’s, there have been growing concerns, worldwide, over the rate and scale of degradation of the environment. In 1992, the UN Conference for the Environment and Development stressed the concept of sustainable development and emphasised a holistic, interdisciplinary approach to the solution of environmental problems. The report includes a programme entitled: “Promoting education, public awareness and training” which states, inter alia, that university and other tertiary activities for environmental and development education should be supported, and new partnerships created with business and other independent sectors.

7.1.2 In the Commonwealth Caribbean, the first comprehensive legislation on the environment was passed into law in 1987 in St Kitts. Other countries have followed, in recognition of the validity of the concept of sustainable development, and of the urgency of solving environmental problems that occur both locally and regionally, in particular those that are peculiar to Small Island States.
7.1.3 Engineers, chemists, physicists, biologists and social scientists play key roles in the solution of environmental problems, so that there is a growing need in these disciplines for the training of specialists who will shoulder the responsibility for the judicious management of the environment. Environmental Engineering in the Caribbean is concerned primarily with the provision of an adequate supply of safe and potable water, the prevention of pollution of land, water and air, the collection, treatment and disposal of solid and hazardous wastes, urban and land drainage, forest and soil conservation, management and mitigation of natural and industrial disasters, safety, management of resources in the coastal zone, the protection of public health and the economics of sustainable development. The programme provides both a theoretical and practical approach to environmental problems with the goal of improving the effectiveness of environmental management. Its objectives are:

- to alert participants to major environmental concerns: global, regional and local.
- to promote, among participants, a holistic and proactive approach to the solution of environmental problems.
- to familiarise participants with instruments and techniques used for the prediction and measurement of environmental quality.
- to train participants in the planning and design of engineering works related to the preservation and improvement of the environment.

7.2 Objectives

7.2.1 The overall objective of the programme is to provide advanced education and training for graduates in Engineering, Science, and related areas to meet current and future needs of environmental engineering in the region.

7.2.2 The purpose of this study is to provide engineers with an in-depth understanding of the technical, economic and managerial factors and their integration in the specification, design and operation of environmental engineering systems. This is expected to appeal to all engineers, but experience elsewhere has shown that those with first degrees in the physical sciences have also been attracted to, and have successfully completed, similar programmes of study.

7.3 Structure of the Programme & Credit Requirements

7.3.1 Candidates for the MSc programme are required to pass examinations and/or coursework, from two (2) groups of courses (one compulsory and the other optional) and to complete a project. Courses in the compulsory group account for 12 credits while those of the optional group should be a minimum of 24 credits. Nine (9) credits are allocated to the project (consisting of either a laboratory or field study or detailed design) giving a total requirement of forty-five (45) credits. Each course will carry four (4) credits, which includes 39 lecture hours per semester and a minimum of 30 hours of Labs, tutorial coursework and mini-projects additional to this.

7.3.2 The compulsory group of courses is designed to introduce students to major global, regional and local environmental concerns and to provide them with the basic background knowledge for a proper understanding of the specialist topics that follow.

7.3.3 Courses should be selected in consultation with the programme co-ordinator according to the student’s background and interest.

7.3.4 Upon the recommendation of the programme co-ordinator, up to two (2) courses (8 credits) can be credited for studies undertaken at other institutions of higher education.
7.4 **Outline Syllabus for the MSc Programme**

7.4.1 **Compulsory Group**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ENGR 6000</td>
<td>Introduction to Environmental Engineering &amp; Management</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6001</td>
<td>Environmental Data: Quality Standards, Sampling &amp; Analysis</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6002</td>
<td>Environmental &amp; Health Effects of Pollution</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6003</td>
<td>Project</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

7.4.2 **Specialised Optional Courses**

(Six courses are to be selected from the following)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 6004</td>
<td>Solid and Hazardous Waste Management</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6005</td>
<td>Pollution Prevention &amp; Industrial Waste Abatement</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6006</td>
<td>Water and Wastewater Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6007</td>
<td>Air Pollution Control</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6008</td>
<td>Environmental Impact Assessment in Environmental Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6009</td>
<td>Engineering in Disaster Management &amp; Mitigation</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6010</td>
<td>Economics for Environmental Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6011</td>
<td>GIS, Land Use &amp; Resource Management in Environmental Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6012</td>
<td>Hydrology &amp; Drainage Systems (inactive)</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6013</td>
<td>Chemistry &amp; Microbiology for Environmental Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6014</td>
<td>Transport of Pollutants (inactive)</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 6015</td>
<td>Environmental Separation Processes (inactive)</td>
<td>4</td>
</tr>
</tbody>
</table>

7.4.3 **Project**

Projects will relate to real environmental problems and will test a candidate’s ability to work independently. A project may be a major laboratory or field investigation, detailed design or research or any combination of these. Its scope will reflect the fact that it counts for close to twenty percent (20%) of the total number of credits.
7.5 **Evaluation**

7.5.1 Evaluation in all courses will normally be by approved combination of coursework and final written examination. However, in some instances evaluation will be entirely by coursework. Candidates will be required to pass both the coursework and written examination where applicable. Students who fail more than two courses in any one semester may be required to withdraw. Students will not normally be permitted more than two attempts at any course examination. Part-time students will normally be allowed a pro-rated number of attempts before withdrawal.

7.5.2 With the exception of those courses listed below, the coursework component of all courses (which may contain individual mini-projects), will count for forty percent (40%) of the final mark. The exceptions are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Coursework Component of Final Mark (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Data: Quality Standards, Sampling &amp; Analysis</td>
<td>60</td>
</tr>
<tr>
<td>Environmental Impact Assessment in Environmental Engineering</td>
<td>40</td>
</tr>
<tr>
<td>GIS - Land Use and Resource Management in Environmental Engineering</td>
<td>100</td>
</tr>
</tbody>
</table>

7.5.3 The MSc Project will be evaluated based on the final report.

7.5.4 The MSc will be awarded with distinction to candidates who achieve an overall average of 70% in the courses, as well as 70% in the Project.

