



COLLEGE OF MARINE STUDIES

- **Marine Biology and Biochemistry**
- **Marine Management**
- **Marine Policy**

Telephone: Newark (302) 831-2841, Lewes (302) 645-4226
For more information, please visit the college web site at:
<http://www.ocean.udel.edu>

PROGRAM OVERVIEW

The goal of the college is to educate scholars who will provide intellectual leadership in the areas of marine biology and biochemistry, marine policy, oceanography, and physical ocean science and engineering. Graduates of the college are expected to understand the complex interactions of these areas in real-world situations, in addition to mastering advanced work in the area of their specialty.

The college has two locations: Robinson Hall at Newark on the main campus of the University and the Hugh R. Sharp Campus in the coastal city of Lewes at the mouth of the Delaware Bay. During the academic year, courses are taught at both sites. Interactive television linking the two sites minimizes the need for commuting between campuses. Students may live at either location depending on the nature of their research and the location of their advisor.

RESEARCH FACILITIES

Robinson Hall, on the UD main campus in Newark, is CMS's administrative base and houses 45% of our faculty and students. It also is home to two of the college's five research centers. The Center for Remote Sensing gathers and analyzes satellite data to yield valuable information about oceanic properties and coastal resources, ranging from the dispersion of oil slicks to global change in plant production. The Center for the Study of Marine Policy, the first of its kind to be established at an American university, conducts interdisciplinary ocean and coastal policy research and education programs with a variety of local, national, and international partners.

Also based on the main campus, the Lammot du Pont Chemistry, Biochemistry, and Marine Studies Laboratory provides state-of-the-art, contamination-free, "clean-lab" facilities for the study of trace metals in marine waters and sediments. The nearby Delaware Biotechnology Institute, a partnership among government, academia, and industry to help establish Delaware as a center of excellence in biotechnology and the life sciences, supports leading-edge interdisciplinary research in genomics and proteomics, including marine science initiatives.

Another major coastal research facility available at UD is the College of Engineering's Ocean Engineering Lab in the Center for Applied Coastal Research. CMS students may use the lab's flumes and wave basins through a joint degree program offered by the College of Marine Studies and the College of Engineering. The lab contains such novel equipment as the directional wave basin - a 66-

- **Oceanography**
- **Physical Ocean Science and Engineering**

foot-long, 66-foot-wide, 3.3-foot-deep apparatus equipped with 34 wave-generating paddles for simulating a realistic sea. Faculty and students use the device to study the physics of waves and the effectiveness of various coastal protection measures.

At the Hugh R. Sharp Campus in Lewes, on the shores of Delaware Bay, CMS provides all the amenities for a thriving marine research and teaching program, including offices, research and teaching laboratories, classrooms, computer facilities, and a library. Cannon and Smith laboratories are equipped with recirculating seawater systems and controlled-environment rooms for maintaining saltwater fish and plants. Cannon Lab also is home to two research centers: the Center for Marine Environmental Genomics focuses on deciphering the genetic code of marine organisms and determining the role that specific genes play, while the Ocean Information Center electronically archives a wide variety of marine data for use by scientists around the world.

Smith Lab includes a shellfish hatchery, algal culture facilities, fish aquaria, microbiology labs, and greenhouse space for halophyte (salt-tolerant plant) research. It also houses the Center for Halophyte Biotechnology, which is developing salt-tolerant plants for agricultural use and wetlands restoration in collaboration with local and international partners.

Two smaller laboratories in Lewes contain specialized research facilities. Henlopen Lab, adjacent to Cape Henlopen State Park, is home to one of the world's only tilting wind-wave tanks for studying physical phenomena at the air-sea interface. The Pollution Ecology Laboratory serves as supplemental space for marine geological research.

The Adrian S. Hooper Marine Operations Building and harbor support the seagoing research activities of the college. The harbor is home port of the 120-foot research vessel Cape Henlopen, which is a member of the University-National Oceanographic Laboratory System fleet. In 2005, the Cape Henlopen will retire and a new 146-foot vessel will be in operation. Several smaller vessels are available for scientific exploration and sampling in nearby Delaware Bay and coastal Atlantic waters.

