MAR

Marine Sciences

MAR 501: Physical Oceanography

Examines physics of ocean circulation and mixing on various scales with strong emphasis on profound effects of Earth's rotation on motions and distribution of properties. An introduction to physics of estuaries and other coastal water bodies.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 502: Biological Oceanography

Examines biological processes in the ocean, and introduces major ocean biomes and groups of organisms. A broad treatment of energy and nutrient cycling in coastal and open ocean environments.

Prerequisite: Enrollment in MAS program or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 503: Chemical Oceanography

Introduction to chemical oceanography. Topics include origin and history of seawater, major and minor constituents, dissolved gases, the carbon dioxide system, distribution of properties in the world ocean, isotope geochemistry, and estuarine and hydrothermal vent geochemistry.

Prerequisite: Enrollment in MAS program or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 504: Statistics and Experimental Design

This course has been devised to provide basic background and hands on experience to assist graduate students in developing key skills in an essential aspect of the research enterprise, namely statistics analysis and experimental design.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 505: General Circulation of the Atmosphere

This course provides an introduction to the general circulation of the atmosphere, covering aspects in observations, data analyses, and basic theories.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 506: Geological Oceanography

An introduction to the geological oceanography of the world ocean with emphasis on the coastal environment; discussions of the physical processes controlling the structure and evolution of the ocean basins and continental margins, the distribution of marine sediment, and the development of coastal features.

Prerequisite: Enrollment in MAS program or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 507: Marine Conservation

The fundamental concepts of conservation science, a synthetic field that incorporates principles of ecology, biogeography, population genetics, systematics, evolutionary biology, environmental sciences, sociology, anthropology, and philosophy toward the conservation of biological diversity will be presented within the context of the conservation of marine resources. Examples drawn from the marine environment emphasize how the application of conservation principles varies in different environments.

Prerequisite: Enrollment in MCP or MAS program or permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 508: Found Mar Sci 1:Biogeochemical

This course provides an integrated view of the chemistry, geology and biology of the oceans, using the carbon cycle as an overarching theme to help students tie more specific concepts, mechanisms, and facts into a unified whole. Several other themes will also be embedded throughout the course, including other elemental cycles, timescales on which various processes operate, differences in how major ocean ecosystems (biomes) function, and the biogeochemical evolution of Earth.

Prerequisite enrollment in MAS program or permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 509: Found Mar Sci 2: Physics of Oceans, Atmos, Climate

Introduction to principles of physics governing the patterns of ocean and atmospheric properties. Discussion of the theoretical basis for energy exchange between the two environments and how it governs the spatial and temporal scales of the fluid dynamics includes how these processes interact with climate.

Prerequisite enrollment in MAS program or permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 510: Modeling Techniques in Chemical Oceanography

Derivation of solutions to advection-diffusion-reaction equations for marine sediments and waters. One- and multi-dimensional models are developed for dissolved and solid-phase substances in cartesian, cylindrical, and spherical coordinates. Effect of imposing multiple layers on these systems is examined.

Prerequisite: Permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 511: Benthic Ecology

This course focuses on the ecological interactions of benthic organisms and their habitat. Topics include life histories, the roles of competition, predation and disturbance, feeding adaptations and food webs, interactions between benthic organisms and water motion, sediment chemistry, and other abiotic factors, and evolutionary history of benthic ecological processes.

Spring, alternate years, 2 credits, Letter graded (A, A-, B+, etc.)

MAR 512: Marine Pollution

Review of the physical and chemical characteristics and speciation in the marine environment of organic pollutants, metals and radionuclides including bioavailability, assimilation by marine organisms, toxicity, and policy issues.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 513: Atmospheric Aerosols-Clouds, Climate, and Chemistry

Atmospheric aerosol particles have been recognized to contribute the largest uncertainties to the global radiative forcing estimates and affect air quality. This course introduces graduate students to the physical and chemical properties of aerosol particles and how those affect the particles' role in the atmosphere. Knowledge of how these particles interact with their surroundings is crucial to assess the impact of aerosols on air quality and climate. This course covers the fundamental mathematical, physical, and chemical descriptions of aerosol particles such as particle size distributions, thermodynamics of aerosols, aerosol hygroscopicity, physical and chemical particle transformation, carbonaceous aerosol, aerosol cloud interaction (cloud condensation and ice nuclei), aerosol optical properties, aerosol climate effects, and gas-to-particle (heterogeneous) reactive processes.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 514: Environmental Management

This is an introduction to environmental management, and will focus on the interplay

between science and public policy. Concepts include problem identification and definition, collection and analysis of relevant data to produce information, and the roles of public perception and action in ultimately determining outcomes when consensus is not reached. Specific fields to which these concepts will be applied will be solid waste management and coastal management. Current local problems will be used to illustrate the broader conceptual issues. Offered as MAR 514, EST 540 and CEY 501. 3 Credits, ABCF Grading

3 credits, Letter graded (A, A-, B+, etc.)

MAR 515: Phytoplankton Ecology

The biology and ecology of marine phytoplankton. Covered are life cycles, growth, nutrient uptake, grazing, and the effects of environmental factors on growth and survival of phytoplankton. The characteristics of various classes are examined and are related to environmental conditions.

