University of the Philippines Cebu
College of Science

Course Offerings

General Education Courses

MATH 10	**Mathematics, Culture and Society** *Appreciation of the beauty and power of mathematics through the examination of its nature, development, utility, and relationship with culture and society*	*3u.*	
SCIENCE 10	**Probing the Physical World** *Understanding the origin of the universe, synthesis of the elements, formation of the earth and the various critical issues affecting our world view and our planet through the methods and interconnected concepts of the physical sciences*	*3u.*	
SCIENCE 11	**Living Systems: Concepts and Dynamics** *Principles, interactions, and contemporary issues concerning living systems*	*3u.*	
STS 1	**Science, Technology and Society** *Analyses of the past, present and future of science and technology in society (including their nature, scope, role and function) and the social, cultural, political, economic and environmental factors affecting the development of science and technology, with emphasis on the Philippine setting*	*3u.*	

Undergraduate Courses

Biology (BIO)			
BIO 11	**Unifying Concepts of Biology** *Unifying themes of life: levels of biological organization and morphology, physiology, homeostasis, reproduction and development, genetics and evolution, and environmental responses*	*3u.*	
BIO 12	**Invertebrate Zoology** *General survey of the invertebrates*	*3u.*	Prereq: BIO 11 *2h lec, 3h lab*
BIO 13	**Plant Morphoanatomy and Diversity** *Developmental patterns, morphoanatomy, evolution and taxonomy of Kingdom Plantae*	*3u.*	Prereq: BIO 11 *2h lec, 3h lab*
BIO 14	**General Ecology** *Recent advances in theories and techniques used in ecology*	*3u.*	Prereq: BIO 12, BIO 13, STAT 178 *2h lec, 3h lab*
BIO 100	**Biotechnique** *Collection and preparation of plant and animal materials for microscopic study; museum methods; scientifica illustration*	*3u.*	Prereq: BOT 10, ZOO 10 *1h lec, 6h lab*
BIO 110	**General Microbiology** *Taxonomy, morphology, ecology, and economic value of micro-organism; microbiological techniques*	*3u.*	Prereq: BIO 11, CHEM 50 *2h lec, 3h lab*
BIO 111	**General Physiology** *Cellular functions of life emphasizing on the chemical and physical properties, the conversion of energy and matter through cell respiration and synthesis, the transport of materials across membranes, cell excitability and contraction, and regulatory processes*	*3u.*	Prereq: BIO 12, BIO 13, CHEM 50 *2h lec, 3h lab*
BIO 112	**Elementary Genetics** *Principles of heredity and variation*	*3u.*	Prereq: BIO 12, BIO 13, CHEM 50, STAT 178 *2h lec, 3h lab*
BIO 113	**Molecular Biology and Its Applications** *Study on the molecular mechanisms of gene expression and the fundamental aspects of recombinant DNA technology*	*3u.*	Prereq: BIO 112 *2h lec, 3h lab*
BIO 114	**Cell Biology** *The cell as the fundamental structural and functional unit of living organisms: cell morphology and morphogenesis, with emphasis placed on mechanisms of intracellular and transmembrane transport, cellular control, and intercellular and intracellular signaling*	*3u.*	Prereq: BIO 112
BIO 115	**Field Biology** *Field sampling protocols for terrestrial and aquatic ecosystems*	*3u.*	Prereq: BIO 14 *1h lec, 6h lab*