MARINE BIOLOGY AND BIOCHEMISTRY

PROGRAM OVERVIEW

Students in the Marine Biology and Biochemistry Program at CMS are exposed to a broad spectrum of modern approaches to understand the organization and function of biological systems in marine environments. The MBB Program is highly integrative and students are exposed to a wide range of subjects in their course work

and research projects, from molecular biology and biochemistry to ecology and ecosystem studies. Areas of faculty interest within the program span the ecology, physiology, genetics, and molecular biology of plants, animals and microbes. Faculty research specializations are particularly concentrated in: microbial physiology and molecular ecology; larval ecology and molecular biology; chemical ecology; fisheries ecology; aquacultural genetics and genomics; wetland restoration. In addition to the sophisticated classroom and laboratory facilities available at CMS, students enjoy ready access to a variety of marine ecosystems near the Hugh R. Sharp Campus in Lewes: dunes, salt marshes, mudflats, estuaries, and the Atlantic Ocean. Field research takes place from Alaska to the Antarctic, in environments ranging from coral reefs to deep sea hydrothermal vents to local salt marshes and coastal waters.

REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1200 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

M.S. IN MARINE STUDIES WITH A CONCENTRATION IN MARINE BIOLOGY AND BIOCHEMISTRY

All students in the master's program are required to complete 30 graduate credits. A course outside of the Marine Biology and Biochemistry program and the student's area of concentration is also required. All students must write a thesis. Students may bypass the master's degree and work directly toward the Ph.D. upon petition. Written and oral qualifying examinations are required before students are admitted to candidacy for the Ph.D. degree.

Required courses:

MAST 627 Marine Biology
MAST 634 Marine Biochemistry
MAST 821 Seminar (once each academic year)

One course (minimum 3 credits) outside of the program. This may be one of the specially designed introductory courses or a more advanced course. Introductory courses include MAST 602 (Physical Oceanography), MAST 637 (Geological Oceanography), 646 (Chemical Oceanography) and MAST 670 (U.S. Ocean and Coastal Policy).

Thesis: 6 credits

Additional graduate-level course work as determined by advisory committee.

PH.D. IN MARINE STUDIES WITH A CONCENTRATION IN MARINE BIOLOGY AND BIOCHEMISTRY

Required courses:

MAST 621 Coastal Field Biology
MAST 627 Marine Biology
MAST 634 Marine Biochemistry
MAST 821 Seminar (once each academic year)

Dissertation: 9 credits

Additional graduate-level course work as determined by advisory committee.

MARINE MANAGEMENT

PROGRAM OVERVIEW

The Master of Marine Management degree program is a degree program that targets a different type of student—mid-career professionals employed in management or policy positions relevant to marine environments. Typical students in this new program might come from the United States Coast Guard (USCG), NOAA, EPA, and the Department of Transportation (Maritime Administration). Local sources include DNREC and port authorities. The non-thesis curriculum is a combination of existing CMS courses and a methods course and an integrated capstone course. The program takes place over a period of 9 months with students enrolled in courses during the fall term, winter session, and spring term. The program can accommodate part-time students but they must be willing to take MAST 801 (winter) and MAST 802 (spring) in sequence during the same year.

REQUIREMENTS FOR ADMISSION

The minimum requirements for admission to this program include: a Bachelor's degree in an appropriate natural or social science program (along with official transcripts of all undergraduate work), an undergraduate grade point average of at least 3.0 (out of a possible 4.0), GRE scores (verbal and quantitative combined) of at least 1050, and a TOEFL score (for international students) of at least 600 (paper-based test) or 250 (computer-based test). Professional experience will be encouraged and will be an important consideration for admission. The application also requires at least three letters of recommendation and a statement of intent, stating specific interests and objectives for pursuing this degree. Admission to the graduate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

FINANCIAL AID

It is expected that students matriculating in this program will not receive financial aid from university sources. Students will be either self-supporting or will be supported by outside funding sources.

REQUIREMENTS FOR THE DEGREE

The overall requirement of the M.M.M. degree is to complete the course work indicated in the table given below and to maintain an overall GPA of 3.0 (on a 4.0 scale) or better.

