

BSc (Hons) Marine Science and Technology – SC304

1. Rationale & Objectives

The need for Mauritius is strong to diversify the economy by developing new sectors. The Seafood Hub and the proposed Land Based Oceanic Industry look promising sectors for new employment and national income generation, but are severely constrained by lack of appropriately trained or skilled manpower. The University of Mauritius endeavours to help bridge some of this gap by offering the needed training through this programme.

Modern marine science entails a multidisciplinary approach and application of relevant marine technology offers the potential for exploring and exploiting the sea for human benefits. This programme provides a basic understanding of how the ocean functions, and gives the background not only for use and exploitation of the marine environment and its resources, but also to deal with the many challenges of how we maximise resource yields without compromising ecological integrity, farm marine species without degrading the coastal environment, expand tourism without dislocating its very ecological assets and promote a marine industry on a sustainable basis for Mauritius.

All three years of the degree programme are based on a modular system with students following the equivalent of six 90-hour modules each year. A combination of compulsory ‘core’ modules and a choice of ‘optional/elective’ modules provides a well structured degree whilst at the same time allowing students to freely study the areas of marine science and technology in which they have the keenest interest and also undertake a research project under guidance in the final year.

This programme provides an opportunity to acquire a solid foundation in Marine Science and Technology with a view to developing skills for higher studies, research and entrepreneurship in the marine sector. Graduates with this qualification can seek employment as Scientific and Environmental Officer in the public sector as well as in the private seafood and marine industry sectors. Adequate attention will also be paid towards the personal development of students in acquiring professional competence and a sense of community responsibility.

Year	Core Modules	Elective Modules	Project	GEMs	Credits Earned	Total
Year 1	<i>Four (6 credits each) + one of 3 credits^a</i>	One (6 credits)	-	One (6 credits)	24 6 3 6	39
Year 2	<i>Four (6 credits each) + one of 3 credits^b</i>	One (6 credits)	-		24 6 3	33
Year 3	<i>Four (6 credits each)</i>	One (6 credits)	One (6 credits)	-	24 6 6	36
Total	14 core modules	3 elective modules	1 project	1	108 credits	

Core modules: 78 credits; Elective modules: 18 credits; Project: 6 credits; GEM: 6 credits. ^aIT module; ^bstatistics module

2. General Entry Requirements

As per General Entry Requirements for admission to the University for undergraduate degrees.

3. Programme Requirements

Credit in five subjects (School Certificate) including Mathematics.
Pass at GCE 'A' Level in two science subjects or equivalent.

4. Programme Duration

Minimum: 3 years
Maximum: 5 years

5. Credits per Year

Minimum 18, Maximum 48, subject to regulation 4.

6. Minimum Credits Required for Award of Undergraduate Degree: 108

Breakdown as shown in table below, subject to regulation 4.

Degree	Core Taught Modules	Project	Electives	GEM
	78	6	18	6

7. Assessment

Each module will be assessed over 100 marks (i.e. expressed as %) with details as follows (unless otherwise specified):

Assessment of a module will be based on a written examination (of 2-3-hour duration) and on continuous assessment done during the semester/year. The continuous assessment will count for 20-30% of the overall percentage mark for the module, except for a programme where the structure makes for other specific provision(s). Continuous assessment may be based on laboratory work, and/or assignments and should include at least 1 class test.

Written examinations for all modules, whether taught in semester 1 or in semester 2 or both, will be carried out at the end of the academic year (unless otherwise stated).

A minimum of at least 30% should be attained in each of continuous assessment and written examination, with an overall total of 40% for a candidate to pass a module. Modules will carry the weightings of 1, 3 or 5 depending on their status (Introductory, Intermediate or Advanced). Weighting for a particular module is indicated within parentheses in the module code.

Projects will carry 6 credits for degree award. They will be carried out normally in the area of marine science and technology

8. List of Modules

CORE MODULES (84 credits)

Code	Module Name	Hrs/Year L+P/Visits	Credits
MST 1001Y(1)	Marine Biology & Ecology	75+30	6
MST 1002Y(1)	Physical Oceanography, Meteorology & Climate Change	75+30	6
MST 1003Y(1)	Introductory Marine Chemistry & Analytical Techniques I	75+30	6
MST 1004Y(1)	Marine Pollution	75+30	6
CSE 1010e(1)	Introduction to Information Technology	O.E.	3
MST 2001Y(3)	Ichthyology, Fisheries Biology & Management	60+60	6
MST 2002Y(3)	Marine Aquaculture Techniques & Business Management	60+60	6
MST 2003Y(3)	Dynamical Oceanography & Ocean Remote Sensing	75+30	6
MST 2004Y(3)	Marine Biogeochemistry & Analytical Techniques II	70+40	6
MST 2005Y(3)	Research Methods	30+30	3
MST 3001Y(5)	Marine Biotechnology	75+30	6
MST 3002Y(5)	Marine Natural Product Chemistry	75+30	6
MST 3003Y(5)	Marine Resources & Law of the Sea	75+30	6
MST 3004Y(5)	Integrated Coastal Zone Management	75+30	6
MST 3000Y(5)	Project/Dissertation	-	6