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BIO 116	**Introduction to Developmental Biology of Animals** *Principles of development, mechanisms of cellular differentiation, specification of cell fate and embryonic axes, as well as cellular interactions during organogenesis*	*3u.*	Prereq: BIO 113, BIO 114 *2h lec, 3h lab*
BIO 117	**Application of Informatics in Biology** *Introduction to the fundamentals of informatics resources and methods for biologists such as accessing, searching, retrieving, analyzing, and archiving data including sequence alignment, phylogenetic analysis, and structure prediction with application to systematics, molecular biology and genetics*	*3u.*	Prereq: BIO 113, BIO 114, STAT 178 *2h lec, 3h lab*
BIO 118	**Introduction to Biological Systems Analysis** *Use of graphical computer programs to analyze biological systems*	*3u.*	Prereq: BIO 14, MATH 40, STAT 178 *2h lec, 3h lab*
BIO 119	**Comparative Anatomy of Vertebrates** *Phylogenetic development of the organ systems in the various classes of vertebrates*	*4u.*	Prereq: BIO 116 *2h lec, 6h lab*
BIO 120	**Biodiversity and Conservation** *Spatial and temporal patterns of biodiversity and how these patterns have implication on biological conservation*	*3u.*	Prereq: BIO 14
BIO 121	**Plant Physiology** *Lectures and laboratory dealings with the fundamental aspects of the activities of plants, such as plant nutrition, absorption and translocation of materials, growth, movement and reproduction*	*3u.*	Prereq: BIO 111, CHEM 50 *2h lec, 3h lab*
BIO 122	**Animal Physiology** *Principles of functional zoology with emphasis on physiological adaptations*	*3u.*	Prereq: BIO 111, CHEM 50 *2h lec, 3h lab*
BIO 123	**Animal Histology** *Structure of the various animal tissues*	*4u.*	Prereq: BIO 12, BIO 119 (co) *2h lec, 6h lab*
BIO 124	**Animal Behavior** *Concepts of animal behavior with emphasis on the mechanisms, ecology and evolution of the diversity of animal behavior that allow them to survive, obtain resources, and reproduce*	*3u.*	Prereq: BIO 14, BIO 112
BIO 125	**Parasitology** *Different parasitic and infectious agents from the evolutionary and biological perspectives to understand the importance of etiology and disease prevention*	*3u.*	Prereq: BIO 12, BIO 110 *2h lec, 3h lab*
BIO 126	**Advanced Microbiology** *Application of immunological, molecular, biological and microbial techniques to the isolation, identification and characterization of bacteria, fungi, viruses and parasites*	*3u.*	Prereq: BIO 110 *2h lec, 3h lab*
BIO 131	**Marine Dynamics** *Concepts on the marine environment and its processes, as well as impacts of anthropogenic factors, including climate, biotic and abiotic interactions*	*3u.*	Prereq: BIO 14, BIO 115
BIO 132	**Introduction to Fisheries Biology and Aquaculture** *Biological basis of fisheries and taxonomic groupings and phyla with subtopics chosen for their relevance to aquaculture including pathology, procedural topics (culture methods) and management*	*3u.*	Prereq: BIO 14, BIO 115
BIO 133	**Vegetation Dynamics** *Vegetation dynamics and the impacts of factors including climate, abiotic and biotic interactions, and disturbance (both anthropogenic and natural)*	*3u.*	Prereq: BIO 14, BIO 115
BIO 134	**Ethnobiology and Pharmacognosy** *Survey, extraction and isolation of putative bioactive compounds from plants and other natural sources traditionally known to have pharmacological applications*	*3u.*	Prereq: BIO 12, BIO 13, CHEM 31, CHEM 31.1 *2h lec, 3h lab*
BIO 135	**Environmental Change Biology** *Introduction to the principles of biogeochemistry, current global climate change, and the modifications caused by human activities on the natural environment*	*3u.*	Prereq: BIO 14
BIO 141	**Introduction to Bioentrepreneurship** *Introduction to principles and methods of biology-related business with emphasis on the importance of protecting intellectual property*	*3u.*	

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BIO 151	**Environmental Management** *Principles of environmental management; technological development and activities affecting the environment and pertinent case studies*	*3u.*	Prereq: BIO 150 (Principles of Ecology) or COI
BIO 152	**Principles of Molecular Biology and Biotechnology** *Principles of molecular biology and its application in biotechnology*	*4u.*	Prereq: BIO 150, CHEM 40 *3h lec, 3h lab*
BIO 164	**Limnology** *Physical, chemical and biological aspects of freshwater habitats*	*4u.*	Prereq: CHEM 11, ZOO 111 *2h lec, 6h lab*
BIO 189	**Scientific Writing in Biology** *Preparation and writing of scientific papers including papers for oral presentation as well as ethics, rights and permission*	*3u.*	
BIO 191	**Special Topics in Biology (Topic to be indicated)** *Relevant topics exploring classic and current/emerging theories, principles, models and techniques in the field of biology*	*3u.*	Prereq: has earned 47 units in foundation and 21 units in core courses
BIO 195	**Biological Evolution** *Theories, principles and mechanisms of evolution*	*3u.*	Prereq: BIO 140
BIO 196	**Seminar in Biology**	*1u.*	Prereq: BIO 189
BIO 200a	**Undergraduate Thesis I** *Thesis proposal and preliminary conduct of student undergraduate research under the supervision of a qualified faculty member*	*2u.*	Prereq: has earned 47 units in foundation and 21 units in core courses
BIO 200b	**Undergraduate Thesis II** *Conduct of undergraduate thesis and defense*	*2u.*	Prereq: BIO 200a
Chemistry (CHEM)			
CHEM 14	**Elementary Inorganic and Organic Chemistry** *Certain fundamental principles and the more important applications of inorganic and organic chemistry for the biological field, both pure and applied*	*5u.*	Prereq: MATH 11 or its equivalent *3h lec, 6h lab*
CHEM 23	**Inorganic Analytical Chemistry** *Principles and techniques of the qualitative and quantitative analyses of inorganic substances*	*3u.*	
CHEM 23.1	**Inorganic Analytical Chemistry Laboratory**	*2u.*	Prereq: CHEM 23 (co) *6h lab*
CHEM 26	**Analytical Chemistry** *Principles and techniques of analysis with emphasis on volumetric methods and stoichiometry; survey of common instrumental methods*	*3u.*	Prereq: CHEM 11, MATH 14 or its equivalent
CHEM 26.1	**Analytical Chemistry Laboratory**	*2u.*	Prereq: CHEM 26 (co) *6h lab*
CHEM 31	**Elementary Organic Chemistry** *Introduction to modern theories in organic chemistry. Correlation of structure with properties of organic compounds. Basic laboratory techniques in elementary organic chemistry.*	*3u.*	Prereq: CHEM 23, CHEM 23.1
CHEM 31.1	**Elementary Organic Chemistry Laboratory**	*2u.*	Prereq: CHEM 31 (co) *6h lab*
CHEM 41	**Physical Chemistry for the Biological Sciences** *Introduction to thermodynamics, chemical kinetics, and chemical equilibrium with emphasis on biological systems*	*3u.*	Prereq: CHEM 23, CHEM 23.1, MATH 40 *2h lec, 3h lab*
CHEM 50	**Elementary Biochemistry** *The chemistry of food and nutrition*	*3u.*	Prereq: CHEM 41
CHEM 50.1	**Elementary Biochemistry Laboratory**	*2u.*	Prereq: CHEM 50 (co) *6h lab*
CHEM 103	**Introduction to Environmental Chemistry and Toxicology** *Chemical transport, fate, persistence, and biological accumulation of toxic substances (synthetic or natural), and their effects on the organisms in the environment*	*3u.*	Prereq: CHEM 50, CHEM 50.1
Computer Science (CMSC)			
CMSC 11	**Introduction to Computer Science** *Introduction to the major areas of computer science; software systems and methodology; computer theory; computer organization and architecture. Students learn to write programs using a high-level block-structured programming language.*	*3u.*	*2h lec, 3h lab*