7.6 **Duration of Study**

7.6.1 The MSc programme in Environmental Engineering is offered on both a full-time and a part-time basis. Full-time students will normally be expected to complete the examination requirements within two (2) semesters and to complete the project in accordance with the relevant University Regulations.

7.6.2 Part-time students will normally be expected to complete the examination requirements within four (4) semesters and to complete the project in accordance with the relevant University Regulations.

7.7 **Facilitation of Short Courses and Distance Teaching**

Although the curriculum has been designed primarily for MSc degree in Environmental Engineering, much of the course material can stand on its own and is therefore suitable for offering under the Continuing Education Programme of the Engineering Institute, as short intensive courses delivered either directly or through distance teaching. Such courses would be of great benefit to part-time students, practising engineers and other practitioners wishing to update their knowledge and skills, i.e. taking the courses without a prior registration for a degree. For these reasons, the curriculum is highly modularised, consisting of four-credit courses, most of which comprise stand-alone modules.

7.8 **Programme Delivery and Academic Supervision**

Since the programme is inter-disciplinary, the Office of the Dean will be responsible for its academic supervision. The Engineering Institute of the Faculty will administer the non-academic affairs of the programme. It will draw mainly on staff in the Departments of Chemical and Civil & Environmental Engineering, but staff in the Departments of Mechanical & Manufacturing Engineering and Surveying & Land Information and of Departments in the Faculties of Science & Agriculture, Social Sciences, Medicine and Law will also contribute to teaching. Teaching will be complemented by the services of visiting specialists from consulting firms, public authorities, international agencies and industry. The programme will be delivered through lectures, laboratory classes, field trips, coursework assignments, design classes, mini-projects, tutorials, seminars and the Project.
7.9 **Entry Requirements**

The requirements for admission to the programme are as follows: Applicants must have a Bachelor’s Degree in Engineering or an equivalent qualification. Candidates with a Bachelor’s Degree in the physical sciences will be considered if they have at least one (1) year relevant experience. Qualifying examinations may also be prescribed for such candidates.

7.10 **Resources**

7.10.1 **Library**

The UWI Library has an excellent stock of books, journals and reports relevant to the many discipline areas, which comprise the MSc programme. This collection is continuously augmented by annual additions.

7.10.2 **Laboratories and Equipment**

The laboratories that will be used for teaching are extensive and well equipped. All the basic equipment for carrying out routine analyses of water, wastewater and solid wastes are available in the Environmental Engineering Laboratory of the Department of Civil Engineering. This facility also includes sophisticated instruments such as an Atomic Absorption Spectrophotometer and a UV/Visible Spectrophotometer for heavy metal and nitrogen analysis respectively. These facilities are complemented by the generously equipped laboratories of the University.

7.10.3 **Computer Facilities**

Considerable expansion of the computer facilities of the Faculty has taken place. Students will have full access to the expanded system resulting from the recent interconnection of the computers of the five departments in a Faculty network, and the INTERNET. Students will be trained in the use of the INTERNET and in tapping the vast information resources available therein. A large collection of specialised environmental software has also been acquired.

7.11 **Syllabuses**

**COMPULSORY COURSES**

**ENGR 6000 (FE61E)**

*Introduction to Environmental Engineering & Management*

The nature of the environment; environmental concerns: global, regional, local; the environmental movement; population and poverty; environmental management; evolution of environmental management, energy consumption; environmental pathways; sustainable development; environmental assessment methods; life cycle assessment; environmental impact statements; economic assessments; environmental auditing; impact matrices; environmental ethics; environmental design, environmental management systems, integration with health, safety and quality management systems; environmental standards and legislation in the Caribbean; economic instruments for pollution control; regulations for pollution control.

**ENGR 6001 (FE61H)**

*Environmental Data - Quality Standards, Sampling & Analysis*

Quality standards for the atmosphere, hydrosphere and lithosphere and for the built environment; sampling techniques; analysis and interpretation of results in connection with standard methods for the physical, chemical and biological examination of water, waste water, air quality and soil; statistical methods in environmental data analysis.

**ENGR 6002 (FE61G)**

*Environmental & Health Effects of Pollution*

Health effects of inorganic and organic contaminants; sanitation and health; pathogenic organisms; waterborne diseases; airborne diseases; diseases spread by vermin; toxic effects of inorganic and organic contaminants on flora and fauna; eutrophication; pollution and self purification of streams; living indices of pollution.
SPECIALIST OPTIONAL COURSES

ENGR 6004 (FE62D)  
Solid & Hazardous Waste Management  
Definition of Municipal Solid Waste Management (MSW) and hazardous wastes systems; system objectives; waste classification; municipal and hazardous waste quantities, composition and characteristics; collection systems; waste disposal at sanitary landfills; design of sanitary landfills, hazardous waste treatment and disposal; hazardous waste handling and transport; secure landfills; hazardous waste management organisations, resource recovery; re-use, recycling and waste minimisation; energy recovery through incineration; composting; agricultural waste treatment process and plant design; disposal of treated agricultural wastes.

ENGR 6005 (FE62E)  
Pollution Prevention, Cleaner Production & Industrial Waste Abatement  
Preventative Environmental strategies versus end-of-pipe treatment, environmentally friendly product design, low-waste production technologies, efficient use of energy and raw materials, optimisation of existing technologies, operational safety, integrated approach to waste minimisation. In plant Survey. Waste minimisation through volume and strength reduction, process modification, separation and segregation, recycle and reuse technology. Characterisation of liquid, solid and gaseous wastes from important industries of the country or region. Treatment of wastes from different industries - case studies. Combined treatment plant for small-scale industries.