Prerequisites: General biology
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 516: Ecosystem Science for Fisheries Management

This course will provide an overview of the science and mathematical models that are typically used to inform Ecosystem-based Fisheries Management (EBFM). The course will review single-species models, multispecies models and full system modelsl Advantages and disadvantages of implementing these approaches into management and policy will be explored. No modeling experience is necessary. The course requires familiarity with quantitative menthods, but emphasizes current literature and case studies where EBFM has been or is being implemented as main learning elements.

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 517: Waves

Theory and observations of surface waves, internal waves, and planetary waves; wave-wave, wave-current, and wave-turbulence interactions; surface wave prediction; beach processes.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 518: Coastal Processes

Coastal Processes: Classification and basic theory of water wavies, tides and sediment transport. This background forms the basis for a description of shote processes including beaches, and coastal erosion. The variety of the world¿s coastal environments will be differentiated in terms of physical processes. The behavior of beaches also will be examined. Co-scheduled with MAR 304 Waves, Tides and Beaches.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 519: Geochemistry Seminar

This course explores topics in low-temperature geochemistry as chosen by the instructors and participants. The seminar series is organized around a theme such as early diagenesis, estuarine geochemistry, or aquatic chemistry. Students are required to lead one of the seminars and to participate in discussions.

Prerequisite: MAR 503 or permission of instructor
Spring, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 520: New Production and Geochemical Cycles

Consideration of oceanic new production for a variety of ecosystems. Quantitative examination of the impact of new production on the transport and cycling of major and minor elements and pollutants.

Spring, alternate years, 2 credits, Letter graded (A, A-, B+, etc.)

MAR 521: Long Island's Groundwater

This course will cover basic groundwater concepts in unconsolidated sediments, and examine contamination issues in light of Long Island's particular hydrogeology, land use, and waste management history. Mathematical principles will be discussed but not stressed; scientific and technical papers discussing particular concepts or problems, including important local examples, will be closely read.

Prerequisite: Permission of instructor. Offered as MAR 521 or HPH 673.
Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 522: Envir Toxicology & Public Health

Principles of toxicology and epidemiology are presented and problems associated with major classes of toxic chemicals and radiation to human and environmental health are examined in case study format.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 523: Marine Mammal Biology and Conservation

This course provides an introduction to the basic biology of marine mammals, focusing particularly on various adaptations (e.g., morphological, physiological, acoustic) to life in the marine environment, as well as the ecology and behavior of marine mammals, and the conservation and management of marine mammal populations.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 524: Organic Contaminant Hydrology

There are a host of chemical, biological, and physical processes that affect the transport and fate of organic chemicals in natural waters. This course concerns understanding these processes and the structure-activity relationships available for predicting their rates. The major focus of this class is on contaminant hydrology of soil and aquifer environments, and includes the principles behind remediation and containment technologies. This course is offered as both MAR 524 and GEO 524.

Prerequisite: GEO 526 or MAR 503 or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 525: Environment & Public Health

Review of the interactions of humans with the atmosphere and water resources, especially in the Long Island coastal community. An introduction is provided to the field of environmental health and the practices relevant to an urban/suburban and coastal setting.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 526: Mechanisms of Pollutant Responses in Aquatic Organisms

This course examines the molecular and biochemical basis for contaminant responses in aquatic organisms. Course will be taught in seminar format utilizing the current scientific literature as a basis for discussion. Prerequisite: Permission of instructor.

Fall, alternate years, 2 credits, Letter graded (A, A-, B+, etc.)

MAR 527: Current Issues in Global Climate Change

This course is designed to strengthen skills in understanding and evaluating scientific papers, writing scientific comments, and making presentations to an audience. Topics will be selected from current research in global climate change relevant to a wide range of disciplines in marine and atmospheric sciences and sustainability studies. The course is organized into four modules which focus on climate-related topics in 1) atmospheric science, 2) marine science, 3) sustainability studies, and 4) communicating climate science to the public.

2 credits, Letter graded (A, A-, B+, etc.)

MAR 528: Ocean Atmosphere Interactions

This course discusses the fundamental physical mechanisms through which the ocean and atmosphere interact. These principles are applied to the understanding of phenomena, such as the El Nino Southern Oscillation, the effects of sea surface temperature on the distribution of low-level winds and development of tropical deep convection, and the effects of tropical deep convection and mid-latitude storms on the ocean's mixed layer. Both modeling and observational aspects are discussed. Material will be taken from selected textbooks, as well as recent literature.

Prerequisite: Permission of instructor
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 529: Isotope Geochemistry

This course deals both with the use of radio and stable isotope applications to the earth sciences.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 530: Organic Geochemistry

Introduction to the organic chemistry of the earth, oceans, and atmosphere. Topics include production transformation and fate of organic matter; use of organic biomarkers and stable and radioisotopes; diagenesis in recent sediments; oil and coal production and composition; dissolved and particulate organic matter in seawater.