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CMSC 21	**Fundamentals of Programming** *Expansion and development of material introduced in CMSC 11. Processing of files and linked-lists; Programming in the C language; Recursion; Systematic program development; Top-down design and program verification.*	*3u.*	Prereq: CMSC 11 *2h lec, 3h lab*
CMSC 22	**Fundamentals of Object-oriented Programming** *Introduction to object-oriented programming; classes; inheritance; polymorphism; and exception handling; Design and implementation of object-oriented programs; API programming*	*3u.*	Prereq: CMSC 21 *2h lec, 3h lab*
CMSC 23	**Programming Paradigms** *Major programming paradigms: imperative, functional, logic, and object-oriented programming*	*3u.*	Prereq: CMSC 21 or COI *2h lec, 3h lab*
CMSC 56	**Discrete Mathematical Structures in Computer Science 1** *Functions, relations, sets, simple proof techniques, Boolean algebra, propositional logic, digital logic, elementary number theory, and the fundamentals of counting*	*3u.*	
CMSC 57	**Discrete Mathematical Structures in Computer Science 2** *Predicate logic, recurrence relations, graphs, trees, matrices, computational complexity, elementary computability, and discrete probability*	*3u.*	Prereq: CMSC 56
CMSC 101	**Introduction to Information Systems** *Essentials of computer systems and information systems including security and ethical responsibilities in ICT, and problem solving in algorithm design and development*	*3u.*	*2h lec, 3h lab*
CMSC 102	**Introduction to Bioinformatics** *Definition and importance of Bioinformatics; its major research areas and problems; biological databases and information retrieval; and, computational approaches (using ICT resources) in: sequence analysis, protein function prediction and classification, and protein structure prediction*	*3u.*	Prereq: Junior Standing *2h lec, 3h lab*
CMSC 103	**Introduction to Geographic Information Systems** *Fundamentals of Geographic information systems. Components, nature, and applications of GIS, data integration, concepts of decision support strategies and multi-criteria evaluation using GIS*	*3u.*	*2h lec, 3h lab*
CMSC 106	**Research Methods for Computer Science** *Techniques on how to formulate research questions, user-study design and experimental execution; Empirical Methods of Algorithm Analysis; Algorithms Applied to Quantitative Analysis in Computer Science Research*	*3u.*	Prereq: STAT 123
CMSC 110	**Technical Writing for Computer Science** *Technical writing, project proposal, project plan, requirements document, users manual, and scientific papers such as academic journals, conference proceedings, poster paper, and technical report*	*3u.*	
CMSC 123	**Data Structures** *Abstract data types and their implementations; lists, stacks, queues, trees, mappings, sets and graphs; searching and sorting techniques, dynamic storage management*	*4u.*	Prereq: CMSC 21, (CMSC 57 or MATH 102) *3h lec, 3h lab*
CMSC 124	**Design and Implementation of Programming Languages** *Study of the fundamental concepts in the design and implementation of the current high-level programming languages; syntax and translation, language definition structures, elementary and structured data types, abstraction mechanisms, sequence and data control, runtime considerations*	*3u.*	Prereq: CMSC 123, CMSC 141 *2h lec, 3h lab*
CMSC 125	**Operating Systems** *Processor management, memory management, file and disk management, resource management, networks and distributed systems*	*3u.*	Prereq: CMSC 124, CMSC 133 *2h lec, 3h lab*
CMSC 126	**Web Engineering** *Programmer-oriented introduction to current internet technologies, web authoring and internet security; design and development of web applications using modern Internet tools*	*3u.*	Prereq: CMSC 23, CMSC 128 *2h lec, 3h lab*