ENGR 6006 (FE63E)  
Water & Wastewater Engineering  

ENGR 6007 (FE63F)  
Air Pollution Control  
Sources of air pollution; natural and industrial sources; emissions from utilities, transportation; domestic emissions and their influence on indoor air quality; estimates of emission; concept of source reduction; process change; fuel change; material substitution. Control devices for: particulates and mist, gaseous pollutants, choice of device and design of trains; control for re-use and recovery; industry-specific control strategies.

ENGR 6008 (FE64B)  
Environmental Impact Assessment in Environmental Engineering  
Elements of the EIA process; design of an EIA: Leopold matrices; EIA in development projects; international EIAs; case studies; Environmental Impact Statements (EIS): definition, documentation, typical headings, major sections; checklist.
ENGR 6009 (FE64C)
Engineering in Disaster Management & Mitigation
Environmental and socio-economic impacts of natural disasters: wind, floods, earthquakes, landslides, tsunamis, volcanoes; preparedness mitigation, prediction emergency response; engineering in management and mitigation. Industrial accidents; oil spills; environmental and socio-economic impacts; hazard and risk assessment; systematic identification and quantification of hazards; flammability assessment and fire prevention; safety of plant in start-up, operation; shut-down, maintenance and modification; fire and explosion; toxicity and toxic release; Factory Acts; Health and Safety at Work Act.

ENGR 6010 (FE65A)
Economics for Environmental Engineering
Economics of environmental management; internalisation of externalities; concept of public ownership of natural resources; resource evaluation; economics of sustainable development in small island states; economics of pollution, project economics; cost-benefit analysis including environmental components; shadow pricing; risk analysis; the role of the international lending agencies.

ENGR 6011 (FE65B)
GIS, Land Use & Resource Management in Environmental Engineering
Principles of integrated land-use planning; planning practice; managing forests and fragile eco-systems; managing renewable resources; sustainable human settlement, principles of land surveying; aerial surveys and photographic interpretation; data acquisition and analysis for geographic and land information systems.

ENGR 6012 (FE66A)
Hydrology & Drainage Systems
Catchment morphology; natural run-off processes in the humid tropics; linear theory and the unit hydrograph; non-linear rainfall run-off models; lumped and distributed flow routing; catchment responses to changing land uses; the role of natural forests in catchment water balance relationships; design of land drainage and flood control systems; modelling of run-off in urban catchments; effects of urban development on catchment responses; lumped and continuous simulation models; numerical solution of the Saint Venant equations; design of storm-water drainage systems; erosivity and erodibility; modelling soil loss; erosion control; design of control structures; the role of forests in limiting erosions; protecting soil quantity and modelling flooding; effects of deforestation; agro-forest systems, forestry management.

ENGR 6013 (FE67C)
Chemistry & Microbiology for Environmental Engineering
Particle dispersion, solutions and solubility; acid-base reactions; Redox reaction; the carbonate system; acidity and alkalinity, laws relating to gases and gaseous mixtures; gas-liquid transfer; mass and charge balances; Nernstíes equation; corrosion; chemical precipitation; chemical coagulation; precipitation of iron and manganese; phosphate precipitation. Special reference to water and waste treatment processes, chemical equilibria and kinetics relevant to the water cycle allowing definition of water quality parameters. Micro-organisms and their characteristics; bacterial growth and death; viruses, algae, fungi and protozoa in wastewater treatment processes and environmental pollution: microbiology of soil, solid wastes, water, wastewater, the atmosphere and indoor air; laboratory techniques for the culture and identification of micro-organisms. The role of different species in the various treatment processes. An outline of the bacterial metabolism which occurs during aerobic biological sewage treatment and anaerobic sewage sludge digestion.
**ENGR 6014 (FE67D)**

**Transport of Pollutants**

Modelling of pollutant transport in watercourses and coastal water; the Navier-Stokes Equations; Diffusion Equations; numerical solutions using finite elements methods; modelling of pollutant transport in groundwater flow; Darcy Equation; Stream and potential functions; flow notes; flow modelling techniques; numerical solution techniques; finite difference and finite element methods; the advection-dispersion equation; use of computer models. Air pollution meteorology, ventilation, stagnation, wind, atmospheric stability, mixing height; modelling air pollution: point, area and line sources; reactive pollutants; heavier than air gases.

**ENGR 6015 (FE67E)**

**Environmental Separation Processes**

Screening of water, wastewater and liquids; settling and flotation; aerobic and biological processes; coagulation and flocculation; filtration; ion exchange; adsorption; disinfection separation by membranes, sludge stabilisation, thickening and conditioning, solidification. Settling of particulates by gravity, inertia, electrostatic and wet collectors, gas and vapour absorption processes; adsorption processes.

**Details of Coursework**

**A.** Coursework counting for forty percent (40%) of the final mark for the Course.

The coursework will be in two parts as follows:

1. Written in-course tests, each of one-hour duration, during the semester in which the course is delivered. In each test, candidates will be required to answer two questions from a total of four questions based on the preceding course instructions. It may also be conducted in the form of multiple-choice tests and short quizzes.

2. Coursework assignments, which may include: Laboratory work, field investigations, engineering design, analysis, essays or short projects.

**B.** Coursework counting for sixty percent (60%) of the final mark for the Course.

1. Two (2) written in-course tests, each of one hour duration or multiple choice quizzes, during the semester in which the course is delivered. In each test, candidates will be required to answer two questions from four questions based on the preceding course instructions. These tests will count for 20 percent (20%) of the total mark for the course.

2. Field assignments, which may include: Laboratory work, field investigations, engineering design, analysis, essays or short projects. The number of assignments will not be less than four and not greater than six. The assignments will count for 40 percent of the final mark.