Prerequisite: Permission of instructor
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 531: Long Island Marine Habitats

Focusing on six representative marine environments around Long Island, this course emphasizes the natural history of local marine communities, as well as quantitative ecology, hypothesis testing, and scientific writing. Students visit the sites, measure environmental parameters, and identify the distribution and abundance of common plants and animals. Using qualitative and quantitative methods in the field and laboratory, the class determines major factors that control the community structure in each habitat. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 532: Marine Protected Areas

Marine Protected Areas (MPAs) are parts of the ocean that are zoned to exclude activities that are potentially detrimental to the ecosystem. Marine Reserves are special types of MPAs in which the harvesting of marine wildlife is prohibited. MPAs are rapidly gaining traction worldwide as a tool to preserve or restore ecosystems, protect endangered species, or sustain nearby commercial and recreational fisheries. This course is designed to provide students with a robust background in the science behind the design, implementation, and expected outcomes of establishing MPAs. The course is largely field-based, and will explore MPA-related issues by traveling to one or more MPAs to learn about the challenges, benefits, and limitations of MPAs for marine conservation from local scientists, managers, and rangers.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 533: Instrumental Analysis

Fundamental principles of instrumental chemical analysis and practical applications of molecular spectroscopy, atomic spectroscopy, mass spectrometry and chromatography. These instruments are widely used in environmental and oceanography problem solving. Lectures cover basic concepts of chemical analysis and the fundamental principles of the analytical techniques to be used. In the laboratory, students gain hands-on experience both by performing a series of required basic chemical determinations (nutrients and trace metals in sediments and in seawater water) and by undertaking special projects. Students prepare written reports describing the methods, the theory underlying those methods, results, and figures of merit. Students also present their results orally in brief presentations.

Prerequisites: Permission of instructor
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 534: Scientific Decision Support

In this innovative course, professional government and industry scientists, policy makers and other decision makers will present and lead discussions on the science, societal and other challenges associated with decision support in their field. We will explore a wide range of decision support systems ranging from decision making in public health, natural resource management, and climate adaptation as well as explore different career paths and work environments involved in scientific decision making. Local speakers will be invited, but most presentations will be remote via standard network tools, thereby eliminating travel costs and greatly lowering the barrier to participation and hence enabling a very wide ranging seminar program. We already anticipate seminars from scientists at NOAA, NASA, NIH, DOE, Global Electric, IBM and CDC laboratories, and from officials of multiple local, state and federal agencies, and from journalists associated with multiple formats. The sessions will be recorded and made available for nationwide access.

1 credit, Letter graded (A, A-, B+, etc.)

MAR 535: The Atom and Environmental Radiation in the Nuclear Age

This course will address technical and societal aspects relating to nuclear power and the general issue of environmental radioactivity. It will cover basics of the nuclear industry and the nature of radioactivity. This includes the production, storage, and disposal of diverse radionuclides emanating from the nuclear fuel cycle and nuclear weapons testing. The properties of major radionuclides will be explored. The course will also consider the complex issue of biological risks posed by radionuclides at different doses to living organisms, including man. Economic and political constraints on nuclear power generation will be discussed for the US and other countries, as will the actual and perceived risks associated with environmental radioactivity.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 536: Environmental Law and Regulation

This course covers environmental law and regulations from inception in common law through statutory law and regulations. The initial approach entails the review of important case law giving rise to today's body of environmental regulations. Emphasis is on environmental statutes and regulations dealing with waterfront and coastal development and solid waste as well as New York State's Environmental Quality Review Act (SEQRA) and the National Environmental Policy Act (NEPA). This course is cross-listed with CEY 503.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 537: Tropical Marine Ecology

The goal of this class is to teach students about the ecology of the tropical coral reef environments through lectures, field trips, snorkeling trips, SCUBA diving trips and student designed research projects. The first half of the course will be devoted to formal lectures, demonstrations, and instructor-led field trips to provide students with a basic knowledge of the common organisms and the roles they play in various coral reef ecosystem. During the second half of the course, with help from faculty, students will develop and carry out individual research projects examining organismal ecology of coral reefs.

4 credits, Letter graded (A, A-, B+, etc.)

MAR 538: Methods of Univariate Statistics in Atmospheric and Ocean Sciences

An introduction to basic statistical concepts and their applications to analysis of data in atmospheric and marine sciences. The topics include distribution, statistical estimation, hypothesis testing, analysis of variance, linear and nonlinear regression analysis, and basics of experimental design. In-depth class discussions of the theoretical concepts are accompanied by extensive applications to data sets supplied by the instructor and the students.

Prerequisites: Enrollment in MAS program or permission of instructor
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 539: Economics of Coastal and Marine Ecosystems

Considering the socioeconomic implications of policy decisions involving environmental and natural resources has become increasingly important for ecosystem management. This course will view human interactions with coastal and marine ecosystems through the lens of economics. Topics will include the basics of welfare analysis, the concept of ecosystem services, the challenges associated with public goods, methods for economic valuation of non-market goods and services, and strategies for sustainable use of coastal and marine resources. In addition to exploring the fundamental principles of environmental economics, the course will also evaluate their real-world application through national and international policy examples.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 540: Marine Microbial Ecology

An historical perspective of the field, aspects of nutrition and growth, microbial metabolism, and trophodynamic relationships with other organisms. Emphasis on roles of microorganisms in marine environments such as salt marshes, estuaries, coastal pelagic ecosystems, and the deep sea, as well as microbial contribution to geochemical cycles. Contemporary and classical methodologies covered.