CMSC 127	**File Processing and Database Systems** *Data models: relational, network, hierarchical models. Database management system, data definition and manipulation language. Data security, integrity, synchronization, protection and recovery. Principal database systems and query languages.*	*3u.*	Prereq: CMSC 123 *2h lec, 3h lab*
CMSC 128	**Software Engineering 1** *Software life cycle from the requirement specification and design phases through the construction of actual software. Topics include planning a software project, cost estimation, software design, implementation, validation, and software maintenance.*	*3u.*	Prereq: CMSC 123 *2h lec, 3h lab*
CMSC 129	**Software Engineering 2** *Principles and methods for the design, implementation, validation, evaluation and maintenance of software systems*	*3u.*	Prereq: CMSC 128 *2h lec, 3h lab*
CMSC 130	**Logic Design and Digital Computer Circuits** *Data representation and computer arithmetic; logic functions and equations; description, analysis and design of combinatorial and sequential circuits; functional properties of digital integrated circuits*	*3u.*	Prereq: CMSC 11 *2h lec, 3h lab*
CMSC 133	**Introduction to Computer Organization, Architecture, and Machine-level Programming** *Computer systems organization from a designer's point of view; memory organization and hierarchy; processor organization, control and performance; processor datapath; pipelining; I/O; instruction set architectures; low-level programming languages; development of low-level programs*	*3u.*	Prereq: CMSC 130 *2h lec, 3h lab*
CMSC 134	**Introduction to Computer Security** *Fundamental concepts and practical applications of secure computing systems with a holistic view and an applied approach; designing, developing, deploying, and maintaining secure wired and wireless computing environments*	*3u.*	Prereq: CMSC 123, CMSC 137
CMSC 137	**Data Communication and Networking** *Network topology, OSI reference model, network applications, network management, and network security*	*3u.*	Prereq: CMSC 125, CMSC 133 *2h lec, 3h lab*
CMSC 140	**Advanced Programming** *Intermediate programming PL/1 procedures; block structures; ON conditions; recursion; introduction to data structures and program analysis*	*3u.*	Prereq: CMSC 21, CMSC 55 *2h lec, 3h lab*
CMSC 141	**Introduction to the Theory of Computation** *Finite automata and regular languages; push-down automata and context-free languages; Turing machine and recursively enumerable sets; linear-bounded automata and context-free languages, computability and halting problem; undecidable problems; recursive functions; and computational complexity*	*3u.*	Prereq: CMSC 57 *3h lec*
CMSC 142	**Design and Analysis of Algorithms** *Algorithm design techniques; use of data structures, divide and conquer, local and global search. Complexity analysis of algorithms: asymptotic analysis, worst case analysis and averaged case analysis, recurrences, lower bounds, NP-completeness.*	*3u.*	Prereq: CMSC 123 *3h lec*
CMSC 143	**Computability** *Computable functions. Turing machines and other formalisms for computable functions. S-m-n theorem. Universal programs. Decidability and undecidability. Recursive and recursively enumerable sets. Introduction to complexity.*	*3u.*	Prereq: MATH 102
CMSC 151	**Systems Analysis and Design** *Systems analysis and design: concepts, philosophies, trends, tools and techniques. Systems development life cycle; structured methodologies; data flow diagrams; entity-relationship diagrams; relational analysis; other design methodologies.*	*3u.*	Prereq: CMSC 128 *3h lec*
CMSC 152	**Management Information Systems** *Fundamental principles of management; information management; general systems model and approach; data processing systems. The MIS approach: executive; marketing; manufacturing; financial and human resource information systems.*	*3u.*	Prereq: CMSC 128 *3h lec*