**C.** Coursework counting for one hundred percent (100%) of the Final Mark for the Course

Each course will have either:

1. One (1) or two (2) detailed projects.

2. Four (4) to six (6) case study assignments. These will be written in the form of short projects.
MSC IN PROJECT MANAGEMENT

8.1 This is a Campus programme involving the Faculty of Engineering, Faculty of Social Sciences (Department of Management Studies) and the Institute of Business, and it is administered in the Faculty by the Department of Civil & Environmental Engineering through a Programme Coordinator. It is academically managed by a Campus-based team led by the Dean of the Faculty. This MSc is a two-year evening programme. The Degree will be awarded with Pass or Distinction, following the normal University requirements for taught Masters Programmes.

8.1.1 Programme Objectives
To train and produce Graduates who will be able to:
• Solve real-world management problems associated with the project cycle and to exercise sound management judgment through practical application of Project Management concepts and skills;
• Apply management principles to business situations;
• Develop and communicate project financial and performance objectives;
• Accurately develop Master Plans for projects and programmes, including tasks, budget and resource requirements;
• Effectively monitor, control and report project costs, the scheduled and quality/performance levels needed to meet agreed milestones and required levels of earned value; and
• Provide effective leadership and promote a true environment that will help motivate team members and resolve conflicts.

8.1.2 Admission Requirements
A first degree from an approved University in Project Management, Information Technology, Planning, Agriculture, Accounting, Engineering, Management Sciences, Economics, Architecture, Quantity Surveying, Land Surveying, Construction Management. Applicants must possess sufficient related work experience that would assist the candidate in becoming eligible for registration in related professional associations and institutions.
8.1.3 Programme Structure Content

The programme is made up of a core of courses, electives, and an integrated experience project, and will be done over a minimum of four (4) semesters or a maximum of six (6) semesters. There are eight (8) core courses to be done over the first two semesters amounting to twenty-four (24) credits, four (4) electives over the third semester amounting to twelve (12) credits, and a project over the third and fourth semesters worth nine (9) credits. The total credits required to complete the programme are forty-five (45).

8.1.4 The programme will be an evening programme delivered on a part-time basis, with lectures and tutorials being delivered between 4.00 pm and 8.00 pm on weekdays, and will involve an interactive approach to learning embracing real life problems and experiences. Group discussions and pursuit of topics and assignments will be an essential feature of the delivery format. The course structure is given below and each course carries three (3) credits.

8.1.5 Core Courses

**First Semester**

- COEM 6009 Contract Management & Construction Law (CE64A)
- PRMG 6001 Project Leadership & Organisational Behaviour (PR60A)
- PRMG 6003 Project & Programme Management (PR62A)
- PRMG 6004 Project Accounting & Finance (PR62B)

**Second Semester**

- PRMG 6002 Project Management Information Systems (PR61B)
- PRMG 6005 Marketing Management & Business Construction (PR63A)
- PRMG 6006 Strategic Project Planning (PR63B)
- PRMG 6007 Procurement Management, Logistics & Contracting (PR64A)

8.1.6 Candidates will be required to deliver seminar presentations for three (3) of the eight (8) core courses.

8.1.7 Electives

The following is a list of the Elective Courses from which the candidate is required to complete four (4) in the third semester. Each course carries three (3) credits:

- COEM 6001 Infrastructure Planning & Construction (CE60B)
- COEM 6007 HR Management & Industrial Relations in Construction (CE63A)
- COEM 6015 Maintenance Facilities & Management (CE68B)
- COEM 6016 Natural Hazards Management (CE69B)
- IENG 6006 Occupational Safety & Health (IE67K)
- MENG 6405 Total Quality Management (ME64N)
- MENG 6505 Industrial Health & Safety (ME65N)
- PRMG 6008 Project Estimating & Cost Management (PR64B)
- PRMG 6009 Managing Information Technology Projects (PR65B)
- PRMG 6010 Risk Management for Project Managers (PR66B)
- PRMG 6011 Advance Project Management Practice (PR67B)
- PRMG 6012 Value Engineering & Management (PR68B)
- PRMG 6013 International Project Management (PR69B)
- SVGI 5002 Geographic Information Systems 1 (SV51A)

8.1.8 Designated courses are already delivered within the Campus Units involved.

8.1.9 Integrated Experience Project

This project-based course carries nine (9) credits, and provides the student with the opportunity to integrate knowledge and skills learned throughout the programme, and should normally be taken as the last course in the delivery of the programme. Conceptual work on the Project will begin at the end of the first semester, and the project should be completed by the end of the fourth semester. Students develop, design and present a project; plan and justify the project; work to satisfy performance, schedule and budget requirements; adjust for unplanned occurrences; and provide status reports.
8.1.10 As an alternative, the student may opt to pursue an internship project, within the mainstream of their area of specialisation, that is approved by the Academic Unit involved.

8.1.11 Syllabuses for Core Courses

**COEM 6009 (CE64A)**
**Contract Management & Construction Law**
An introduction to the different legal systems. The impact of law on the delivery of engineering goods and services; law and the construction sector. The making of law and the courts; litigation. The elements of contract law and relation with the construction sector. Types of contracts; different procurement systems; standard form building contracts (specifications codes of practice; standards, statutes and local government regulations); The elements of the Law of Tort, disputes and conflict resolution methods; professional associations, codes of ethics, professional liability; construction claims; different forms of business organisations; business law and the company act; health and safety legislation; environmental law; introduction to intellectual property; confidentiality of information; warranties and indemnity. Introduction to international law.

**PRMG 6002 (PR61B)**
**Project Management Information Systems (PMIS)**
This course addresses project management principles and methods from the standpoint of the project and programme manager who must organise, plan, implement and control non-routine activities to achieve schedule, budget and performance objectives. Topics include: project life cycles, definition of PMIS, the planning system and the control systems, networking systems, performance management systems, cost and resource management systems, capacity planning systems. Evaluating systems, project management procedures, system selection and implementation, project management software, earned value techniques and project audits are studied.