Prerequisite: MAR 502 or permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 541: Foundations of Atmospheric Sciences I

This course is intended to introduce graduate majors to the foundations in the atmospheric sciences necessary for future, more specialized courses. This course covers atmospheric thermodynamics, radiative transfer, tropospheric and stratospheric chemistry, and cloud microphysics.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 542: Foundations of Atmospheric Sciences II

This course introduces cloud physics, atmospheric chemistry, boundary layer turbulence, and atmospheric radiation. This is the second course in a two-course series taught at the level appropriate to all students in atmospheric sciences.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 543: Reading and Proposal Development

This course is intended to help young scientists read relevant literature, discuss and analyze it critically and prepare a research proposal based on some aspect of the readings over the semester. The skills learned will help PhD students prepare for their comprehensive or oral qualifying exam. It will also serve for cohort-building among first-year students, all of whom are required to take it.

1 credit, Letter graded (A, A-, B+, etc.)

MAR 544: Atmospheric Radiation

Discussion of the compositions and radiative components of planetary atmospheres. Blackbody and gaseous radiation with emphasis on the respective roles of electromagnetic theory and quantum statistics. Derivation of the equation of transfer and radiative exchange integrals, with application to energy transfer processes within the atmospheres of Earth and other planets.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 545: Paleoceonography and Paleoclimatology

This course will provide an extensive overview of the methods used in paleoclimate research and an examination of important climate events during the Late-Mesozoic and Cenozoic eras. We will discuss proxies used to create paleoclimate reconstructions forcing mechanisms on interannual to million year time scales, climate effects on geological and biological processes, and the modeling of present climate and extrapolation to past and future climates.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 546: Marine Sedimentology

Study of sedimentology in the marine environment including an introduction to fluid mechanics, sediment transport theory, quantitative models of sedimentation, and dynamic stratigraphy.

Prerequisite: Permission of instructor
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 547: Geophysical Fluid Dynamics I

Fundamentals of rotating, stratified fluid dynamics as applied to atmospheric and oceanic flows: primitive equations, shallow water theory, potential vorticity dynamics, quasigeostrophic approximation, barotropic instability, and baroclinic instability. Prerequisite: MAR 501, MAR 509, or permission of instructor Offered Spring

3 credits, Letter graded (A, A-, B+, etc.)

MAR 548: Geophysical Fluid Dynamics II

Continuation of geophysical fluid dynamics I. Course covers waves and wave-mean flow interaction in geophysical fluids dynamics with examples from oceanic and atmospheric flows. Prerequisite: Mar 547 or permission of instructor Offered Fall

3 credits, Letter graded (A, A-, B+, etc.)

MAR 549: Current Topics in Atmospheric Sciences

This course will discuss current research topics in atmospheric sciences and their connections with advance course materials.

Semesters Offered:
Fall and Spring, 0-2 credits, S/U grading
May be repeated 1 times FOR credit.

MAR 550: Topics in Marine Sciences

This is used to present special interest courses, including intensive short courses by visiting and adjunct faculty and courses requested by students. Those given in recent years include Nature of Marine Ecosystems, Science and Technology in Public Institutions, Plutonium in the Marine Environment and Problems in Estuarine Sedimentation.

Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 551: Special Topics in Management

This course involves in-depth examination and assessment of one or two topical problems and issues in the management of fisheries in the mid-Atlantic region. Fisheries management encompasses a diversity of disciplines and interests: biology, ecology, mathematics, law, policy, economics, analytical modeling, sociology, and anthropology. The class

conducts a detailed and thorough review of one or two key fisheries management problems that incorporate component issues spanning this range of disciplines. Students form several teams, each team focusing on one aspect of the overall problem and preparing a report detailing that aspect and making recommendations on how management decisions can be improved.

Prerequisite: Permission of instructor
Fall and Spring, 1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 552: Directed Study

Individual studies under the guidance of a faculty member. Subject matter varies according to the needs of the students. Fall, Spring and

Summer, 1-12 credits, S/U grading
May be repeated for credit.

MAR 553: Fishery Management

Survey of the basic principles of and techniques for studying the population dynamics of marine fish and shellfish. Discussion of the theoretical basis for management of exploited fishes and shellfish, contrasting management in theory and in practice using local, national, and international examples. Includes lab exercises in the use of computer-based models for fish stock assessment.

Prerequisite: Calculus I or permission of instructor
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 554: Aquatic Animal Diseases

This course is designed to expose students to fundamental and current issues pertaining to host/pathogen interactions in aquatic environment. By the end of the course, students should have a basic understanding of disease processes in aquatic animals; knowledge of the tools used for disease diagnosis; and an appreciation of disease management tools available today. A particular accent is given to the role of the environment as an important factor in infectious and non-infectious diseases.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 556: Conservation's 3 Rs: Reading, Writing, Raising Money

By providing instruction in critical reading, effective writing, and fundraising, this course will fill a need for graduate students, particularly for students in the Marine Conservation and Policy (MCP) program. This course will help students to both understand the public discourse in marine and wildlife conservation and policy issues and to effectively communicate these issues to a wide audience. Although the course was designed with Marine Conservation and Policy students in mind, the course will also be useful to graduate students interested in improving their ability to write effective, understandable, and interesting pieces that help advance public understanding and support for issues in conservation and science more generally. Communication and outreach, and particularly the ability to express the importance of scientific research to the public, is an important component of conducting research and doing conservation work, and is increasingly becoming required and emphasized by funding agencies.