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CMSC 153	**Accounting and Information Systems** *Fundamental principles of accounting; programming of accounting modules: general ledger, journal ledger, transaction ledger, accounts receivable, accounts payable, etc.*	*3u.*	Prereq: CMSC 21 *2h lec, 3h lab*
CMSC 161	**Interactive Computer Graphics** *Graphics systems software and hardware, 2D drawing algorithms, geometrical transformations, surface modeling, 3D viewing, visible surface determination algorithms, illumination and reflection models, shading models for polygons, color theory, ray tracing. Students write their 3D rendering engine.*	*3u.*	Prereq: CMSC 57, CMSC 123 *2h lec, 3h lab*
CMSC 162	**3D Computer Graphics and Animation** *3D graphics systems software and hardware; 3D modeling, texturing, and lighting; animation basics: principles, armatures, constraints, IPO drivers, rigging, effects and physical simulation; rendering; compositing, video sequence editing*	*3u.*	Prereq: CMSC 123 *2h lec, 3h lab*
CMSC 165	**Introduction to Project Management** *Project management fundamentals, methodologies and basic practices, project management processes*	*3u.*	Prereq: CMSC 128
CMSC 166	**Introduction to Quality Concepts** *Software process model, software quality assurance (SQA), SQA group responsibilities, SQA techniques, SQA standards*	*3u.*	Prereq: CMSC 128
CMSC 167	**Software Validation and Verification** *Validation/verification planning; testing fundamentals; black-box and white-box testing techniques; unit integration, validation, and system testing; object-oriented testing; and inspection of software engineering process documents*	*3u.*	Prereq: CMSC 166
CMSC 170	**Introduction to Artificial Intelligence** *Introduction to the major fields of application of AI: natural language processing; image recognition; pattern recognition; learning. Introduction to AI programming languages: PROLOG; LISP. Search and control strategies; probabilistic reasoning; matching techniques; knowledge and state space representation.*	*3u.*	Prereq: CMSC 123 *2h lec, 3h lab*
CMSC 171	**Expert Systems and Knowledge Engineering** *Expert system shells and architectures; knowledge representation languages; uncertainty handling; techniques of knowledge elicitation and acquisition; rule-based expert systems; knowledge organization and management*	*3u.*	Prereq: CMSC 123 *2h lec, 3h lab*
CMSC 172	**Computing with Symbolic Expressions** *Basic discrete mathematics, sets, functions, and predicates. Functional programming in LISP or PROLOG: function and declarative programming; atoms and lists; list processing by recursive functions; mapping functions; local function binding; data abstraction; and evaluation.*	*3u.*	Prereq: CMSC 123 *3h lec*
CMSC 173	**Machine Learning** *Introduction, Supervised vs Unsupervised Learning, Machine Learning System Design, Hypothesis Evaluation, Model Selection, Machine Learning Diagnostics, Error Analysis*	*3u.*	Prereq: CMSC 170
CMSC 176	**Topics in Theoretical Computer Science (Topic to be indicated)** *Current emerging trends in the field of Computer Science*	*3u.*	Prereq: Junior Standing *may be taken twice for a maximum of 6 units*
CMSC 177	**Topics in Net-Centric Computing (Topic to be indicated)** *Current emerging trends in the field of Net-Centric computing environment*	*3u.*	Prereq: Junior Standing *may be taken twice for a maximum of 6 units*
CMSC 178	**Topics in Software Technology (Topic to be indicated)** *Current topics/advances and trends in multimedia technology*	*3u.*	Prereq: Junior Standing *may be taken twice for a maximum of 6 units*
CMSC 179	**Topics in Computer Systems (Topic to be indicated)** *Current topics/advances and trends in Computer Systems*	*3u.*	Prereq: Junior Standing *may be taken twice for a maximum of 6 units*
CMSC 180	**Computer Simulation and Modeling** *Algorithms and packages for standard graphics; advanced 2-D and 3-D rendering techniques; realism; visualization of scientific data. Use of statistical tools and techniques, knowledge in expert systems and artificial intelligence for data representation and analysis. Problems in other disciplines of science will be chosen as examples to be used for modeling and simulation.*	*3u.*	Prereq: CMSC 123 *2h lec, 3h lab*

CMSC 181	**Introduction to Parallel Computing** *Parallel computational models, machine architectures, parallel programming languages, performance models, algorithms, and parallel programming*	*3u.*	Prereq: CMSC 133 *2h lec, 3h lab*
CMSC 191	**Special Topics** *Lecture course in topics of current interest, such as data communications, prallel computation, artificial intelligence, neural networks. It can be taken twice provided that the total number of units to be credited to the student's program will not exceed 4 units.*	*3u.*	Prereq: COI *may be taken twice but not to exceed 4 units*
CMSC 192	**Ethical and Professional Issues in Computing** *Ethical and professional issues, licensing, intellectual property rights, privacy and security issues, cyber crime, business challenge of computer malware, and the impact of computing in business and society*	*1u.*	
CMSC 194.1	**Research Internship 1** *Review of related literature and presentation: reading journal and conference papers, writing systematic reviews, pinpointing the open questions in that particular field and delivering a presentation to the research group under the guidance of the research group head*	*1u.*	Prereq: CMSC 106 *3h lab*
CMSC 194.2	**Research Internship 2** *Problem identification, hypothesis generation, research design, baseline implementation, results analysis and interpretation, presentation. The students will work on a small problem under the guidance of the head of the research group.*	*1u.*	Prereq: CMSC 194.1 *3h lab*
CMSC 195	**Practicum**	*3u.*	Prereq: CMSC 129 *240 hours*
CMSC 196	**Technopreneurship** *This takes the students through the steps of an IT-based startup. Students work in a team (which can be from other degree programs) to produce a minimum viable product by doing pivots in idea refinement and software development.*	*3u.*	Prereq: CMSC 128 *2h lec, 3h lab*
CMSC 198.1	**Special Problem 1** *Research activity*	*2u.*	Prereq: CMSC 194.2 *1h lec, 3h lab*
CMSC 198.2	**Special Problem 2** *Research activity*	*2u.*	Prereq: CMSC 198.1 *1h lec, 3h lab*
Environmental Science (ENS)			
ENS 101	**Introduction to Environmental Science** *The course will deal primarily with some basic principles of ecology and the following environmental issues: population, sustainable use of renewable and nonrenewable resources, and environmental degradation due to pollution and different forms of disturbance in the ecosystem.*	*3u.*	*3h lec*
ENS 110	**Environmental Impact Assessment** *The course will deal primarily with the methods used in environmental impact assessment including collection of environmental and social baseline data, impact assessment, prediction, selection of alternatives and provision of mitigating measures and the preparation of an environmental impact statement.*	*3u.*	Prereq: ENS 101 *3h lec*
ENS 120	**Biological Resource Management** *Methods and approaches in the conservation and management of renewable and non-renewable resources including biodiversity and land use*	*3u.*	Prereq: ENS 101, GEOL 11 *3h lec*
Mathematics (MATH)			
MATH 11SP	**College Algebra (Supplemental Class)** *Linear equations; algebraic and graphical solutions of the quadratic equations; exponents and radicals; complex numbers; binomial expansions; determinants; progression theory of equations*	*3u.*	
MATH 40	**Calculus for the Life Sciences** *Limits, continuity, derivatives, integrals, separable differential equations and their application to life sciences*	*5u.*	

