Marine Sciences and Technology

The School for Marine Sciences and Technology (SMAST) at UMass Dartmouth conducts research and provides instruction in the interdisciplinary areas of marine science, oceanography, technology development, and policy. SMAST is a major center for research and economic development for UMass Dartmouth and the University of Massachusetts.

SMAST's faculty and staff engage in basic and applied research in areas that foster interactions with industries and public agencies on issues of environmental policy and economic development. While SMAST research tends to concentrate on the regional coastal ocean, estuaries, and watersheds of Massachusetts, New England and the adjacent U.S., some of its programs focus on remote regions of the global oceans.

SMAST is located on 2.6 acres in south New Bedford on Clark's Cove and Buzzards Bay. SMAST is the home at UMass Dartmouth of the Intercampus Graduate School MS and PhD programs in Marine Sciences and Technology.

Marine Sciences and Technology

Faculty and Fields of Interest

Altabet, Mark A marine biochemistry and environmental change, stable isotopes, biogeochemistry, oceanic nitrogen cycling, paleoceanography, and paleoclimatology

Brown, Wendell S coastal physical oceanography, moored ocean observations, real time circulation modeling and data/information management system development

Chen, Changsheng modeling and observational exploration of coastal ocean circulation, oceanic frontal processes, turbulent mixing/bottom boundary layer dynamics, chaotic mixing, western boundary currents, internal waves and tides, and biological/physical interaction

Goodman, Louis physical oceanography, ocean internal waves, turbulence and mixing, bottom and surface mixed layers; ocean acoustics, and autonomous underwater vehicles

Grögen, Joachim fisheries, biomatics and modeling

Howes, Brian estuarine and embayment nutrient cycling and modeling; saltwater and freshwater wetland, lake, embayment management and restoration

MacDonald, Daniel estuarine oceanography, estuarine hydrodynamics, stratified turbulence, and environmental engineering

Rothschild, Brian (dean, School for Marine Science and Technology) ocean ecosystems: marine fish population dynamics, models of plankton dynamics and interactions

Stokesbury, Kevin marine biology/ecology focusing on fisheries including scallop population dynamics and life history studies

Sundermeyer, Miles dispersion and transport processes, numerical modeling of mixing and stirring, numerical modeling of physical and biological interactions

Faculty with SMAST Joint Appointments
Primary Departments

Bisagni, James
Physics

Buck, John R
Electrical and Computer Engineering

Eberback, Eugene
Computer and Information Science

Fain, Gilbert
Electrical and Computer Engineering

Friedman, Peter D
Mechanical Engineering

Georgianna, Daniel L
Economics

Gangopadhyay, Avijit
Physics

O'Connor, Nancy J
Biology

Singh, Bal-Ram
Chemistry/Biochemistry

Tandon, Amit
Physics

Turner, Jefferson
Biology

Zuo, Yuegang
Chemistry/Biochemistry

Programs

Graduate students who enroll in the School for Marine Sciences and Technology (SMAST) at UMass Dartmouth access MS and PhD degrees which are offered through the University of Massachusetts Intercampus Graduate School of Marine Sciences and Technology (IGS).

The IGS is an administrative umbrella for the multi-campus faculty, who have diverse teaching and research interests in the marine sciences and associated technologies. The IGS faculty reside on one of the four campuses—UMass Amherst, UMass Boston, UMass Dartmouth, and UMass Lowell.

The IGS offers students advanced academic studies and research in a range of specializations clustered in five option areas.

At UMass Dartmouth, the administrative home of the IGS program is the **School for Marine Sciences and Technology (SMAST),** headed by Dr. Brian Rothschild as Dean. SMAST offers interdisciplinary programs in the areas of marine science, oceanography, technology, development, and policy.

SMAST is a major center for teaching, research, and economic development for UMass Dartmouth and the University of Massachusetts. Its faculty and staff engage in basic and applied research in areas that foster and interactions with industries and public agencies on economic development and environmental and marine resource policy issues. While SMAST research tends to concentrate on the regional coastal ocean estuaries and watersheds of Massachusetts, New England and the adjacent U.S., some of our programs are focused in remote regions of the global ocean.

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Graduate Courses in Marine Sciences and Technology

MAR 510 three credits
Introductory Chemical Oceanography
Prerequisite: Enrollment in IGS or permission of instructor
Chemical oceanography starting with the basic chemical and physical properties of sea water and going through the major processes shaping chemical distributions in the ocean. A brief review of basic thermodynamics and chemical equilibria precedes a discussion of carbonate equilibria and trace metal speciation. Throughout much of the course an interdisciplinary approach is taken and pertinent material on the interaction between ocean chemistry and marine physics, biology, and geology will be presented. Whenever possible, the results of recent studies will be incorporated into class material and the last few class periods are devoted to special topics.