2 credits, Letter graded (A, A-, B+, etc.)

MAR 557: Case Study and Project Planning Seminar

This seminar will introduce students to case studies in marine conservation carried out regionally, nationally, and internationally through seminars given by professionals in the field. In addition students will be given direction on how to develop a plan for a case study as well as instruction on how to obtain, analyze, and present data. Students will be required to submit a written project plan for either their Capstone Project or Internship prior to the end of the semester.

Fall, 1 credit, S/U grading

MAR 558: Remote Sensing

Theory and application of remote sensing and digital image analysis to marine research. Students use standard software and PCs for digital filtering, enhancement, and classification of imagery.

Prerequisite: MAR 501, 502, 504, 506, or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 559: Risk Analysis, Error and Uncertainty

This seminar style course will explore error estimation, uncertainty propagation, risk analysis, model validation, and decision analysis.

Fall, alternate years, 2 credits, Letter graded (A, A-, B+, etc.)

MAR 560: Ecology of Fishes

Introduction to current research in the ecology of fishes. Topics such as population regulation, migration, reproductive strategies, predator-prey interactions, feeding behavior, competition, life history strategies, and others are discussed.

Prerequisite: Familiarity with concepts of ecology or biological oceanography
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 561: Quantitative Fisheries Ecology

The course covers quantitative models that are currently utilized to assess the status of fish stocks and academic pursuits of understanding single-species and ecosystem dynamics. The course builds on basic ecological models such as the density-independent expotential and density-dependent logistic models and introduces equilibrium and non-equilibrium production models and statistical-catch-at-age techniques. Recruitment and growth models commonly used infisheries ecology are also covered. Least-squares, non-linear and likelihood methods are methods are utilized in model parameter estimation. Statistical techniques such as bootstrapping and Monte Carlo methods are used to assess uncertainty in models outputs. This course is useful for students that plan academic or management careers in fisheries and wildlife research.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 562: Early Diagenesis of Marine Sediments

The course treats qualitative and quantitative aspects of the early diagenesis of sediments. Topics include diffusion and adsorption of dissolved species; organic matter decomposition and storage; and diagenesis of clay materials, sulfur compounds, and calcium carbonates. The effects of bioturbation on sediment diagenesis are also discussed. This course is offered as both MAR 562 and GEO 562.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 563: Early Diagenesis of Marine Sediments II

The basic principles and concepts of diagenetic processes developed in MAR/GEO 562 are used to examine in detail early diagenesis in a range of sedimentary environments. These include terrigenous and biogenic sediments from estuarine, lagoonal, deltaic, open shelf, hemipelagic, oligotrophic deep-sea, and hydrothermal regions.

Prerequisite: Permission of instructor
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 564: Atmospheric Structure and Analysis

Real world applications of basic dynamical principles to develop a physical understanding of various weather phenomena. Topics include the hypsomatric equation, structure and evolution of extratropical cyclones, fronts, hurricanes and convective systems, surface and upper air analysis techniques, radar and satellite interpretation, and introduction to operational products and forecasting.

Prerequisite: 1 year of calculus.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 565: Tropical Meteorology

The goal of this class is to provide a working knowledge of the dynamics and thermodynamics of the tropical atmosphere. A variety of tropical circulations and phenomena will be studied in detail, including regional and large-scale tropical circulations and their role in the global general circulation, tropical wave dynamics, convection and convective systems, synoptic, intraseasonal, and seasonal variability; monsoons, the El Niño/Southern Oscillation, tropical cyclones.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 566: Air Pollution and Global Warming

This course provides a detailed introduction of the formation of gaseous and particulate pollutants and the role they play in affecting global warming. The pollutants discussed include carbon monoxide, sulfur oxides, nitrogen oxides, ozone, hydrocarbons, particulate matter, and greenhouse gases. The emissions of these gases from natural and industrial sources and the principles used for controlling the latter are described. The chemical and physical transformations of the pollutants in the atmosphere are investigated and the phenomena of urban smog and acid rain are discussed. The impact of these pollutants on the planet¿s climate are outlined. Current proposals of renewable energy supply and combatting temperature increase by geoengineering solutions are examined. This course discusses technical, ethical, and commercial perspectives that have shaped pollution producing industrial processes during historical times and in the present era. The efforts to formulate regulatory control mechanisms to limit the impact of air pollution and to ameliorate global warming are outlined in this class.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 567: Chemical Sensors in Oceanography

An introduction to chemical sensors and their application in oceanography with emphasis on in-situ sensing in coastal environments, discussions of the sensor principles and fabrication, and biogeochemical processes revealed by in-situ measurements.