MATH 53	**Elementary Analysis I** *Functions and their graphs; concepts of limit and continuity; theory of differentiation, derivatives of algebraic and trigonometric functions; theory of integrals; applications of the definite integral*	*5u.*	*5h lec*
MATH 54	**Elementary Analysis II** *Integration methods; determinants, plane and solid analytics; hyperbolic functions; polar coordinates; vectors; parametric equations*	*5u.*	Prereq: MATH 53 *5h lec*
MATH 55	**Elementary Analysis III** *Partial differentiation; multiple integrals; infinite series, differential equations*	*3u.*	Prereq: MATH 54 *3h lec*
MATH 100	**Introduction to Calculus** *Limits; derivatives; integrals; applications*	*4u.*	*4h lec*
MATH 102	**Logic and Set Theory** *Algebra of propositions; predicate calculus; algebra of sets; Zermelo-Fraenkel axioms; functions and relations; cardinal numbers, axiom of choice, orderings; formal systems; logical problems of finiteness, completeness, constructibility and effective procedures*	*3u.*	
MATH 111	**Abstract Algebra I** *Mathematical systems; groups; rings and integral domains*	*3u.*	Prereq: MATH 53, MATH 102
MATH 112	**Abstract Algebra II** *Fields; vector spaces; linear transformations; matrices; characteristic values; diagonalization; inner product; quadratic forms*	*3u.*	Prereq: MATH 111
MATH 114	**Linear Algebra** *Vector spaces; linear transformations; matrices; eigenvalues; canonical forms; orthogonality; applications*	*3u.*	Prereq: MATH 54
MATH 116	**Elementary Theory of Numbers** *Properties of integers; divisibility; unique factorization theorem; solutions of congruences; residue systems; primitive roots and quadratic reciprocity law; solutions of Diophantine equations*	*3u.*	Prereq: MATH 102
MATH 121	**Advanced Calculus I** *Topology of the real line; limits; continuity; derivatives; Riemann integral; improper integrals*	*3u.*	Prereq: MATH 55, MATH 102 or its equivalent
MATH 122	**Advanced Calculus II** *Uniform convergence of sequences, series and improper integrals; transformations; selected topics*	*3u.*	Prereq: MATH 121
MATH 123	**Complex Analysis I** *Complex numbers; functions of a complex variable; limits; continuity; sequences and series of complex numbers; analytic functions; elementary functions; contour integration; power series; residues; conformal mapping; applications*	*3u.*	Prereq: MATH 55, MATH 102 or its equivalent
MATH 124	**Complex Analysis II** *Continuation of Complex Analysis I*	*3u.*	Prereq: MATH 123
MATH 125	**Real Analysis** *Properties of real numbers; integral of step functions; Lebesgue integral; convergence theorems; measurable functions; measurable sets; selected topics*	*3u.*	Prereq: MATH 121
MATH 127	**Vector Analysis** *Vector algebra and calculus; invariants; Green's theorem; Stoke's theorem; Gauss' theorem; applications to geometry and physics*	*3u.*	Prereq: MATH 55
MATH 129	**Introduction to Fourier Analysis** *Fourier representations of suitably regular complex valued functions, synthesis and analysis equations of any given suitably regular complex-valued function defined on* $\mathbb{R}$, $\mathfrak{I}_p$, $\mathbb{Z}$, and $P_{\mathbb{N}}$, generalized functions and their Fourier transforms, applications	*3u.*	Prereq: MATH 121, MATH 123
MATH 131	**Modern Geometry** *Synthetic and analytic treatments of projective geometry; projective plane; Desargues' theorem; Pappus theorem; cross ratio; duality; projective transformations; conics*	*3u.*	Prereq: MATH 102, MATH 114