**PRMG 6003 (PR62A)**
**Project & Programme Management**
This course addresses the culture, principles and techniques of project and programme management. The following are covered: What is a project? What is project management? The project life cycles for different industries, project context: Planning the project (project selection - tools and techniques), scope management defining the project, project planning, work breakdown structures, Gantt chart, PERT chart, CPM, preparing the master plan, project budgeting, responsibility matrix, communication plan, project criterion for success, project control (project baseline, status reporting, control cycle, monitoring and control tools, resource grading, change control, resource levelling, variance reporting tools, project audit), implementation, Project Finalisation and close-out. Project cost, risk and quality management. What is programme management, benefits of programme management, programme management organisation/programme planning, benefits management, stakeholder management, programme management processes, effective project and programme teams, the project support office, audit, applications of project management software, e-business programme management.
PRMG 6004 (PR62B)  
**Project Accounting & Finance**


PRMG 6005 (PR63A)  
**Marketing Management & Business Communications**

This course presents a structured approach to understanding the marketing function. Each student chooses a product or service and develops a written marketing plan to learn how to determine and integrate the elements of marketing strategy. Topics include: marketing segregation, targeting and positioning, market research, product decisions, pricing, channels of distribution, sales management, advertising, marketing budgets. Business communication emphasises communication competencies that can help ensure business success. Topics covered include how to conduct research, analyse information and prepare business reports, deliver effective information and persuasive oral presentations, work successfully with an assigned group and communicate effectively in a global workplace.

PRMG 6006 (PR63B)  
**Strategic Project Planning**

This course examines practical, real world tools and techniques for many projects, in order to help students develop distinctive skills in managing strategic projects across functions: students will also learn how to develop twenty critical plans for managing projects to maximise returns from investment in capital projects. Topics include: the growth in project management, success, maturity and excellence definitions, strategic planning for project and programme management, project execution, The project charter, the project planning basis, plans for production and control, project implementation profile. The integrated logical framework and stakeholder management.

PRMG 6007 (PR64A)  
**Procurement Management, Logistics & Contracting**

Principles and concepts essential to effecting large procurement programmes. Planning, sourcing and contractual design for diverse acquisitions. This course examines processes through which works, goods and services are acquired in the project management. Topics include: What is procurement management, contract and procurement strategies [IDB, WB, EEC, CDB, private sector and public sector]; legal issues, contracting pricing alternatives; writing terms; reference, technical, managerial and commercial requirements, request for proposals (RFP) development, source selection, invitation to bid, bid evaluation (process criteria report), risk assessment, contract negotiation and administration, contract close out and case studies.

8.1.12 Syllabuses for New Electives

PRMG 6008 (PR64B)  
**Project Estimating & Cost Management**

This course addresses the need for project managers to understand and apply advance tools and techniques to the development and management of project financial plans. Topics include project cost and benefit estimation, project financial analysis, project simulation, budgeting, cost/schedule integration, the cost breakdown structure, the cost commitment profile, techniques for monitoring and controlling project cost, methods of payment and their uses, types of estimate, estimates at different stages of the project life cycle, estimating methods such as: parametric, comparative, bottom-up estimating, computerised tools, analytical, accuracy of estimates, earned value management systems.
PRMG 6009 (PR65B)  
Managing Information Technology Projects  
(Prerequisite: PM61B)
This course addresses all areas of IT project management, hardware, software, systems integration, and human resources. It extends traditional project management concepts into the IT arena. Topics covered: IT project phases, strategies for IT projects, project initiation and requirements definition, establishing IT project teams, project planning estimation, project execution and control, project close-out, managing hardware and telecommunications projects, managing software projects, managing systems integration projects.

PRMG 6010 (PR66B)  
Risk Management for Project Managers
This course will emphasise risks and risk management processes in projects and firms that are involved in project management. It will discuss and explore the concept of risk management both from the strategic and tactical levels. Topics: Why project risk management? The risk management cycle, the nature of risk management, risk and decision-makers, integration, general approach and definitions, risk identification, risk assessment goals and methodology, computer applications, risk response and documentation, management of contingency allowances, managing the risks of the project environment dealing with risks in contracts and project risk analysis and management (tools and techniques) e.g. assumption analysis, check lists, prompt lists, brainstorming, Delphi technique, probability impact tables, interviews, risk register, decision trees, influence diagrams, Monte Carlo simulation, sensitivity analysis, PERT and control techniques). The practical use of statistics in collecting, organising, analysing, interpreting and presenting data both descriptive and inferential techniques are covered. The perspective will be aimed at medium and upper level project managers in various organisations.

PRMG 6011 (PR67B)  
Advanced Project Management Practice
Advanced PM practice and professional exam preparation examines current topics in the project management field and provides a comprehensive review of the project management body of knowledge PMBOK (USA) and BOK (Europe). Topics include: global project management, leadership, virtual teams and project information systems.

PRMG 6012 (PR68B)  
Value Engineering & Management
This course provides students with central concepts and practical tools and techniques in Value Engineering (VE), Value Management (VM) and Value Analysis (VA). Topics include: the value concept, value engineering methodology [information phase, speculative phase, analytical phase, proposal phase and final report phase]. Several techniques for project selection e.g., breakdown analyses, cost modelling techniques, delphi techniques, energy modelling, lifecycle cost model. Life cycle costing methodology. Value management plan, keys to successful VE implementation and programme management strategy for a VE/VA programme.