ELECTIVES (18 credits)

MST 1005Y(1)	Biochemistry, Molecular Biology & Bioinformatics	75+30	6
MST 1006Y(1)	Sustainable Development	90+0	6
MST 2006Y(3)	Coastal Engineering	75+30	6
MST 2007Y(3)	Sustainable Marine Tourism	80+20	6
MST 3005Y(3)	Public Health, Food Hygiene & Food Processing	60+60	6
MST 3006Y(3)	Environmental Management Tools	75+30	6

(Note: new electives may be introduced later)

9. Outline Syllabus

Core Modules

MST 1001Y(1) - MARINE BIOLOGY & ECOLOGY

This module provides basic knowledge on the biology and ecology of marine organisms, primary and secondary production, and sampling and estimation methodologies. The main topics include planktology, phycology (phylogeny and main algal taxonomic groups), invertebrates (Spongia, Cnidaria, Plathyhelminthes, Annelida, Mollusca, Arthropoda, Echinodermata), spawning, embryonic development, growth, reproduction, feeding behaviour and physiology. The biology of cetaceans (whales & dolphins) will be covered including their life-history, population behaviour, conservation and sustainable management. Tropical coastal ecosystems (estuaries, shores and lagoons, coral reefs, mangroves, seagrass beds & wetlands) and their survey techniques for developing relevant monitoring strategies for assessment and management will be introduced. The rationale for Large Marine Ecosystems (LMEs), biodiversity conservation strategies, marine parks/marine protected areas and legislation will be discussed. Snorkelling and Scuba Diving will be promoted, and acquisition of a professional qualification encouraged during this course.

MST 1002Y(1) - PHYSICAL OCEANOGRAPHY, METEOROLOGY & CLIMATE CHANGE

An insight is provided of the physical nature of the coastal environment (lagoons, beaches, sand dunes, estuaries), the factors affecting coasts, the motion of seawater from the molecular to the global scale including vorticity and circulation, barotropic, baroclinic, and geostrophic current and Ekman transport. Mechanisms of ocean circulation and occurrence of tsunamis, eddies, waves, tides, turbulence, and deep water currents will be explained. Interaction of the ocean with atmospheric processes for climate study, principles of physical meteorology, data collection and presentation, and weather forecasting will also be introduced. Climate change, climatic hazards and vulnerability, impacts, and mitigation and adaptation strategies and measures will be discussed.

MST 1003Y(1) - INTRODUCTORY MARINE CHEMISTRY & ANALYTICAL TECHNIQUES I

Origin and seawater composition, chlorophyll and algal pigments, anoxic and oxic environments, pH, salinity, alkalinity, temperature variation, upwelling and mixing, dissolved and particulate species, residence time, study of the nomenclature, properties, reactions and synthesis of major classes of organic compounds with reference to marine natural products will be introduced. Environmental assessment will involve analytical techniques covering spectrophotometry (Beer's Law, etc.), atomic absorption, chromatographic techniques (gas, liquid, HPLC, thin layer, etc.), electrochemistry, among others.

MST 1004Y(1) - MARINE POLLUTION

This module deals with the following: types, sources and fates of marine pollutants, pollutant transport and transformation, economic losses and effects on living marine resources and humans, effects of eutrophication, harmful algal blooms, marine biofouling, coastal water quality monitoring and assessment, bio-indicators for pollution control strategies, waste water treatment and bioremediation, functions of microbes in marine pollution and regeneration of nutrients, oil pollution and contingency planning, pollution control and international law. Particular emphasis will be on impacts from extractive and petrochemical industries, humic substances, fatty acids, heavy metals, PAHs and radioactivity in the marine environment.

CSE 1010e(1) - INTRODUCTION TO INFORMATION TECHNOLOGY

The module covers information technology (IT) and computers, stepping in the computer, input and output devices, secondary storage, programming, systems software, applications software, systems development, computer networks, the Internet, computer security, software utilities, and issues and trends in IT.

MST 2001Y(3) - ICHTHYOLOGY, FISHERIES BIOLOGY & MANAGEMENT

The range and systematic positions of marine invertebrates and fish based on taxonomic methods will be presented. Methods of measuring body parts and counting meristic characters (e.g. fin rays, scales and otoliths for fish), larval morphology and method of larval taxonomy will be introduced. Focus will also be on fish viscera composed of gills, air bladder and digestive tract, and osteological and muscle structures. Basic knowledge of fishes including their morphology, physiology, ecology and life histories will be compared with those of other animals, namely marine mammals. The types of capture fisheries, fishing

technology, fish and fish products, reproductive biology and methods of stock assessment, fisheries management techniques, and decision/policy-making will be covered.