MAR 520 two credits
Thesis Proposal Development Seminar
Guides graduate student preparation of an acceptable master's thesis or PhD dissertation proposal in a series of papers and in-class oral presentations. Students work with a thesis advisor and committee within a framework defined by the instructor to define a thesis problem in terms of relevant literature and design a research plan, including a support budget. In the process, students are expected to improve their skills in literature research, writing, and oral presentations.

MAR 540 three credits
Introductory Fisheries Science
Provides a background on the development of fisheries science and examines the theories and techniques of biology, ecology, oceanography, and population dynamics presently employed. Components include fish and shellfish basic population dynamics, early life history recruitment, migration, growth, fishery dependent/independent surveys, alternative abundance measurement techniques, habitat considerations, and introductory fisheries modeling.

MAR 555 three credits
Introductory Physical Oceanography
Prerequisite: Permission of instructor
A descriptive treatment of ocean atmosphere interactions, water properties, general wind driven and thermohaline circulation, waves and tides, and coastal processes. Simplified conceptual models demonstrate the important principles.

MAR 560 three credits
Acoustical Oceanography
Prerequisite: Basic calculus and physics courses
Modern methods of acoustics in oceanography and the use of acoustics in other subdisciplines of the marine sciences emphasizing fundamental theories of relevance to the ocean. The course introduces students to the fundamental nature of wave propagation, the concept of acoustic impedance, sources of sound, array theory, and duct propagation. Students apply sonar equations to both passive and active acoustics. Reverberation, scattering, deep and shallow propagation are discussed. Students examine tools and techniques used in modern acoustical oceanography, including acoustical tomography, propagation through ocean internal waves, fisheries acoustics, and Doppler techniques.

MAR 572 three credits
Marine Resource Economics
Prerequisites: Graduate standing and consent of instructor (for economics undergraduates prerequisite is ECO 472)
Application of economic reasoning to understanding causes and solutions of problems faced in managing the marine environment. Students learn to analyze natural resources management issues from an economic perspective with emphasis on management of marine fisheries. Students learn how economists determine the value of environmental goods and services that are not traded in markets and about economic policy tools used to address problems such as marine pollution and other threats to the marine environment.

MAR 596 three credits
Directed Study
Prerequisite: Permission of the instructor, the SMAST Graduate Program Director, and the department chairperson.
Allows completion of a numbered course formally in the graduate program listing but not being offered as a scheduled class.

MAR 599 three credits
Special Topics in Marine Sciences and Technology
Prerequisites: Variable, depending on topic
An advanced treatment of a special topic in specific areas of marine sciences and technology with an emphasis on recent developments. The subject matter varies according to the interests of the instructor and the students.

MAR 600 up to 6 credits
Masters Thesis Research
Prerequisite: Graduate Standing and approval of student's Graduate Committee
Thesis research on an experimental or theoretical project in Marine Science or Technology under a faculty advisor.

MAR 603 three credits
Pre-Dissertation Research
Research for and preparation of doctoral dissertation proposal. The dissertation proposal must provide a thorough survey of the research activities in the research topic area and it must present original and innovative research ideas and preliminary results as well as a defined research scope and directions. PhD students must have passed this course before registering for doctoral dissertation research credits. Graded P/F.

MAR 610 three credits
Ocean Turbulence
Prerequisite: MAR 555 or undergraduate fluid dynamics
Fundamental fluid dynamics underpinning ocean turbulence theory. Emphasis is placed on both a mathematical and physical understanding of turbulence, and considerable time is spent on classical turbulence theory and its application to ocean processes. Random variables and their quantification are introduced, as are dimensional scaling and analysis and non-dimensional quantities such as the Reynolds, Richardson, and Prandtl number. Other course emphases include exchange of energy between the mean flow and turbulent field, turbulent diffusion, modern data analysis techniques, and recent observations and newly emerging observational tools and techniques.

MAR 620 four credits
Case Studies in Estuarine Dynamics
3 hours lecture, 3 hours laboratory
Prerequisite: Permission of instructor
Interdisciplinary estuarine dynamics emphasizing how interactions between physical, biological, and chemical phenomena govern major estuarine processes. The course uses two estuaries as case studies of the types of interdisciplinary problems encountered in marine ecosystems with partial focus on temperate estuarine environments. The two case studies are used to compare and contrast physical, biological, and chemical characterization of estuaries of differing watersheds, tidal dynamics, and geomorphologies. Field and laboratory studies are used to complement the theory taught in lectures and serve as a "hands on" part of the course.