Spring, alternate years, 2 credits, Letter graded (A, A-, B+, etc.)

MAR 568: Practical Skills for Scientists

This course is designed to introduce first-year graduate students to the standards and practices of conducting original scientific research in a professional and responsible manner. This course will guide students as they develop practical skills in communicating in both oral and written formats, and as they practice some of the formal and informal interactions (including questions and discussions after presentations, critical reading, and peer review) characteristic of working as a scientist. Students will learn to construct hypotheses and approaches to test them, write a scientific proposal, evaluate proposals as a peer reviewer, critically read papers from the primary scientific literature, give interesting, informative, and concise oral scientific presentations, explain and justify the standards of responsible conduct of research, identify irresponsible conduct of scientific research and respond appropriately. Spring

3 credits, Letter graded (A, A-, B+, etc.)

MAR 569: Statistics With R

Essentials of conducting statistical analyses using software developed by the R Project for Statistical Computing. R is free software that has been developed by contributors around the world and is quickly becoming a standard environment for conducting scientific data analyses. The course will cover the basic language, data management, graphics, and the application of R to a variety of statistical techniques such as ANOVA, regression, MDS and PCA, GLMs and GAMs. The class is intended to explore the capabilities of R and a basic graduate understanding of statistics is required.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 570: Methods of Multivariate Statistics in Atmospheric and Marine Sciences

This course on multivariate statistical methods of interest in marine and atmospheric sciences discussesPrincipal component (EOF) analysis, canonical correlation analysis, maximum covariance analysis, discrimination and classification, and cluster analysis. Applications of the topics to oceanographic/ atmospheric data are shown using MATLAB. The class provides a hands-on experience requiring each student to apply the techniques to his/her own data and the results are discussed in class with feedback from the instructors and other students.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 571: Zooplankton Ecology

The course is designed to acquaint the student with the theoretical problems and applied methodology in ecological studies of marine and freshwater zooplankton. Topics will include taxonomy, anatomy, physiology, life history strategies, population dynamics, and food chain interaction.

Prerequisites: MAR 502 and permission of instructor
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 572: Geophysical Simulation

Basic equations and boundary conditions. Linear and nonlinear instabilities. Finite-difference and time integration techniques for problems in geophysical fluid dynamics. Numerical design of global atmospheric and ocean models.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 573: Special Topics-Chemical Oceanography

This course is designed for the discussion of topics of special interest on demand that is not covered in regularly scheduled courses. Examples of possible topics include carbonate chemistry, isotope chemistry, and microbial chemistry.

1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 574: Special Topics: Ocean Dynamics

Introductory dynamical oceanography, framework and applications.

1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 575: Special Topics-Geological Oceanography

The course proposes to take several views of the ecology and biogeochemistry of intertidal wetlands to see whether one or more of these views might be useful in reinvigorating interest in the study of wetland function for its own sake. Ecology and plant life history will be studied in addition to geology and wetlands management.

1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 576: Special Topics-Biological Oceanography

The course is designed for the discussion of topics of special interest on demand that is not covered in regularly scheduled courses. Examples of possible topics include grazing in benthic environment, coastal upwelling, the nature of marine ecosystems, and marine pollution processes.

Prerequisite: Permission of instructor
Fall, 1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 577: Special Topics-Coastal Zone Management

The course is designed for the discussion of topics of special interest on demand that is not covered in regularly scheduled courses. Examples of possible topics include microcomputer information systems, environmental law, coastal pollution, dredge spoil disposal, science and technology in public institutions, and coastal marine policy. Prerequisite: Permission of instructor

Fall and Spring, 1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 578: Bio & Conservation/Seabirds

This course provides an overview of the biology and conservation of seabirds, covering basic and applied aspects of seabird biology. We examine specific biological adaptations (e.g., morphological and physiological adaptations for diving and flying) in the first third of the course, and review population-level processes and behavioral patterns (e.g., population ecology and migration) in the second part of the course. The last third of the course applies this knowledge of seabird biology and ecology to current conservation issues and management efforts, both within the United States and internationally.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 579: Bio & Conservation/Sea Turtles

This course provides an overview of the biology and conservation of sea turtles, and highlights different "solutions" to challenges these organisms face while living in the marine environment. We begin by discussing biological adaptations and ecological processes, and will then examine these concepts in relation to conservation and management issues facing different sea turtle species. This course will be primarily lecture-based, although we will take advantage of additional learning opportunities, such as necropsies conducted with the Riverhead Foundation.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 580: Seminar

A weekly series of research seminars presented by visiting scientists and members of the staff.

Fall and Spring, S/U grading
May be repeated for credit.

MAR 581: Next Generation Sequencing Applications in Functional Genomics

Functional and Integrative genomics is a new area of marine research that seeks to place the functional significance of an organism¿s genes into an ecological and evolutionary context. This course provides an integrated view of how these methods can be used to answer questions regarding marine organisms, evolution, biology and ecology. Over the course of the semester, examples will cover various topics including marine biodiversity, population structures, environmental adaptation, stress responses, phylogeny of animals, aquaculture and fisheries, interaction between species (predation, parasitism, mutualism). A particular accent is given to the role of Next Generation Sequencing technologies in answering questions related to these topics.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 582: Advanced Atmospheric Dynamics

Application of the concepts of balanced flow and potential vorticity thinking - conservation and inversion - to study wave propagation, baroclinic instability, evolution of cyclones and baroclinic waves, and wave- mean flow interactions.