PRMG 6013 (PR69B)  
International Project Management
Geography, culture and society, transnational commerce and finance; international principles and regulations for procurement of finance, goods and services, tendering procedures; project preparation, planning, financing and execution; international contract law and operations in the conduct of transnational projects, preparing contracts, negotiating contracts, dispute resolution; transnational joint ventures and the management of resources for project execution and closure.
REGULATIONS FOR POSTGRADUATE DIPLOMAS

9.1 General Regulations

9.1.1 The Postgraduate Diploma shall be awarded on the basis of an examination by written papers and/or approved combinations of written papers and coursework which may include a Project. The duration of the programme shall be not less than one (1) calendar year for full-time study and not less than two (2) calendar years for part-time study. The appropriate University Regulations for the Postgraduate Diploma shall apply.

9.1.2 Candidates applying for registration for the Postgraduate Diploma shall have either:
   a. A Bachelor’s Degree in Engineering from an approved institution
   or
   b. An equivalent qualification in those subjects specific to individual programmes

9.1.3 Applicants holding non-engineering Bachelor’s degrees may be required to pass a qualifying examination.

9.1.4 All applications must be approved by the Board for Graduate Studies and Research and a candidate may be required to satisfy such prerequisites as are deemed necessary before proceeding to the Postgraduate Diploma programme.

9.1.5 No candidate will be allowed to proceed to a Project before successfully completing the written papers of the examination unless the Board of Examiners decides otherwise.

9.1.6 Candidates with full-time registration who start their Projects after completing their written papers of the examination may be allowed to change their registration to part-time provided they are in full-time employment and that they make the necessary request to the Registry.

9.1.7 There shall be at least one External Examiner and his role and duties shall be identical to those for the BSc (Eng) Examination.

9.1.8 Boards of Examiners shall be established by the Board of the Faculty of Engineering. The Faculty Board shall establish from time to time, guidelines for the Board of Examiners.

9.1.9 The Board of Examiners shall make recommendations to the Chairman of the Campus Committee on Graduate Studies and Research on passes and failures in the examination. Permission to repeat all or part of the examination shall be at the discretion of the Board for Graduate Studies and Research.

9.1.10 The results of the examination shall be published in a Pass Lists in which names of the successful candidates shall be arranged alphabetically as follows:
   i. Distinction
   ii. Pass

9.1.11 The Board for Graduate Studies and Research may recommend to the Senate the withdrawal of any candidate whose performance it considers to be unsatisfactory.
REGULATIONS FOR MASTERS DEGREES

10.1 General Regulations

10.1.1 The Masters (Eng) Degree shall be awarded on the basis of an examination by written papers and/or approved combinations of written papers and course work which may include a Project. The duration of the programme shall be not less than one (1) calendar year for full-time study and not less than two (2) calendar years for part-time study. The appropriate University Regulations for the Master’s Degree shall apply.

10.1.2 Candidates applying for registration for the Masters (Eng) Degree should have either:

a. A Bachelor’s Degree in Engineering from an approved institution, or

b. An equivalent qualification subject to the approval of Senate.

10.1.3 Applicants holding non-engineering Bachelor’s Degrees may also be considered provided they hold passes, not lower than Second Class Honours level, in appropriate or equivalent Engineering subjects. Such candidates may also be required to pass a qualifying examination.

10.1.4 All applications must be approved by the Board for Graduate Studies and Research and any candidate may be required to satisfy such prerequisites as are deemed necessary before proceeding to the Masters Degree programme.

10.1.5 No candidate will be allowed to proceed to a Project before successfully completing the written papers of the examination unless the Board of Examiners decides otherwise.

10.1.6 Candidates with full-time registrations who start their project after completing their written papers of the examination may be allowed to change their registration to part-time provided they are in full-time employment and that they make the necessary request to the Registry.

10.1.7 There shall be at least one External Examiner and his role and duties shall be identical to those for the BSc (Eng) Examination.

10.1.8 A Board of Examiners shall be established by the Board of the Faculty of Engineering. The Faculty Board shall establish from time to time, guidelines for the Board of Examiners.

10.1.9 The Board of Examiners shall make recommendations to the Chairman of the Campus Committee of Board for Graduate Studies and Research on passes and failures in the examination shall be at the discretion of the Board for Graduate Studies and Research.

10.1.10 The results of the examination shall be published in a Pass List in which names of the successful candidates shall be arranged alphabetically as follows:

i. Distinction
ii. Pass

10.1.11 The Board for Graduate Studies and Research may recommend to the Senate the withdrawal of any candidate whose performance it considers to be unsatisfactory.
REGULATIONS FOR
MSC/ MME PROGRAMMES

- MASTERS IN CIVIL ENGINEERING (MSC)
- MASTERS IN CIVIL WITH ENVIRONMENTAL ENGINEERING (MSC)
- MASTERS IN MANUFACTURING ENGINEERING (MME)

11.1 General Regulations

11.1.1 These programmes are specially designed for candidates seeking to fulfill the academic requirements for advancement to practise as a registered professional engineer and are of twelve (12) months duration, full-time.

11.1.2 Admission

11.1.3 Candidates for admission to these programmes should have a Bachelor’s degree, normally at the level of at least Second Class Honours in the relevant discipline.

11.1.4 Qualified candidates opting to pursue these Masters programmes immediately following completion of the BSc programmes in Engineering, will not be required to submit an application for entry, but be allowed to progress seamlessly into these programmes.

11.1.5 A student who has completed the Level 2 programme at the Bachelors’ level with a weighted average of a minimum of 50% may be granted provisional direct entry into these Masters programmes.

11.1.6 Course of Study

11.1.7 The course of study for these Masters programmes include in addition to the courses of instruction, examination by written papers, supervised design/research work which may be industry-based and oral and written presentations.

11.1.8 Full-time Masters students must complete and submit project requirements at the time stipulated by the Departments. All project work must have been completed within one (1) calendar year of the start of the programme.

11.1.9 Candidates failing the examination in any course or the project may be allowed a second attempt at the examination on the recommendation of the Board of Examiners. Candidates are not permitted to repeat the examination in any one course on more than one (1) subsequent occasion.