Required courses:

(Fall Term):

MAST 663	Decision Tools for Policy Analysis	3
MAST 670	U.S. Marine Policy	
or		
MAST 677	International Marine Policy	3
	Science Elective	3
	Policy Elective	3
	Science Seminar (MAST 821, 853, or 822)	3

(Winter Term):

MAST 801	Environmental Measurement Tools	3
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(Spring Term):

MAST 802	Case Study in Coastal and Ocean Management	3
	Policy or Science Electives	9
MAST 873	Policy Seminar	1

Total Credits 31

MARINE POLICY

PROGRAM OVERVIEW

The Marine Policy Program examines the economic, legal, political, and social aspects of the world ocean, the seabed, and the coastal zone. Students and faculty in the program analyze public issues regarding the law of the sea, ports and shipping, marine minerals, ocean and coastal zone management, fisheries, naval affairs, marine biotechnology, and the global environment, frequently making recommendations for policy at the regional, national, and international level.

The master of marine policy prepares students for careers in research, management, and administration in marine-oriented government agencies, private associations, and business firms. For a few highly qualified students who already hold an advanced degree in marine policy or a related subject and who generally have some experience in policy research or management, the Ph.D. in marine (policy) studies is available.

REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1100 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

REQUIREMENTS FOR THE DEGREES

All students in the master's program are required to complete 39 graduate credits. A course outside of the Marine Policy program and the student's area of concentration is also required. All students must write a thesis. Students may bypass the master's degree and work directly toward the Ph.D. upon petition. Requirements for the Ph.D. degree are similar to those for the master's degree, but are more intensive. Written and oral qualifying examinations are required before students are admitted to candidacy for the Ph.D. degree.

MASTER OF MARINE POLICY (MMP)

Required courses:

MAST 670	U.S. Ocean & Coastal Policy
MAST 873	Marine Policy Seminar taken three times
MAST 675	Natural Resource Economics
MAST 676	Environmental Economics
MAST 677	International Ocean and Environmental Policy

MAST 817	Research Design and Methods
or	
MAST 672	Applied Policy Analysis

CMS course outside the marine policy program.

Thesis: 6 credits

Elective courses in policy and policy analysis approved by advisor (12 credits)

PH.D. IN MARINE STUDIES WITH CONCENTRATION IN MARINE POLICY

Required courses:

Completion of MMP or equivalent work at another university or MMP bypass.

MAST 873 Marine Policy Seminar taken three times *

CMS course outside the marine policy program. *

*Does not apply to students who satisfied the requirement during MMP.

Disciplinary concentration approved by advisor (e.g., economics, political science)

Additional Research and Methodology course approved by advisor.

Dissertation: 9 credits

Additional graduate-level course work as determined by advisory committee

OCEANOGRAPHY

PROGRAM OVERVIEW

Oceanography Program faculty and students conduct research on physical, geological, biological, and chemical problems in estuarine, coastal, and marine environments. Historically, the program's focus has been estuarine, coastal, and continental shelf studies in the mid-Atlantic region. CMS studies have made the nearby Delaware, Chesapeake, and Delmarva Coastal Bays some of the most extensively studied estuaries in the world. More recently, however, faculty and students have had increasing interests in issues related to global environmental change in a number of other regions of the world.

Estuarine waters, salt marshes, and sediments provide ideal sites for work on the cycling of particulate material, trace metals, nutrients, and organic matter. An integrated picture of contrasting estuarine behavior is emerging from studies of circulation, chemistry, sedimentary geology, and planktonic biology in these contrasting environments. Faculty and students investigate topics at scales as large as paleohistorical circulation patterns, and as small as chemical cycles in algal mats. Multidisciplinary studies of the hydrology and ecology of intertidal groundwater seepage and the controls of harmful and noxious algal blooms are also explored. Together with the Center for Remote Sensing, faculty and students study the impact of land-use changes on wetlands and estuarine waters and the effects of oceanic circulation on climate. The Oceanography Program fosters an environment where a diverse faculty and student body work together to understand marine and environmental processes in the interest of solving environmental and societal problems.

REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1200 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

REQUIREMENTS FOR THE DEGREES

All students in the master's program are required to complete 30 graduate credits. A course outside of the Oceanography program and the student's area of concentration is also required. All students must write a thesis. Students may bypass the master's degree and work directly toward the Ph.D. upon petition. Requirements for the Ph.D. degree are similar to those for the master's degree, but are more intensive. Written and oral qualifying examinations are required before students are admitted to candidacy for the Ph.D. degree.

M.S. WITH A CONCENTRATION IN OCEANOGRAPHY

Required courses:

Any two of the following core courses:

MAST 602	Physical Oceanography or equivalent
MAST 646	Chemical Oceanography or equivalent
MAST 637	Geological Oceanography or equivalent
MAST 627	Marine Biology or equivalent
MAST 853	Oceanography Seminar or equivalent must be taken at least one semester during each year of residence

At least three (3) credits of 800-level courses other than courses used to meet seminar and core required courses must be completed.