Prerequisite: MAR 594
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 583: Doppler Weather Radar

This class is designed to provide students who have not previously had an undergraduate class on the topic with a working knowledge of Doppler weather radar, including: what the basic components of a weather radar are, a theoretical background of how radars operate, an in-depth understanding of the wide variety of weather radar applications used in atmospheric science careers, and an overview on the use of emerging radar technologies in new and updated Doppler weather radar systems. Students also will gain hands-on experience working with Doppler radar data and radar viewing and editing software.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 584: Applied Marine Ecology Seminar

This course provides an opportunity for advanced graduate students to practice presenting data on their thesis research in areas broadly related to how individuals and communities of marine organisms respond to changes in their environments. Each student will prepare an abstract of the work they plan to present and assign an appropriate review or research paper for the class to read. They will then prepare a formal presentation of their work suitable for a departmental seminar. Faculty and students will provide constructive criticism of the presentation as well as participate in a discussion of the work.. May be taken more than once for credit.

Fall, 1 credit, S/U grading
May be repeated for credit.

MAR 585: Coastal Geology Seminar

An assessment of recent developments in coastal geology. Discussion of advances in the application of sedimentology, stratigraphy, and geomorphology to the study of coastal environments. Modern-ancient analogues are emphasized where appropriate.

Prerequisite: Stratigraphy and sedimentary marine geology
Fall, 2 credits, S/U grading
May be repeated for credit.

MAR 586: Introduction to Ecological Modeling

This course will provide students with a familiarity of the major concepts, approaches, and underlying rationale for modeling in the ecological sciences. Topics will include reviews of theoretical and empirical models, the use of models in adaptive management, and how to confront models with data to evaluate alternative hypotheses. Roughly 1/3 of the course will be devoted to the use of models in management, focusing on the problems of fitting models to data and management pitfalls that follow. Course work will consist of readings, in class exercises, and group assignments that involve the construction, analysis, and interpretation of ecological models.

Prerequisite: BEE 550, BEE 552; MAT 131 or equivalent; any statistics course.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 587: GIS: Display and Analysis of Environmental Data

Elements of Geographic Information Systems (GIS) with an emphasis on environmental applications, especially those related to marine and coastal systems. The course includes hands-on exercises to familiarize students with GIS capabilities. A project will be required.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 588: Molecular Marine Ecology

DNA analysis offers a new window into the ecology of marine organisms, shedding light on aspects of their biology that are traditionally difficult to study, such as their evolutionary history, population structure, population demographic history and reproductive patterns. In this way, DNA analysis can help us better manage fisheries and conserve endangered marine species. This course is designed to expose graduate students to the burgeoning field of molecular ecology and the application of molecular analyses to fisheries management and conservation. Lectures will be supplemented by a group laboratory project, where students will apply techniques such as DNA extraction, polymerase chain reaction, DNA sequencing and computer based analysis of genetic data to address a contemporary marine conservation or fisheries issue.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 589: Capstone Project in Marine Conservation and Policy

Students will conduct an in depth capstone study involving independent analysis of available data and produce an original synthesis paper based on a committee-approved, consequential topic in marine conservation. All students will also present their project at the annual Program Symposium.

Prerequisite: Permission of Instructor
Summer, 1-6 credits, S/U grading
May be repeated for credit.

MAR 590: Research for MS Students

Original investigation undertaken with the supervision of the advisor.

Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.

MAR 591: RCRS and Professional Development

This course is intended to help young scientists begin to plan and enact purposeful professional development activities. The course will focus on using Individual Development Plans as a mechanism for accomplishing career development and advancement, on studying both formal definitions of research misconduct and the daily dilemmas of conducting research and scholarship in a responsible manner, and on other professional development issues of student interest.

1 credit, Letter graded (A, A-, B+, etc.)

MAR 592: Internship in Marine Conservation and Policy

Students will obtain practical work experience through an internship with local, state or federal agencies or not for profit organizations working in the area of marine conservation and policy. To complete the internship, students will prepare a written report on their activities and present their internship project at the annual Program Symposium.

Spring,
Summer, 1-6 credits, S/U grading
May be repeated for credit.

MAR 593: Atmospheric Physics

Advanced cloud physics. atmospheric convection, and other moist processes.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 594: Atmospheric Dynamics

This course covers atmospheric waves, quasi-geostrophic theory, and atmospheric dynamic instability.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 595: Graduate Seminar in Atmospheric Sciences

Discussion of special research topics centered on monographs, conference proceedings, or journal articles. Topics include climate change, atmospheric chemistry, radiation transfer, and planetary atmospheres. This course is intended primarily for students who have passed the written qualifying examination in atmospheric sciences, although other students may enroll with permission of the faculty seminar leader.