MATH 140	**Graph Theory and Combinatorics** *Graph characterization and operations; graphs and algorithms; trees, connectivity, traversability, matching and factorization, planarity, colorability, digraphs and tournaments, binomial and multinomial coefficients, pigeonhole principle and Ramsey numbers, the principle of inclusion and exclusion, generating functions, recurrence relations*	*3u.*	Prereq: MATH 111
MATH 141	**Elementary Topology** *Topologies and topological spaces; functions; homeomorphisms; continuity; metric spaces; compactness and connectedness*	*3u.*	Prereq: MATH 102, MATH 121
MATH 152	**Introduction to Computer Software Applications** *Hands-on experience on the use of different application softwares*	*3u.*	Prereq: COI
MATH 161	**Elementary Differential Equations** *Ordinary differential equations of order one; linear differential equations; differential operations; Laplace transforms; non-linear equations; series solutions about an ordinary point*	*3u.*	Prereq: MATH 55, MATH 102 or its equivalent
MATH 163	**Introduction to Mathematical Biology** *Difference and differential equations, steady states, phase line and phase plane techniques, oscillations and limit cycles, basic bifurcation theory, and applications*	*3u.*	Prereq: MATH 114, MATH 161
MATH 164	**Introduction to Partial Differential Equations** *First-order linear partial differential equations, initial and boundary conditions, the wave equation, the diffusion (heat) equation, boundary problems, Fourier series solutions, Laplace's equation and Green's functions*	*3u.*	Prereq: MATH 121, MATH 161
MATH 165	**Introduction to Mathematical Modeling** *Applications of dimensional analysis, optimization, numerical simulation, elementary probability and stochastic processes, and differential equations in economics and science*	*3u.*	Prereq: CMSC 21, MATH 123, MATH 131, MATH 161
MATH 173	**Numerical Methods I** *Numerical methods for solving roots of single nonlinear equations and systems of linear equations, polynomial interpolation, numerical differentiation and integration*	*3u.*	Prereq: MATH 55, MATH 114 *2h lec, 3h lab*
MATH 174	**Numerical Methods II** *Numerical methods for solving ordinary and partial differential equations, spline and least-square approximation, optimization, and selected advanced topics in numerical methods*	*3u.*	Prereq: CMSC 11, MATH 173 *2h lec, 3h lab*
MATH 178	**Mathematical Economics** *Mathematical methods applied to elementary economic theory*	*3u.*	Prereq: ECON 11
MATH 181	**Linear Programming and Applications** *Equivalent formulations of a linear program; graphical solution of E^2; pivoting; the simplex and dual simplex algorithms; post-optimality analysis*	*3u.*	Prereq: MATH 114
MATH 182	**Nonlinear Programming** *Formulation, computation, solutions and applications of nonlinear programming*	*3u.*	Prereq: MATH 165, MATH 181
MATH 183	**Integer and Dynamic Programming** *Survey of integer and dynamic programming techniques*	*3u.*	Prereq: MATH 181
MATH 189	**Scientific Writing in Mathematics** *Principles underlying the preparation of scientific papers in mathematics*	*3u.*	Prereq: has earned 53 units of Mathematics and Statistics courses
MATH 197	**Special Topics (Topic to be indicated)**	*3u.*	Prereq: COI *may be taken twice*
MATH 198.1	**Special Problem**	*1u.*	Prereq: CMSC 123, MATH 112, MATH 123, MATH 131, MATH 141, MATH 161, STAT 136 or its equivalents (waiver not allowed)
MATH 198.2	**Special Problem (Continuation)**	*3u.*	Prereq: MATH 198.1
Marine Biology (MB)			
MB 161	**Biological Productivity of the Sea** *Marine primary productivity and the factors affecting it; energy transfers in different trophic levels of the food chain; techniques in productivity measurements*	*5u.*	

Course Offerings

PHYSICS			
PHYSICS 81	**Intermediate Physics 1** *Calculus-based physics in the areas of mechanics, fluids, and acoustics*	*3u.*	Prereq: MATH 40 or MATH 53
PHYSICS 81.1	**Intermediate Physics 1 Laboratory** *A quantitative and ICT-enabled laboratory course in mechanics, fluids, and acoustics*	*1u.*	Prereq: PHYSICS 81 (co) *3h lab*
PHYSICS 82	**Intermediate Physics 2** *Calculus-based physics in the areas of electrostatics, electrodynamics, electromagnetism, optics, and wave mechanics*	*3u.*	Prereq: PHYSICS 81, PHYSICS 81.1
PHYSICS 82.1	**Intermediate Physics 2 Laboratory** *Provides laboratory techniques in the areas of electrostatics, electrodynamics, electromagnetism, optics and wave mechanics*	*1u.*	Prereq: PHYSICS 82 (co) *3h lab*
Statistics (STAT)			
STAT 101	**Elementary Statistics** *Presentation of data; frequency distribution; central tendencies; index numbers; dispersion; normal curve; Poisson curve; correlations; sampling distribution; elements of statistical inference*	*3u.*	*2h lec, 3h lab*
STAT 104	**Descriptive Statistics** *Statistics; statistical measurement; statistical notations; collection, organization and presentation of data; measures of central tendency, location, dispersion, skewness, kurtosis; letter values, boxplots and stem & leaf display; measures of association and relationship; rates, ratios and proportions; construction of index numbers and indicators*	*3u.*	
STAT 115	**Basic Statistical Methods** *Computer-assisted statistical analysis on the tests for means; tests for proportions; tests for independence; simple linear regression; analysis of variance; forecasting using classical techniques*	*3u.*	Prereq: STAT 101 or STAT 104 or its equivalent *2h lec, 3h lab*
STAT 121	**Probability Theory I** *Elements of probability; random variables; discrete and continuous random variables; probability distributions; special distributions; mathematical expectations*	*3u.*	Prereq: MATH 54 (co), MATH 102
STAT 122	**Probability Theory II** *Joint, marginal and conditional distributions; independence of several random variables; distributions and expectations of functions of random variables; characterization of* F, t, χ^2 *distributions; limit theorems*	*3u.*	Prereq: STAT 121
STAT 123	**Probability and Statistics** *Probability and probability distribution, sampling distributions, estimation, hypothesis testing*	*3u.*	*2h lec, 3h lab*
STAT 125	**Applications Software and Software Packages** *Use of database software, spreadsheet and statistical software packages for database management*	*3u.*	Prereq: STAT 101 or STAT 104 or its equivalent *2h lec, 3h lab*
STAT 131	**Parametric Statistical Inference** *Population and sample; statistics and sampling distributions; point and interval estimation; statistical hypothesis testing; applications of* z, t, χ^2 *and* F *tests*	*4u.*	Prereq: STAT 122 *3h lec, 3h lab*
STAT 132	**Nonparametric Statistical Inference** *Levels of measurement; goodness-of-fit tests; sign and signed rank tests; distribution tests; association tests; tests for independence*	*3u.*	Prereq: STAT 131
STAT 133	**Bayesian Statistical Inference** *Elements of Bayesian probability inference; assessment of prior likelihood and posterior distributions; Bayesian estimation and hypothesis testing; predictive distribution and asymptotics; Bayesian hierarchical models; introduction to empirical Bayes; use of statistical software*	*3u.*	Prereq: STAT 131 *2h lec, 3h lab*
STAT 135	**Predictive Statistics** *Computer assisted regression, multivariate and time series analyses to build predictive models for business decision making*	*3u.*	Prereq: STAT 101 *2h lec, 3h lab*
STAT 136	**Regression and Correlation Analysis** *Linear regression model; model selection; regression diagnostics; use of dummy variables; remedial measures*	*3u.*	Prereq: MATH 114, STAT 131