MST 2002Y(3) - MARINE AQUACULTURE & BUSINESS MANAGEMENT

Highlighting the present status and potential of marine aquaculture, this module deals with culture systems (site, species, aqua-farm design and construction), culture maintenance (nutrition & feeds), examples of cultured organisms (fish, crustaceans, molluscs and seaweeds), with emphasis on seed production (genome science & molecular techniques to induce reproduction), hatchery management (including health, pathology and pharmacology), and fry rearing and grow-out technology. Aquaculture management covers economic feasibility, farm management, harvest and post-harvest technology, quality control (handling, preservation, transport) and product marketing. Business management concepts deal with entrepreneurial culture, creativity, innovation, economic importance of entrepreneurship, and the 'Business Plan' as a preliminary for business creation, marketing strategies, human resource management, accounting and finance, strategic planning and business law. The WTO, international trade and regional opportunities for aqua-business are discussed. Writing a marine aquaculture business plan by the student is a requirement of this module.

MST 2003Y(3) - DYNAMICAL OCEANOGRAPHY & OCEAN REMOTE SENSING

The coastal, estuarine and sedimentary processes (depositional environments of beaches and the process of coastal erosion, sediments and the benthic boundary layer), shelf sea processes, continental margin processes, introduction to marine acoustics, the nature of the changing oceans (major ocean basins, changes in sea level) and related effects. Satellite remote sensing (RS) and its application to ocean sciences will be introduced. Topics for learning will include characteristics of the electromagnetic radiation, absorption, scattering and transmittance in the atmosphere and ocean, the platforms and sensors for measurement of sea surface temperature (SST) and its applications, water colour and reflectance of microwaves, algorithms to estimate chlorophyll concentration, sea surface topography, ocean wave activity, sea ice concentration, meteorology, Advanced Earth Observation and the RS & GIS (Geographical Information Systems) tools for coastal mapping in coastal zone planning.

MST 2004Y(3) - MARINE BIOGEOCHEMISTRY & ANALYTICAL TECHNIQUES II

This module deals with the planetary material cycles, characteristics and degradation of organic matter in the ocean, carbon, nitrogen, phosphorus, silicon and sulfur budgets, aquatic and solution chemistry (redox processes, pH and carbonates), acid-base equilibria in natural waters (carbonate-hydrogen carbonate system, other reversible reactions involving metal ions like Fe(II) and associated pH curves), metal speciation, trace metals, ecotoxicity, hydrogeochemistry, water quality, nutrient fluxes and cycling, radioisotopes as tracers in oceanography including submarine groundwater discharge. Aspects of sediment chemistry will cover metal association, cation exchange and adsorption, clay minerals, hydrous Fe/Mn oxides, sediment contamination, coastal and terrestrial pollutants and pathways, dissolved and particulate fluxes, sources and sinks, metal mobilisation. The analytical techniques cover reverse-phase osmosis, extraction techniques (SFE), spectrofluorimetry, UV-Vis spectrophotometry, and ICP-AES/MS among others.

MST 2005Y(3) – STATISTICAL METHODS FOR RESEARCH

This module will deal with research, survey and sampling design, and cover topics such as primary and secondary sources of data, quantitative techniques (in-depth interviewing and analysis), quantitative techniques (questionnaire design and analysis), the choice of analysis, review of basic statistics, regression analysis, analysis of variance, multiple regression, hypothesis testing, computer-based skills such as knowledge of Environmental Software, data analysis software, SPSS, DSS, MIS and effective research report writing.

MST 3001Y(5) - MARINE BIOTECHNOLOGY

Students will learn the principles and fundamental techniques of genetic engineering (extraction and purification of nucleic acids, vectors and molecular cloning, construction of gene libraries, preparation of labelled DNA, hybridisation, synthesis of oligonucleotides, sequencing, the polymerase chain reaction, and strategies of gene cloning). Subsequently, biotechnological applications in aquaculture (expression of the eucaryotic gene, genes cloned from fish, introduction of the heterologous gene in fish, gene therapy) and safety evaluations of applications in aquaculture will be detailed. The potential for producing new pharmaceuticals, biomaterials and other products including bioremediation and bioprocessing will be examined.

MST 3002Y(5) - MARINE NATURAL PRODUCT CHEMISTRY

This module provides an overview of oceanic industrial products, and covers marine natural product chemistry of secondary metabolites derived from marine flora and fauna e.g. alkaloids, prostaglandins, marine peptides, terpenes, pharmaceuticals, and commercially exploited biopolymers from seaweeds/algae. Students will also learn about the structure and mode of action of red tide and paralytic marine toxins, proteinaceous toxins and drugs from marine organisms.