Fall and Spring, 0-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 596: Principles of Atmospheric Chemistry

The application of photochemistry and reaction kinetics to the atmospheres of the Earth and planets. The composition and structure of various regions of atmospheres, including the troposphere, stratosphere, and ionosphere. Incorporation of chemical rate processes and physical transport into models. Production of airglow and auroral emissions.

Prerequisite: Permission of instructor
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 598: Synoptic and Mesoscale Meteorology

Course examines the structure and evolution of synoptic and mesoscale systems using observations, modern dynamical analysis, and numerical weather prediction models. Diagnosis of synoptic systems includes applications of quasi-geostrophic theory to baroclinic waves; jet stream and frontal circulations. A survey of the concepts of mesoscale systems includes convective systems, gravity waves, and terrain-coastal circulations. The student will investigate such phenomena in the laboratory as well as individual projects.

Spring, alternate years, 4 credits, Letter graded (A, A-, B+, etc.)

MAR 599: Atmospheric Boundary Layer Processes

This course provides the theoretical foundation for a quantitative understanding of transport processes and chemical transformations in the atmospheric boundary layer. Topics covered in this course include the equations of motions for the lower troposphere; the budget of turbulent kinetic energy; turbulent fluxes of momentum, heat and mass; treatment of chemical transformations; and the representation of these processes in numerical models.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 600: Fisheries Stock Assessment

Stock assessment is essential in a sustainable fisheries management. It involves data collection, data processing and modeling to estimate stock size and status, quantify the impacts of fishing activity on the stock dynamics, and identify maximum sustainable fisheries catch. Building on the quantitative fisheries ecology course, this course will be focused on the application of different stock assessment models in estimating fish stock dynamics, determining stock status, and develop catch advice for fisheries management. The course will be covered by lectures, hands-on stock assessment modeling using NOAA toolbox, case studies, peer reviewing real stock assessment reports, and group projects. This course is designed for the students who are interested in fisheries stock assessment and management. It is ideal for the students who are interested in marine fisheries resource assessment and management and who have taken MAR 561: Quantitative Fisheries Ecology or have good knowledge about fish population dynamics.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 601: Dynamic model with Matlab

This course is designed to provide basic programming skills with the use of selected Matlab toolboxes to analyze marine and atmospheric science data, to perform challenging simulations, and to explore selected problems in marine and atmospheric and related fields. The course will emphasize functionalities and applications of the

matrix manipulations, signal processing, statistical, and mapping toolboxes within the context of marine science problems. The goal is to give the students exposure to tools and programming techniques to enable them to work individually or in a group on a final project relevant to their research interest. Topics will include efficient Matlab programming techniques, simple numerical modeling and learning to build a classifier for recognition and measurement, separating and clustering data, graph and representation and spectral clustering.

2 credits, Letter graded (A, A-, B+, etc.)

MAR 602: Marine Invasive Alien Species in Tropical and Temperate Climates

The course is designed to instruct students in the biology and ecology of marine invasive species using real examples from the Caribbean and the temperate areas of the US Atlantic coast. Additionally, it will include management strategies to control current invasive species, as well as strategies to prevent future invasions. Topics in this course will span policy and legislative requirements, marine conservation and planning, scientific research, biological and ecological characteristics, survey and monitoring methods, public outreach and education strategies. These topics will enable the students to provide sound technical and scientific guidance to the management and prevention of marine invasive species in the Wider Caribbean and the Atlantic Regions.

0-3 credits, Letter graded (A, A-, B+, etc.)

MAR 603: Ocean Physics Seminar

This course explores topics in ocean physics as chosen by the instructors and participants. The seminar series is organized around themes such as estuarine physics, or coastal dynamics, ocean and climate, ocean circulation, etc. Students are required to lead at least one of the seminars and to participate in discussions. Prerequisite: MAR 509 or permission of instructor Fall and spring, 1 credit, ABCF grading, May be repeated for credit

1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

MAR 604: Coral Biology and Conservation: Red Sea program

Coral reefs of the world are at the brink of collapse with only 10% expected to survive past mid-century. We will combine field work and lab projects with lectures to facilitate student exploration of the causes of this global decimation and potential approaches to conserve what remains of a critically important ecosystem. Conducted at an advanced research facility in Eilat, Israel on the shores of the Gulf of Aqaba, this course will enable students to closely study the northern Red Sea l s reefs, one of the few major reef ecosystems expected to survive this century. The course location allows students to conduct field work on fringing reefs located a few meters from the beach of the research facility, attend lectures from international faculty, and interact with the international students participating in the course.

3 credits, Letter graded (A, A-, B+, etc.)

MAR 650: Dissertation Research for PhD

Original investigation undertaken with the supervision of research committee.

Fall and Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAR 655: Directed Study for PhD

Individual studies under the guidance of a faculty member. Subject matter varies according to the needs of the student.

Prerequisite: Permission of instructor
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAR 670: Practicum in Teaching

Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

MAR 699: Dissertation Research for G5

Research course exclusively for students who have been advanced to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Fall and Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAR 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/ or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAR 701: Dissertation Research off Campus - International

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

MAR 800: Summer/Winter Research

Summer/Winter Research. 0 credits, S/U grading. May be repeated.

S/U grading
May be repeated for credit.