11.1.10 Candidates are not normally allowed oral examinations in more than two (2) full courses per semester.

11.1.11 A proportion of the marks which make up the final result of a particular course examined by a written Paper may be derived from the candidate’s performance in course work assignments, in course tests, etc. All such assignments must be completed and submitted to the examiners before the date of the written examination.

11.1.12 Candidates must pass both the written examination and the course work component with at least a 50% mark to be credited with a Pass.

11.1.13 Candidates whose work is at any time reported by their Supervisors to be unsatisfactory or who do not satisfy the Examiners on Courses or Project Work that form part of the programme will be required to withdraw and will be removed from the Register of Postgraduate students.

11.1.14 Such students shall not normally be readmitted for at least one (1) year thereafter. Students readmitted to these programmes shall be eligible for credits for those courses passed creditably during their previous registration, provided that not more than five (5) years have elapsed since the applicants withdrew from the University and that the course content has not changed significantly in the interval.

11.1.15 Distinctions - MSc

11.1.16 A Distinction may be awarded for a Masters degree provided that the candidate obtains 70% or more in EACH component of the course of study, i.e., (i) written Papers and (ii) Research/Design Project.
REGULATIONS FOR RESEARCH DEGREES

12.1 General Regulations

Master of Philosophy
12.1.1 The MPhil Degree shall be awarded on the basis of an examination by thesis and the appropriate University Regulations for the Master's Degree shall apply.

12.1.2 Candidates applying for registration should normally be holders of a Bachelor's Degree in Engineering or other appropriate field of at least the standard of Second Class Honours Degree of The University of the West Indies. Holders of a Pass Degree or a General Bachelor’s Degree must normally pass qualifying examinations.

Doctor of Philosophy
12.1.3 The appropriate University and Faculty of Engineering Regulations for the Degree of Doctor of Philosophy shall apply.

12.1.4 Attendance at the oral examination for the PhD Degree in the Faculty of Engineering shall be open to the academic and professional community. A minimum of seven days' notice shall be given before the examination.

REGULATIONS FOR MPHIL QUALIFYING EXAMINATIONS

13.1 General Regulations

13.1.1 Any person wishing to proceed to MPhil in the Faculty of Engineering must take a qualifying examination unless:

a) He/she possesses at least a Second Class Honours Degree or equivalent in the area in which he/she is working or in a related area;

or

b) He/she has been appointed to the post of Assistant Lecturer or higher in the Faculty;

or

c) The Board for Graduate Studies and Research exempts him/her on the recommendation of the Faculty Sub-committee of the Board for Graduate Studies and Research.

13.1.2 The qualifying examination shall consist of at least two (2) papers lasting three (3) hours each.

13.1.3 Normally, one of the papers shall be taken from the BSc (Eng) Degree Examination or be of equivalent standard and one will be specific paper in the specialist area of interest.

13.1.4 There shall be a Moderator appointed by the Dean on the recommendation of the Head of Department from among persons not working in the Department(s) involved in the research.

13.1.5 The Head of the Department will assign the responsibility for the preparation of the question papers and the marking of the scripts.

13.1.6 The Moderator mentioned in the Regulations above shall be required to examine the question papers before the examination and to examine the scripts after they have been marked. He may, if he wishes, require an oral examination. In order for the candidate to pass, the Examiners must certify to the Board for Graduate Studies and Research that the candidate has reached at least a standard equivalent to Second Class Honours in the papers examined and the Moderator must give his approval of the examination.
REGULATIONS FOR PART-TIME POSTGRADUATE STUDENTS

14.1 General Regulations

14.1.1 A part-time postgraduate student is anyone who, while reading for the Masters or PhD Degrees or any other Postgraduate Degree or Diploma, spends an average of nine or more hours a week in any paid employment. A part-time student will not, except in very special circumstances, be permitted to register for PhD in Engineering without having previously achieved the Masters in Engineering of this University.

14.1.2 Applicants for registration for part-time study towards a postgraduate degree will be required to meet all the academic requirements for admission into full-time postgraduate studies.

14.1.3 Those applicants who are required to pass qualifying examinations will sit such examinations under existing Faculty Regulations.

14.1.4 On acceptance for postgraduate studies a part-time student shall be assigned to one or more supervisors to whom the student shall report in person or in writing not less than once every term.

14.1.5 All part-time postgraduate students may be required to attend such postgraduate seminars as may be arranged by the department in the Faculty of Engineering during the academic year.

14.1.6 Not less than two (2) calendar years (unless the Faculty relaxes this requirement if it can be shown that the candidate’s employment is such that his normal work is the same as the research work for his degree) after passing the qualifying examination a part-time student for the MPhil will present a dissertation and may also be orally examined on the general field of study or on the dissertation.

14.1.7 A part-time student for the PhD will submit a thesis and be orally examined in the general field of study and on the thesis not less than three (3) calendar years (unless the Faculty relaxes this requirement if it can be shown that the candidate’s employment is such that his normal work is the same as the research work for his degree) after registration for the degree.

14.1.8 The award to a part-time student of the postgraduate degree, be it Masters or PhD Degree, will be subject to the conditions of award to full-time postgraduate students.

14.1.9 For part-time students, an MPhil thesis must be submitted normally not later than six (6) years after the date of registration. Similarly, a PhD thesis must be submitted not later than eight (8) years after the date of registration.
REGULATIONS FOR CERTIFICATE COURSES

15.1 General Regulations

Construction Engineering and/or Management

15.1.1 Before registration as a student of the University proceeding to a Certificate in Construction Engineering and/or Management, a candidate must:

a. Satisfy the matriculation requirements of the University, and

b. Have, in the opinion of the Faculty, practical experience, or other qualifications or general standard of education of special relevance to the course of study.