MST 3003Y(5) - MARINE RESOURCES & LAWS OF THE SEA

Today we face urgent questions of how and what ocean resources can be used without environmental damage and at what rate. Topics to be covered include the continental margin, continental shelf and deep-sea mineral resources, biological resources, and energy resources (tidal, OTEC, wave, deep water currents, ocean, wind, biomass). Offshore oil exploration, polymetallic nodules, economics, environmental impacts, Intellectual Property Rights (IPR) issues, the role of the IMO, the Maritime Law and the Law of the Sea will be addressed

MST 3004Y(5) - INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

This module focuses on the integrated, holistic approach to managing the coastal area. It deals with the special nature of the coastal zone, the resources, human activities, conflicts and the scope for management. The objectives, concepts, principles, tools and techniques, and practice of ICZM are introduced together with the need for integrated coastal zone management plans (CZMPs). Legal instruments addressing significant problems and case studies will be reviewed.

MST 3000Y(5) - PROJECT/DISSERTATION

The project normally has to be on an approved topic and should be of about 8000-12000 words excluding figures and tables. It is designed to test the ability of the student to undertake a piece of independent scientific research under guidance and demonstrate analytical capabilities.

Electives

MST 1005Y(1) - BIOCHEMISTRY, MOLECULAR BIOLOGY & BIOINFORMATICS

Basic biochemistry will be introduced, e.g. classification, structure, function and metabolism of sugar, protein, lipid, nucleic acid, enzyme, vitamin, stimulant, chemical and biochemical energetics, and protein biosynthesis and regulation in heredity. A sound background will be provided on the structure and function of DNA and RNA, DNA replication, transcription, translation and the genetic code, recombinant DNA and genetic engineering, vectors for gene cloning and expression, plasmids, viruses, genotype, phenotype and types of mutation, recombinant and genetic mapping, regulation of gene expression and human genetic disease. The bioinformatics component combines formal lectures with hands-on sessions in which students will work to solve a series of higher-level problem sets covering common scenarios in the acquisition, validation, integration, analysis and visualisation of biological data. Complex applications applied to drug discovery, microarray technology and molecular modeling will be covered.

MST 1006Y(1) - SUSTAINABLE DEVELOPMENT (SD)

This module introduces the concept and principles of SD, considers SD issues and challenges in relation to capacity building, information for decision-making, participation, and development of National SD Strategies (NSDS), with particular reference to Small Island Developing States (SIDS), examines the critical trends in SD and discusses the use of indicators to track progress towards sustainability and the role of environmental policy and legislation.

MST 2006Y(3) - COASTAL ENGINEERING

Topics in this module include coastal ecosystems, shoreline and coral reef geomorphology, wave motion and interaction with shoreline structures, coastal hydraulics, sedimentary processes and beach formation, remote sensing for shoreline mapping, beach profiling and monitoring, dredging techniques and related environmental impacts, beach erosion and control measures, protection of beach structures, design of sea outfalls and case studies.

MST 2007Y(3) - SUSTAINABLE MARINE TOURISM

As the world's largest industry, tourism is associated with the prime sectors of the economy and intricately interwoven into the fabric of life – economically, socio-culturally and environmentally. The rationale of this module is “increasing the benefits from marine tourism resources while maintaining cultural and environmental integrity and enhancing the protection of ecologically sensitive areas and natural heritages”. Topics covered include tourism policy, planning & development, infrastructure, services and businesses, destination marketing, visitor management, ecotourism, the impact of tourism development on physical, social and cultural environments, the tensions between the demands of tourism and the need to protect key natural environments. The critiques of sustainability and case studies in sustainable tourism development will be reviewed.

MST 3005Y(5) - PUBLIC HEALTH, FOOD HYGIENE & FOOD PROCESSING

The science of public health will be introduced: basic concepts, infectious diseases, auto-immune diseases, life-mode diseases, marine-related diseases, major food poisoning and indicator organisms of concern to public health, and functional foods. Food-related problems based on sanitation law will be elaborated: natural toxins, hazardous substances (e.g. mycotoxins, heavy metals), food additives, parasites, and food allergy. Fundamentals and techniques of food processing (especially seafood) and food safety will be discussed: purpose and types of processing techniques for marine plant and animal products, preservation techniques, microbiological examining methods, packaging, standardisation of processed foods, product value, labelling and quality control.

MST 3006Y(5) - ENVIRONMENTAL MANAGEMENT TOOLS

This module provides students with knowledge of a range of environmental management tools and techniques including Environmental Impact Assessment (EIA), Environmental Management Systems (EMS), environmental legislation, environmental audits, environmental accounting, environmental performance evaluation and life cycle analysis, waste audits, risk assessment, cleaner production and an introduction to environmental economics. Strategic responses and approaches to sustainable development (e.g. Natural Step, Zero Emission Technology) will be explored.