STAT 138	**Introduction to Sampling Designs** *Probability and non-probability sampling: systematic, cluster, stratified and multi-stage sampling designs; applications*	*3u.*	Prereq: STAT 131
STAT 143	**Survey Operations** *Research process; technique of data collection; principles of questionnaire design; data coding and encoding; data quality control; presentation of research findings*	*3u.*	Prereq: MATH 189, STAT 132, STAT 136, STAT 138
STAT 145	**Introduction to Time Series Analysis and Forecasting** *Classical methods; ARIMA models; Box-Jenkins method; intervention analysis*	*3u.*	Prereq: STAT 136
STAT 146	**Introduction to Exploratory Data Analysis** *Displaying and summarizing batches; re-expressing data; median polish; robust and resistant measures; fitting resistant lines*	*3u.*	Prereq: STAT 136
STAT 147	**Introduction to Multivariate Analysis** *Principal component analysis, factor analysis, discriminant analysis, cluster analysis and other multivariate techniques*	*3u.*	Prereq: STAT 136 *2h lec, 3h lab*
STAT 148	**Introduction to Experimental Designs** *Principles of experimental designs; completely randomized design; randomized complete-block design; Latin-square design; factorial experiments*	*3u.*	Prereq: STAT 136
STAT 149	**Introduction to Categorical Data Analysis** *Categorical data; cross-classification tables; analysis using loglinear, logistic and logit models*	*3u.*	Prereq: STAT 136
STAT 151	**Computer Programming Applied to Statistical Problems** *Introduction to the computer: flow-charting; Fortran IV programming; kinds of Fortran IV statements; arithmetic statements, control statements, declaration statements, input-output statements, logical statements, functions*	*3u.*	
STAT 171	**Elementary Economic Statistics** *Time series analysis; measurement of national income and real national product*	*3u.*	Prereq: STAT 136
STAT 174	**Elementary Statistical Quality Control** *Construction and analysis of control charts for variables and attributes; practical applications of acceptance sampling plans*	*3u.*	Prereq: STAT 131
STAT 175	**Introduction to Demographic Statistics** *The significance and principal measures of fertility, mortality, and migration in various settings. A critique of the various sources of demographic data.*	*3u.*	Prereq: STAT 131
STAT 178	**Introduction to Biostatistics** *Descriptive and inferential statistics in biological sciences*	*4u.*	*3h lec, 3h lab*
STAT 179	**Statistics for Business Decisions** *Statistical problems in business with emphasis on the decision theory approach to decisions — a priori and posteriori —using expected values, monetary and utility, decision trees, opportunity loss; case problems for classical approach to decisions*	*3u.*	Prereq: STAT 121
STAT 197	**Special Topics in Statistics (Topic to be indicated)**	*3u.*	Prereq: COI *may be taken twice*
Zoology (ZOO)			
ZOO 113	**Parasitology** *Origin and degree of parasitism, structural peculiarities of parasites, life cycles and host-parasite relationships*	*5u.*	Prereq: ZOO 102 or ZOO 111 *3h lec, 6h lab*
ZOO 132	**Vertebrate Embryology** *Processes and theories of development of representative vertebrates*	*5u.*	Prereq: ZOO 102 *3h lec, 6h lab*