One three (3) credit course in Marine Policy or one three (3) credit course outside of the student's declared sub-discipline of interest (not including courses taken to meet the program core course requirement) as approved by the advisor and the program director must be completed.

Thesis or Research: 6 credits

Additional courses may be required by the student's advisory committee.

PH.D. IN OCEANOGRAPHY

or

PH.D. IN MARINE STUDIES WITH A CONCENTRATION IN OCEANOGRAPHY

Required courses:

MAST 602	Physical Oceanography or equivalent
MAST 646	Chemical Oceanography or equivalent
MAST 637	Geological Oceanography or equivalent
MAST 627	Marine Biology or equivalent
MAST 853	Oceanography Seminar or equivalent must be taken at least one semester during each year of residence

At least six (6) credits of 800-level courses other than courses used to meet seminar and core required courses must be taken.

One three (3) credit course in Marine Policy or one three (3) credit course outside of the student's declared sub-discipline of interest (not including courses taken to meet the program core course requirement) as approved by the advisor and the program director must be completed.

Dissertation or Research: 9 credits

Additional courses may be required by the student's advisory committee.

PHYSICAL OCEAN SCIENCE AND ENGINEERING

PROGRAM OVERVIEW

Students in the Physical Ocean Science and Engineering Program apply basic physical principals in their research in coastal physical oceanography, ocean acoustics, nearshore processes, environmental fluid dynamics, estuarine dynamics, and ocean engineering. Two degree plans are offered. The Master of Science and Doctor of Philosophy in Marine Studies are offered through the College of Marine Studies. The Master of Science and Doctor of Philosophy in Ocean Engineering are offered through a cross-disciplinary program operated jointly by the College of Marine Studies and the College of Engineering. (See the Ocean Engineering section in the College of Engineering for specific degree).

This multidisciplinary academic program provides students with broad knowledge in physical oceanography as well as opportunities to focus on desired areas of expertise. The program is particularly appropriate for students with physics, mathematics, or engineering backgrounds.

REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1200 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

REQUIREMENTS FOR THE DEGREES

All students in the master's program are required to complete a minimum of 30 graduate credits. A course outside of the POSE program and the student's area of concentration is required. All students must write a thesis. Students may bypass the master's degree and work directly toward the Ph.D. upon petition. Requirements for the Ph.D. degree are similar to those for the master's degree, but are more intensive. Written and oral qualifying examinations are required before students are admitted to candidacy for the Ph.D. degree.

M.S. IN MARINE STUDIES WITH A CONCENTRATION IN PHYSICAL OCEAN SCIENCE AND ENGINEERING

Required courses:

Minimum of 24 graduate course credits (including those listed below):	
MEEG 690	Intermediate Engineering Mathematics
MAST 693	Waves in the Marine Environment
MAST 691	Ocean Fluid Dynamics
MASTS 882	POSE Seminar

One of the following courses:

MEEG 864	Engineering Analysis II
MAST 800	Dynamical Physical Oceanography

One course outside of the student's home program (minimum of 3 credits). This may include one of the specially designed introductory courses or a more advanced course. Students may not test out of these classes. Introductory courses outside of this program include MAST 627 Marine Biology or MAST 670 U.S. Ocean and Coastal Policy. NOTE: MAST 601 Introduction to Oceanography will not meet this requirement. Physical oceanography courses will not meet this requirement.

Thesis or Research: 6 credits

Additional graduate-level course work as determined by advisory committee

PH.D. IN MARINE STUDIES WITH A CONCENTRATION IN PHYSICAL OCEAN SCIENCE AND ENGINEERING

Required courses:

MEEG 690	Intermediate Engineering Mathematics
MAST 693	Waves in the Marine Environment
MAST 691	Ocean Fluid Dynamics
MASTS 882	POSE Seminar
MEEG 864	Engineering Analysis II
MAST 800	Dynamical Physical Oceanography

One course outside of the student's home program (minimum of 3 credits). This may include one of the specially designed introductory courses or a more advanced course. Students may not test out of these classes.

Dissertation: 9 credits.

Additional graduate-level course work as determined by dissertation advisory committee.