MAR 622 three credits
Case Studies in Fisheries Science and Management
Prerequisite: Permission of instructor
Integration of fundamental concepts of natural science and social science relating to management of living marine resources. This course utilizes a case study of a fishery to explore how knowledge and methods from a variety of disciplines including oceanography, biology, ecology, mathematics, and economics are used together in management of marine fisheries.

MAR 630 three credits
Estuarine Biogeochemistry
Prerequisites:: Biogeochemistry or microbiology and biological oceanography or permission of instructor
Biogeochemistry of estuaries emphasizing complex interactions of the major geochemical cycles and biological systems such as animal and plant production, nutrient uptake, and marine system transformations. Among the topics covered are the basic biogeochemical cycles as they related to both the productivity and function of estuarine systems, and the role of estuaries within the coastal zone relative to their watersheds and adjacent off shore waters. Estuaries are examined both within the global and the New England context. Current issues of estuarine management and restoration are addressed.

MAR 640 three credits
Global Marine Biogeochemistry
Prerequisite: MAR 510
Advanced treatment of marine biogeochemistry and global environmental change. The oceans play a predominant role in global environmental change particularly with respect to their major geochemical cycles of carbon, nitrogen, oxygen, phosphorus, sulfur, etc. The major features of these cycles as they operate on a global basis are presented. Examples of natural and anthropogenic perturbations at present and in the past are a major focus of this course. A significant segment of the material deals directly with the role of oceans in controlling atmospheric carbon dioxide through its biological and solubility pumps.

MAR 650 four credits
Marine Ecosystem Dynamics Modeling
Prerequisites: IGS core courses, preparation in calculus and partial differential equations, or permission of instructor
3 hours lecture, 2 hours laboratory
Structures and dynamics of ocean ecosystems. The dynamics of global to local scale biophysical interaction processes are explored in terms of basic dynamic principles. Existing ecosystem models are used to solve some realistic coastal ecosystem problems. There is a strong emphasis on solving process oriented problems requiring integration of lecture materials. A term paper is required.

MAR 655 three credits
Marine Ecosystem Dynamics Modeling
Prerequisites: Calculus, and permission of instructor
The basic concept of finite-difference, finite-element, and finite-volume methods; the various numerical methods used in solving the advection, diffusion, and elliptical equations; numerical instability; open boundary conditions; and numerical solutions of the primitive equations.

MAR 660 three credits
Coastal Physical Oceanography
Prerequisite: Permission of instructor
Physics of the coastal ocean covering a wide variety of coastal physical oceanographic processes with emphasis on the continental shelf processes. Topics include tides and tidal currents, upwelling and downwelling, front processes, fresh water plumes, coastally trapped waves, boundary layer flows, and vertical and horizontal dispersion processes. This course is intended for students in IGS who require a working understanding of coastal ocean circulation and dynamics. Students enrolling in this course should be thoroughly comfortable with differential and integral calculus.

MAR 670 four credits
Advanced Time Series Analysis of Ocean and Earth System Data
Prerequisites: College calculus and introductory statistical methods
Advanced statistical tools are used to analyze ocean and earth system time series with specific application to fixed location oceanographic and meteorological data sets. Lectures describe the theoretical aspects of the advanced statistical tools that are used to analyze discrete data sets. Students use practical analysis exercises to learn the various ways to interpret set of equally spaced time and or space data series in the context of instrumental and statistical noise.

MAR 700 one credit
SMAST Seminar in Marine Science and Technology
Prerequisite: Graduate standing
Seminar discussions and presentations based on research or detailed literature surveys.

ECE 701 up to nine credits each
Doctoral Dissertation Research
Prerequisites: Successful completion of PhD comprehensive examination and approval of doctoral dissertation proposal by the student's graduate committee
Investigations of a fundamental and/or applied nature representing an original contribution to the scholarly research literature of the field. PhD dissertations are often published in refereed journals or presented at major conferences. A written dissertation must be completed in accordance with the rules of the Graduate School and the School for Marine Science and Technology. Admission to the course is based on successful completion of the PhD comprehensive examination and submission of a formal proposal endorsed by the student's graduate committee and submitted to the SMAST Graduate Program Director.