15.1.2 Any candidate for the Certificate may be required by the Faculty to sit an entrance examination and/or successfully complete an introductory course before being granted permission to read the Certificate.

15.1.3 Candidates for the Certificate will be required to follow the prescribed course of study for a period of not less than one (1) academic year (full-time) or two (2) academic years (part-time).

15.1.4 They will also be required to carry out coursework as prescribed.

15.1.5 The examination will be conducted by means of written papers and course work. Candidates may be orally examined on any part of the examinations.

15.1.6 Part-time students will be required to take examinations in two (2) courses in the first year and the third course in the second year.

15.1.7 The Board of the Faculty of Engineering may recommend to the Senate the withdrawal of any candidate whose performance it considers unsatisfactory.

15.1.8 Successful completion of the examination will lead to the award of a Certificate in Construction Engineering or Construction Management or Construction Engineering & Management. The designation will depend on the course combinations.

15.1.9 The results of the examinations shall be published in a Pass List in which the names of the successful candidates shall be arranged alphabetically.

15.1.10 The reports of the examiners and the Pass List shall be laid before the Senate for approval.

15.1.11 A Certificate in Construction Engineering or Construction Management or Construction Engineering & Management under the seal of the University shall be sent thereafter to each successful candidate.
GUIDELINES FOR POSTGRADUATE PROGRAMMES: MSc/Diploma

16.1 Guideline for Postgraduate Programmes: MSc

16.1.1 The following are the approved guidelines for the conduct of Graduate Programme in the Faculty of Engineering.

16.1.2 Registration
A full-time candidate will not normally be permitted to register for more than 18 credits per semester, and a part-time candidate for not more than 9 credits.

16.1.3 Total Number of Credits in Masters Programme
The total number of credits should normally be set at 45 in accordance with the recommendations of the Board for Graduate Studies.

16.1.4 Value of a Course Credit
A course credit is defined as one (1) contact hour per week OR one (1) 2-hour lab per week OR one (1) hour supervised research per week.

16.1.5 Performance of Students:
Number of attempts at any one examination
Qualifying candidates: Normally, candidates may be allowed one (1) attempt at the original examination. Masters/Diploma Candidates: May normally be allowed to repeat up to the maximum allowable time for completion of the degree.

University Regulations state that candidates may not have more than two (2) attempts at an examination.

16.1.6 Oral Examination
A student failing a course examination with a mark of 45% or more shall be provided the opportunity to be orally examined up to a maximum of two (2) courses. The final mark obtained by this means shall not exceed 50%.

In special circumstances as determined by the department, an oral examination may be given. These circumstances may include the following:

(i) A high failure rate in the course (>25%)

(ii) Following a failure in an examination for which student has provided acceptable written advice of extreme personal or professional difficulties prior to the scheduled examination date.

Note: Resit examinations are being phased out from the Academic Year 2002/2003. Thereafter, there shall be no resit examinations.

16.1.7 Length of Project Report
Postgraduate Diploma - The report should not normally exceed 100 pages including appendices.
Masters - The report should not normally exceed 150 pages including appendices.

16.1.8 Marking System
Examination of Project Report
Examiners must observe the University guidelines for report marking. Marks awarded for each section should be indicated in the report together with brief comments. Where this is not done, the report will be sent back to the examiner for re-examination.

16.1.9 Procedure for Examination Reports
The Faculty will continue to submit all project reports to External Examiners. Project Reports are to be submitted simultaneously to all examiners. For a student to pass, all three examiners should normally concur. Where there is no-agreement among examiners, the Board of Examiners will decide on the appropriate action to be taken.

16.1.10 Withdrawal: Number of failed courses allowed before mandatory withdrawal.

16.1.11 To maintain registration, candidates should normally pass a minimum of 50% of the course load in each semester.

16.1.12 A full-time student should complete all the course requirements (including project) within two (2) years, a part-time student within four (4) years.
16.1.13 A candidate required to withdraw should be allowed to re-enter after one (1) year, but within five (5) years after withdrawal. The candidate will retain credits for courses already successfully completed. Candidates who voluntarily withdraw may be allowed to re-enter at the next available opportunity. In this case, all credits previously accumulated will be retained by the candidate (normally for up to five (5) years thereafter, at the discretion of the department).

16.1.14 No extensions will be granted to students beyond three (3) years full-time and six (6) years of part-time.

### CALENDAR

#### SEMESTER ONE - 2004

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>Sunday August 29</td>
<td>Semester I begins.</td>
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<tr>
<td>Monday August 30</td>
<td>Registration opens.</td>
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<tr>
<td>Friday September 3</td>
<td>Registration closes.</td>
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<tr>
<td>Monday September 6</td>
<td>Teaching begins.</td>
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<tr>
<td>Friday December 3</td>
<td>Teaching ends.</td>
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<tr>
<td>Monday December 6</td>
<td>Examinations begin.</td>
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<tr>
<td>Wednesday December 22</td>
<td>Examinations end.</td>
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<tr>
<td>Wednesday December 22</td>
<td>Semester ends.</td>
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#### SEMESTER TWO - 2005

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>Sunday January 16</td>
<td>Semester II begins.</td>
</tr>
<tr>
<td>Monday January 17</td>
<td>Teaching begins.</td>
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<tr>
<td>March 27 - April 2</td>
<td>Mid-semester break.</td>
</tr>
<tr>
<td>Friday April 22</td>
<td>Teaching ends.</td>
</tr>
<tr>
<td>Wednesday April 27</td>
<td>Examinations begin.</td>
</tr>
<tr>
<td>Friday May 13</td>
<td>Examinations end.</td>
</tr>
<tr>
<td>Friday May 13</td>
<td>Semester ends.</td>
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</tbody>
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For further information, contact the
Office of the Dean
Tel: 662-2002; ext: 2199/3396